# COSMOLOGY

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# COSMOLOGY
# BY THE NUMBERS

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# COSMOS–BY THE NUMBERS INTRODUCTION

Recent observations of Cepheid variables in distant galaxies[1] and measurements of distant type II supernova[2] converge on a value close to 72 km/sec/mpc. If further observations confirm this value, then there is a strong possibility that the Hubble parameter, $H_o$, is related to the fundamental constants of physics by the relation,

$$H_o^{-1} = (\alpha\mu S)^{3/2}\sqrt{\frac{G\hbar}{c^5}}$$

where $\alpha$ is the fine structure constant, $\mu$ the proton to electron mass ratio, S the coulomb-gravity force ratio, G Newton's constant, $\hbar$ Planck's constant, and c the velocity of light. The value of $H_o^{-1}$ given by this equation is 71.977 km/sec/mpc or 10 ^ 17.456067 seconds. This corresponds to an age of 9.056 billion years or a Hubble time of 13.584 billion years.

While it is not surprising that the value of the Hubble parameter should depend on the values of the fundamental physical constants, it is disturbing, since it is believed the constants involved do not vary with time, that the equation implies a constant Hubble time and hence an unaging universe. We conclude either

1) The original assumption of the correctness of the equation is wrong
2) One or more of the fundamental may constants vary
3) The models relating Hubble time to the age of the universe are wrong
4) The interpretation of redshifts as purely velocity shifts is wrong.

The validity of a model depends on the number of observations explained and on there being a consistent relation or pattern between all the observational check points. The above equation is consistent with all the observations involved, but is not consistent with present interpretations of those observations, particularly those relating Hubble time to an age and possibly the doppler interpretation of redshifts. The following tables show the many ways in which the particular value $\log_{10}(H_o^{-1}) = 17.456067$ sec links other objects, including the Planck particle, baryons, stars, and the universe itself. But every good model should also make predictions by which it can be further tested. This equation and others related to it predict the existence of certain astronomical objects whose existence, if confirmed, would contribute to the solution of other problems. These predictions plus the extent and accuracies of the overall pattern involving this value of $H_o^{-1}$ suggest the above equation and its implications be investigated further.

[1]Wendy Freedman et al. Physics Today August 1999, p19ff 71±7 km/sec/mpc

[2]R. Kirshner ApJ 438 L17 1995 73±7 km/sec/mpc

# COSMOS– BY THE NUMBERS PART I

| OBJECT | LENGTH | VALUE (cm) | TIME | VALUE (sec) | $\sigma$ | $\gamma$ | $\delta$ | T (sec) |
|---|---|---|---|---|---|---|---|---|
| Planck particle | $l_o$ | -32.791545 | $t_o$ | -43.268366 | 0 | 3/2 | $\infty$ | 17.456067 |
| W particle | $l_w$ | -22.670802 | $t_w$ | -33.147623 | 1/4 | 5/4 | 6 | 17.456067 |
| baryon | $r_e$ | -12.550068 | $t_b$ | -23.026899 | 1/2 | 1 | 6/2 | 17.456067 |
| Q particle | $l_q$ | -2.429328 | $t_q$ | -12.906151 | 3/4 | 3/4 | 4/2 | 17.456067 |
| star | $l_a$ | 7.691310 | $t_a$ | -2.785412 | 1 | 1/2 | 3/2 | 17.456067 |
| star cluster | $l_c$ | 17.812049 | $t_c$ | 7.335329 | 5/4 | 1/4 | 6/5 | 17.456067 |
| Universe | $l_U$ | 27.932888 | $t_U$ | 17.456067 | 3/2 | 0 | 2/2 | 17.456067 |

NOTES:

1) The value of T = 17.456067 sec is equivalent to a Hubble parameter of 71.977 km/sec/mpc
2) The time values, $t_i$, are the light travel time = $l_i /c$
3) $\sigma_i$ is the exponent of $l_i / l_o$ or of $t_i /t_o$ ; $\gamma_i$ is the exponent of $(\alpha\mu S)$
4) $l_i = (\alpha\mu S)^{\sigma i}\, l_o$ ; $t_i = (\alpha\mu S)^{\sigma i}\, t_o$ ; $T = (\alpha\mu S)^{\gamma i}\, t_i = (\alpha\mu S)^{\sigma i+\gamma i}\, t_o$
5) $\sigma_i + \gamma_i = 3/2$ ; $\delta_i = 1 + \gamma_i /\sigma_i$ ; $\sigma_i \cdot \delta_i = 3/2$
6) If $\sigma$ represents scale and $\delta$ represents dimension, then [scale]·[dimension] is an invariant = 3/2.
7) Values: $c = 10.476821$ cm/sec
   $(\alpha\mu S)^{1/4} = 10.120738$
   $(\alpha\mu S)^{1/2} = 20.241477$
   $(\alpha\mu S)^{3/4} = 30.362216$
   $(\alpha\mu S) = 40.482954$
   $(\alpha\mu S)^{5/4} = 50.603690$
   $(\alpha\mu S)^{3/2} = 60.724431$
   1 L.Y. = 17.975932 cm

$$T \le \left(\frac{t_i}{t_o}\right)^{\delta_i} t_o \qquad \frac{t_i}{t_o} = (\alpha\mu S)^{\sigma_i}$$

$$\frac{T}{t_o} \le \left(\frac{t_i}{t_o}\right)^{\delta} = \left[(\alpha\mu S)^{\sigma}\right]^{\delta} = (\alpha\mu S)^{3/2}$$

$$\frac{T}{t_i} = (\alpha\mu S)^{\gamma_i}$$

$$\frac{T}{t_i}\cdot\frac{t_i}{t_o} = (\alpha\mu S)^{\gamma_i}(\alpha\mu S)^{\sigma_i} = (\alpha\mu S)^{\sigma+\gamma} = (\alpha\mu S)^{3/2}$$

# COSMOS– BY THE NUMBERS PART II

| OBJECT | LENGTH cm | TIME | VALUE (sec) | $\sigma$ | $\gamma$ | $\delta$ | |
|---|---|---|---|---|---|---|---|
| Planck particle 0 | -32.791545 | $t_o$ | -43.268366 | 0 | 3/2 | $\infty$ | |
| particle 1 | -27.731171 | $t_1$ | -38.207992 | 1/8 | 11/8 | 12/1 | |
| particle 2 | -22.670802 | $t_2$ | -33.147623 | 1/4 | 5/4 | 12/2 | |
| particle 3 | -17.610433 | $t_3$ | -28.087254 | 3/8 | 9/8 | 12/3 | |
| baryon | -12.550068 | $t_4$ | -23.026899 | 1/2 | 1 | 12/4 | |
| particle 5 | -7.489695 | $t_5$ | -17.966516 | 5/8 | 7/8 | 12/5 | |
| Tritone particle 6 | -2.429328 | $t_6$ | -12.906151 | 3/4 | 3/4 | 12/6 | |
| object 7 | 2.631043 | $t_7$ | -7.845778 | 7/8 | 5/8 | 12/7 | |
| neutron star 8 | 7.691310 | $t_8$ | -2.785412 | 1 | 1/2 | 12/8 | |
| max star 9 | 12.751781 | $t_9$ | 2.274960 | 9/8 | 3/8 | 12/9 | |
| star cluster 10 | 17.812049 | $t_{10}$ | 7.335329 | 5/4 | 1/4 | 12/10 | |
| galaxy 11 | 22.872519 | $t_{11}$ | 12.395698 | 11/8 | 1/8 | 12/11 | |
| Universe 12 | 27.932888 | $T=t_{12}$ | 17.456067 | 3/2 | 0 | 12/12 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| $(\alpha\mu S)^\sigma$ | $\sigma = 1/8$ | 5.060369 | $\sigma = 1/4$ | 10.120738 | $(\alpha\mu S)^{\sigma i}\, t_o = t_i$ | $c = 10.476821$ |
| | 3/8 | 15.181107 | ½ | 20.241477 | $(\alpha\mu S)^{\gamma i}\, t_i = t_{12} = T$ | $l_i = c \cdot t_i$ |
| | 5/8 | 25.301845 | 3/4 | 30.362216 | $(\alpha\mu S)^{\sigma i + \gamma i} = t_{12} = T$ | $T = (\alpha\mu S)\, r_e/c$ |
| | 7/8 | 35.422583 | 1 | 40.482954 | $\sigma_i + \gamma_i = 3/2$ | $T = (\alpha\mu S)^{3/2} \sqrt{(G\hbar/c^5)}$ |
| | 9/8 | 45.543321 | 5/4 | 50.603690 | $\delta_i = 1 + \gamma_i/\sigma_i$ | $H_o^{-1} = T = 71.977$ km/sec/mpc |
| | 11/8 | 55.664059 | 3/2 | 60.724431 | $\sigma_i \cdot \delta_i = 3/2$ | |

# COSMOS BY THE NUMBERS —PART III

This is not a report of new observations nor the presentation of a new theory, rather it is an alternate synthesis of existing observations and experimental results. It may be considered as an on going continuation of earlier work of Eddington, Dirac, and others on the patterns or web displayed by the fundamental constants of physics and other physical and astrophysical values. The linkages involved are numerical and dimensional and are based on the assumption of the validity of three physical limits:

1. The Einstein bound: $v \leq c$, physical velocities limited by the velocity of light.
2. The Schwarzschild bound: $M/L \leq c^2/G$, potential bounded by fundamental constants.
3. The Heisenberg bound: $ML \geq \hbar/c$, in effect Heisenberg's uncertainty principle.

It will be seen that these three inequalities may be more properly considered as boundaries between physical domains than as limits.

The structural origin of the web is the Planck particle, a virtual particle defined by the values of the constants, c, $\hbar$, and G. The mass, extension, and frequency of the particle are given by:

# COSMOLOGY - THE ULTIMATE ENVIRONMENT

## Part I. INTRODUCTION

One of the realizations which has emerged from the scientific age which contradicts a traditional common sense point of view is that entities which are very small or very far away, have little or no relevance for events which occur on the human scale, a scale which we might term the mezzocosmic. We have learned,through the studies of molecules, atoms, nucleii, that the properties of the microcosmos governed to a very large extent through either deterministic or stochastic processes, what happens in the mezzocosmos. In fact, the explosion of the first atomic bomb forever dispelled the prejudice over the irrelevance of the minute. However, it is less evident to us in what way, if any, the macrocosmos, that is, the astronomical environment, governs the mezzocosmos. This is because it is customary to seek the explanation of things by examining their component parts rather than examining the milieu in which they are embedded. To find out what makes a watch tick, we take it apart, we see what the parts are and how they fit together. Our thinking about causality has thus been very much tainted by two centuries of living with machines. The explanation of how a rifle, or an automobile engine, or a TV set works, is to be found inside the rifle, the engine, or the set. The properties of the large may be derived from the properties of the small. The whole is determined by the parts. Causality flows from the micro to the macro. These ideas are so called reductionist point of view. This point of view has formed such a bias to our thinking that we become uncomfortable with a notion that the events on earth may be deterministically or stochastically defined by what is outside the earth. This idea conjures in our minds images of astrology and supernaturalism. We feel it is an absurdity to ask whether the cause of the solar cycle, for example, may not be found outside rather than inside the sun. The fact that physics has been highly successful relying almost exclusively on a reductionist approach is one of our main reasons for repudiating the other approach, the so called wholistic one, which states that the properties of the parts are determined or at least are affected by the nature of the whole, or that the structure of the small derives from the structure of the large. In spite of our successes with reductionism, wholistic effects that need not in any way be considered supernatural or teleological, are demanding attention in many fields of science today. In meteorology no one anymore tries to explain the properties of the atmosphere solely by the reductionist method, looking at properties of small samples of air, or the properties of the molecules out of which air is composed. It is very essential to consider what is going on outside the atmosphere, to consider the milieu in which the atmosphere is to be located, the radiative and particle environments, the rotation of the earth, etc. The biologist has long been concerned with wholistic effects. The structure of the neural optical system of a rabbit which alerts to moving vertical patterns and not to horizontal patterns, is derived from the form and habits of the rabbit's predatory enemies, not from some micro structure within the rabbit's eye. Evidence for wholistic effects in some specifics as in these meteorological and biological examples, creates a climate of permissivity, if not acceptability, to the concept that the properties of bodies which occur at various cosmic levels from the micro to the macro result from an interaction of reductionistic and wholistic sequences of properties. Specifically, a principle might be enunciated which states that the nature of the atom itself in some way is determined by the nature of the universe as a whole. This in addition to that the properties of the universe must be those which derive and are consistent with the properties of the atom. The fundamental constants of physics, Planck's constant, the gravitational coupling constant, the velocity of light, and the fine structure constant, etc., may in some way depend on the total mass of matter in the universe, its rate of expansion, its mean density, etc. This possibility is consistent with the surprising numerical coincidences which exist between the dimensionless micro and macro constants.

This discussion of reductionism and wholism provides a modern rationale for a very important 19th century concept, which has cast its shadow importantly over all the modern cosmology. This is Mach's principle. The above statements concerning the atom and the universe are but generalizations of Mach's principle. This famous principle first arose out of the perplexity over what coordinate frame should be taken as an inertial frame and why. You recall the usual illustration of this question, Newton's rotating pail of water, which assumes a parabolic surface when rotating differentially with respect to the earth. More generally, we might state if two bodies, such as two stars, are rotating differentially about an axis which passes through their two centers, and one star assumes an ellipsoidal form whereas the other remains spherical, the mean positions of the atoms in the spherical star define the inertial coordinate frame. Mach's solution to this paradoxical situation was to state that an inertial frame is determined by the distribution and state of all the matter in the universe. Certainly an example of wholism, if it is true. And in some modified form, this principle does appear to be true.

We cannot at the present time trace in detail causal relations from the macrocosm to the mezzocosm or to the microcosm, but there is evidence, for example, the numerical coindences and the Mach's principle, which suggest that we should be open to cosmological and cosmogonic hypotheses which permit the wholistic direction for causality. We must be open to the idea that what underlies the laws of laboratory physics may be understandable only in terms of the macrocosmos. We shall return to this idea later in connection with some properties of cosmic hierarchies.

## II. THE COSMOLOGICAL QUESTIONS

In viewing cosmological questions, we find a curious dichotomy. One set of questions may be termed philosophical, or even theological. These are large general questions, such as, what is the nature of the universe. How did it originate? What is its destiny? And what is the place of life in the universe? What is man's relationship to the universe? These are essential, timeless, cosmological questions. They are found in the cultures of all peoples. They do not arise from the scientific dialectical process of forming hypotheses from observations and testing the hypotheses against additional observations and forming new questions. These basic questions seem to arise directly from the psyche of man. In contradistinction to these large cosmological questions, we find the specific questions which each age casts in terms of its own understanding and which derive from questions posed through its own research and which are meaningful in terms of its own constructs. For example, in our times specific cosmological questions take form such as, is the universe of galaxies best described by a finite or an infinite space. Is the universe in a steady state or is it in an evolving state? Whereas the basic cosmological problem is still centered on the general problem of the origin and nature of the universe, in our times it has several more specific formulations. One very important aspect of modern cosmological research deals with the construction of cosmological models and the comparison of these models with the observable sample of the universe. Instead of trying to build a map of the universe on the basis of observation alone, we find because the number of quantities which we can observe is limited, it is very important to supplement our observations with a theoretical construct. This even more so in cosmology than in other branches of science. The idea of constructing as many conceivable theoretical models as possible and then comparing all of them with the observed world and eliminating those which are inconsistent derives from a philosophical notion of Alfred North Whitehead, the same notion which was applied in mathematics by David Hilbert. This is the system which is employed in modern cosmology.

Modern models are mostly based on the general theory of relativity. This is because it is currently felt that the force which governs the interactions, the motions, the form of cosmic bodies, is gravity and that any model must be built on the best theory of gravity which we have available. This is the general theory of relativity. True, there are models built on other bases, but most current models make use of the gravitational concepts involved in the general theory of relativity. The main stream of cosmological model building has been centered around the so called homogeneous cosmological model in which the matter which exists in the universe is approximated by a uniform perfect fluid whose properties are homogeneous and isotropic. When these assumptions are adopted, Einstein's general field equations

take the form

in which this third equation represents the so called Robertson Walker line element.

The problem of model building and selection is to solve these equations with boundary conditions that fit the observed sample of the universe. Our cosmological model according to these equations will be characterized by several parameters. The parameter $k$ represents the constant curvature of the space. In this form $k$ may be equal to either -1, 0, or +1, which represents a space of negative curvature which is an open or hyperbolic space; a flat euclidean space, or a closed positive curvature space which may be either elliptical or spherical. Other parameters or independent variables which appear in these equations are the density $\rho$ and the pressure $p$. Finally there is a parameter $\lambda$, the so called cosmological constant. Many large classes of models assume that this cosmological constant vanishes. It is important to say a word about the history of this constant. It was introduced originally by Einstein because his first solution of equations when he was looking for a static universe was unstable without the introduction of a positive constant. Subsequently, with the discovery of an expanding universe, it was no longer necessary to have this constant. However, it has been reintroduced even though it was removed by Einstein and it is now felt to represent possibly a residual repulsive force whose cause may not be associated with what we normally think of as pressure, although it acts like a pressure. The dependent parameter, $R(t)$, represents the radius of the universe. Our principle problem is to decide how this radius varies as a function of time in accordance with the values at certain times, usually the present time, for the various observable parameters. Two derived parameters are found to be very convenient in characterizing cosmological models. These are H, the so called Hubble parameter, which is equal to our $\frac{R}{\bar{R}}$, and q, the deceleration parameter, which is equal to

Thus, in our family of models which are of current interest, there are six characterizing parameters: $\lambda$ and k are constant, p, $\rho$, H, and q vary with time. It is the problem of the observational astronomer to determine the present values of p, $\lambda$, H, and q in order to decide what $\rho$ and k may be and to describe the functional relationship between R and t.

The slides show the various forms which the equation provides for the function R(t) in terms of the various characterizing parameters.

How are the parameters H, q, $\rho$, which can be related to observables, to be determined? There are three classic tests due to Hubble and Tollman in which the values of these parameters may be related to various models by means of comparing the counts of galaxies, the diameters of galaxies, or the apparent magnitude of galaxies with the observed redshifts of these galaxies. In essence, these tests show how the observable quantities of the numbers, sizes, and brightnesses change with the distance. Sets of theoretical curves such as those shown in the next three slides can be used for comparison with the observed relationships to decide what model best fits the observed sample of the universe. Because of observational difficulties tests based on counts of galaxies and tests based on diameters have not been found to be very useful. The principal test upon which astronomers hope to determine which model best fits the observed sample of the universe is the magnitude log redshift relationship shown in the third slide. A large class of models with $\lambda = 0$, called Friedman models, have been used by Sandage to approximate the observed sample of the universe. The next slide shows the family of curves corresponding to various values of q in a Friedman model, together with the points representing the redshifts magnitudes of galaxies and clusters.

It is seen that there are two basic parameters which characterize relativistic cosmological models. These are the curvature and cosmological constants. If the curvature takes on the value +1, the universe is said to be closed. If it assumes the value 0 or -1, it is said to be open. The slide shows that open universes will oscillate whenever the cosmological constant is less than 0, they will expand in a decelerating manner if the cosmological constant is equal to 0, whereas they will expand in an accelerated manner if the cosmological constant is greater than 0. These are the only possibilities permitted for open universes. The cases for closed universes, however, are more complex. Again if the cosmological constant is less than 0, the universe will oscillate. If it is equal to 0, it will also oscillate. However, if the cosmological constant is positive, several interesting subcases occur. There exists a critical value of the cosmological constant, $\lambda_c$, since the dimensions of the cosmological constant are $l^{-2}$, $\lambda^{-1/2}$ as the dimensions of length, the critical value of $\lambda$ corresponds to the gravitational radius of the universe $\frac{GM}{c^2}$. If the value of the cosmological constant is less than this critical corresponding to the gravitational radius of the universe, then the universe contracts then expands according to curve No. 1 or it oscillates. If the cosmological constant is equal to $\lambda_c$, then the universe expands from a critical non-zero initial radius or it remains static at this radius, or it may expand to 0 asymtotically to this critical radius. And finally, if $\lambda$ exceeds $\lambda_c$, the universe expands in the same way that it would if it were an open universe.

In recent years a great deal of attention has focused on so called Friedman models in which $\lambda$ is assumed to be equal to 0. There are two possible types of Friedman models, open and closed. The closed Friedman models must necessarily oscillate, whereas the open models will expand in a decelerating manner. The attraction of the Friedman models is largely in that the equations can be solved explicitly. Sandage and Hoyle have shown that the curvature of a Friedman universe can be uniquely discriminated by the so called deceleration parameter. According as the deceleration parameter which is designated by $q_o$ is greater than, equal to, or less than 1/2, the curvature will be +1, 0, or -1. Recently Sandage has shown on the basis of theoretical curves, constructed for Friedman models relating $q_o$ to the magnitude redshift diagram, that the best fit of the data which includes radio galaxies and clusters but not quasars, corresponds to a $q_o$ of 1.65. Since this value exceeds 1/2, k must be +1, the universe must be closed, and hence oscillating. In the Friedman universes a basic equation can be obtained relating three observables. This equation is $q_o = 4\pi g\rho$ divided by $3H^2$. Now $q_o$, $\rho$ and H may all be observed. A few years ago Oort estimated $\rho_o$, the present density of the universe, to be on the basis of the density of galaxies and their distributions to be $3.1 \times 10^{-31}$ gm/cm$^3$. The present value of H, the Hubble parameter, appears to be in the neighborhood of 75 km/sec/mpc. These two values in the Friedman equation demand a $q_o$ near 0. That is an open universe. Sandage's value of $q_o$ of 1.65 together with the value of 75 km/sec/mpc for the Hubble parameter leads to a density of the order of $3.5 \times 10^{-29}$ gm/cm$^3$ or in the neighborhood of 100 times what Oort observes. We here have a serious discrepancy between the observed value of $q_o$ and the observed density. We may assume that the value of the Hubble parameter is correct. It is difficult to account for the fact, if the value for $q_o$ is correct, that we are seeing only one percent of all the matter in the universe, 99% being invisible.

A second difficulty which is encountered in these latest results of Sandage has to do with the time scale. Now the time scale is not a new difficulty in cosmological models. You will recall that during the 30's the value of the Hubble parameter as then derived by Hubble and Humison was such that the age of the universe, the Hubble time, was about 2 billion years and we had observed the ages of rocks on the surface of the earth which were of the order of twice that age. This interesting discrepancy gave rise to the so called steady state universe which did not get into this trouble with the time scale. However, later ___________ showed that the zero point in the calibration of the set of luminosity curves was in error and that the Hubble parameter had to be changed up to about five billion years.

This removed the difficulty with the time scale. But today, if Sandage's new values are to be believed, we are again in trouble with the time scale. The Hubble time corresponding to 75 km/sec and a $q_o$ of 1.65 is about 6.5 billion years. For a $q_o$ of .5, it would be 8.7 billion years. Recent work in stellar evolution and new observations of certain types of stars shows that to adequately account for these stars on the basis of well established ideas of stellar evolution would require a time greater than 20 billion years. This second discrepancy together with the density discrepancy may be resolved if we are willing to abandon $\lambda = 0$ universes or Friedman universes. There are two additional difficulties with the $\lambda = 0$ universes which we shall discuss later.

If we are forced to abandon Friedman models, then regretfully we lose the value of these beautiful tests of the curves which discriminate between open and closed universes according to the value of $q_o$. In other universes we must know the value of the cosmological parameter itself before we can distinguish between cosmological models.

It is proper at this point to say a few words about the steady state model of the universe, although at the present time there are very few who still believe that the steady state model fits the observations without introducing a large number of ad hoc hypotheses. The steady state universe requires a $q_o$ of -1 and certainly Sandage's value of $q_o$ exclude this particular one. But the steady state hypothesis is in difficulty in several other respects. For example, the counts of radio sources with distance show that the universe is not homogeneous as would be required by a steady state hypothesis. But worse are problems of how to construct galaxies which must be condensing in a universe in which all the new matter is expanding. The die-hards with the steady state model are now holding that the sample of the universe we see may be just one additional cosmic hierarchy and that the steady state holds in the large but in a large which is far beyond the capabilities of our instruments to resolve. The principal value of the steady state model has been its stimulation to cosmological research, and although the model was never on either theoretically sound grounds or observationally proven, it did contribute a great deal of ____________________ which lead to the development of cosmology.

The scientific dialectic consists of observing a paradox forming some sort of hypotheses to explain the paradox; testing this hypothesis experimentally or with further observations and if valid, proceeding to formulate new questions, or if invalid, formulate new hypotheses. Two situations are typical in the operation of the dialectic. The first situation is that which is represented by the state of meteorology. Here we have an abundance of data which has been collected over large portions of the earth over a great many years. The problem is to find a theory for the circulation of the atmosphere which will allow the weather to be predicted. It is felt that the observations are in advance of the theory because it is impossible to get a theory to fit the observations. Although the cry goes up continually for more and more data, what is really required is basic theoretical work. The second situation is typified by cosmology. In the case of cosmology, there are an abundance of theories concerning the origin and evolution of the universe, but too few observational check points to allow a decision to be made as to which of these theories are valid, and which may be excluded. Here what is required are more observations, and especially, more observational check points.

The observational approach to the selection of the homogeneous cosmological model which best fits the observed sample of the universe has been primarily based on the three Tollman Hubble tests; the counts versus redshifts, the diameters versus redshifts, and the magnitudes versus redshifts. In the case of a Friedman type universe in which $\lambda$ is chosen to be 0 and the pressure is neglected, it turns out that discriminating observable which will allow us to decide which of two possible types of Friedman universe best fit the observable sample, is the deceleration parameter $q_o$. The deceleration parameter $q_o$, however, is of use in discriminating between cosmological models only in the case of the Friedman models. If it turns out that the cosmological constant $\lambda$ is not equal to 0, then the $q_o$ is useless for discrimination purposes.

Whenever a new observational check point becomes available which may be useful in a cosmological problem, a great deal of research effort is devoted to developing the new area. In the past two decades, three new possible observational check points have come into existence. I want to say a few words about these new observational developments.

The first development was radio astronomy. With the first detection of radio signals of a discreet nature from outer space, there was absolutely no knowledge as to their cause or how far away the source might be. The first problem in radio astronomy was to obtain a high enough resolution to get accurate positions of the radio sources so that they might possibly be identified with optical sources. The history of the first fifteen years of radio astronomy is largely history of improvements in resolving power and hence in the positions of the radio sources. Ryall was the first to point out that radio sources might possibly be at cosmic distances rather than being nearby radio stars within our own galaxy. At the present time, there is strong evidence supporting Ryall's view that a very large percentage of all radio sources are extragalactic. This is known largely through the identification of the radio source with an optical source. Until recent years, certain types of large or irregular galaxies were the best established radio sources. Astronomers in England and Australia principally were active in assembling catalogs of these radio sources. When counts of the radio sources to different apparent power limits were made, it was found that the distribution did not correspond to a uniform distribution in euclidean space, but seemed to fall off more rapidly with distance than is consistent with a -3/2 law. This problem put all forms of the steady state cosmology into a serious difficulty. To this day, no satisfactory solution to the distribution of radio sources has yet been found.

But one of the most exciting discoveries of modern times, and certainly one of the most exciting discoveries in the entire history of astronomy, came about through the compilation of the catalogs of radio sources and the obtaining of accurate positions for the radio objects. This discovery is all the more interesting because there is nothing in any existing theory which predicted it or even hinted to the existence of a new type of body which was first found in 1961 and which has since been called quasar. As a parenthetical remark, it is valuable to remind ourselves that our theories have not yet reached the point where they can continue to develop without the aid of observation. In the early 1920's, a very famour debate took place between two distinguished American astronomers, Curtis of the University of Michigan, and Chapley of Harvard. The subject of their debate was whether or not the spiral galaxies were nearby systems in our own galaxy or were actually external to the Milky Way. In 1923 this question was resolved by the discovery of cepheid type variables in certain of the spirals which definitely located them well outside the Milky Way. But at the same time this discovery was made a certain prejudice or set of ideas came into astronomy and this was that in order for anything to be outside the Milky Way, it would have to have an appearance something like a spiral or one of the other types of nebulae. The existence of stellar like objects that we could discern outside the Milky Way was dismissed. This is perhaps why the discovery of the quasars or quasistellar radio sources came as such a complete surprise. A slide which illustrates this situation shows a band which passes through the domain of all objects showing those which may be observed photographically. Within the band on the right are the faint galaxies,moving to the left, the bright and more concentrated galaxies. Further to the left of the second line are stellar like objects. It was felt until the discovery of the quasars that all objects in extragalactic universe which we could detect would lie within this band. Zwicky and his colleagues had observed near the left side of the band highly compact galaxies which showed wisps of nebulosity showing that they were not stars. These discoveries of Zwicky, plus some of his blue stars which had large redshifts, were the only clues we had that there might perhaps be something quite stellar-like in extragalactic space which we could detect. However, it is interesting, the fact that one star which had a very high redshift was explained by saying that it had fallen coincidentally on a line of sight with an extragalactic nebulae.

The story of the discovery of the quasars is one of the most exciting and romantic stories in modern science and I regret that we do not have time to point out some of its more interesting details. In brief, quasars were discovered when a very accurate position of one of the radio sources, 3C273, had been determined by astronomers in Australia by means of an occultation of the source by the moon. When this very accurate position was checked against plates made with the 200 inch telescope, it was found that there was nothing interesting like an unusual galaxy in the field; in fact, only one ordinary looking star was in the position indicated by the radio source. This was disappointing and about to be ignored as a coincidence when Sandage decided to investigate this star just to see whether by chance it had any peculiar properties. Color photometry showed that the star had a very large ultraviolet excess. In addition, the spectra showed that it had an extremely high redshift, .19, which definitely placed this star way beyond the limits of our galaxy. Hence, there was no question that what this very unusual optical object was associated with the radio source. As accurate radio positions became available several additional stellar-like sources were detected, and in each case, they had an unusual spectra, and an ultraviolet excess. The slide shows a so called three color diagram in which the color of the object in ultraviolet light minus the color in blue light is plotted against the color in blue minus the color in yellow. Most stars so called main sequence or normal stars lie on the solid curve which approximates a cubic curve. It was found that the representative points in the two color diagram of the quasistellar sources were in the upper right hand part of the diagram above a black body line or above even the white dwarfs and blue halo stars. The color diagram,once the characteristic region for these new types of objects had been outlined, served as a tool for discriminating between normal stars and quasistellar objects. However, the discrimination was not complete because of the regions where blue halo stars and quasistellar sources overlapped. In these cases the redshift would serve as the ultimate discriminator. The principal interest of the color diagram centers around the fact that a great many objects were found,far more than the number of radio sources suggest, which occupied the upper right portion of the diagram. This led Sandage to suspect that there was a large class of objects like the quasars which were radio quiet. Redshifts of some of these objects later proved Sandage to be correct and that there are large classes of stellar-like extragalactic objects whose nature and even distance is unknown.

The most challenging aspect of the quasars is the tremendous amounts of energy which they radiate. Of course, these amounts of energy depend upon whether or not our interpretation of the distance to the objects in terms of their observed redshifts is correct. One of the most exciting stories in connection with the quasars is the derivation of their redshifts by Schmidt. He found through a systematic analyses of different displacements that the unusual spectral characteristics of the quasars could be interpreted in terms of very high redshifts. He succeeded in determining these redshifts and found that for several objects, the redshifts exceeded two. This is quite startling in view of the fact that before the detection of quasars, the largest known redshift was hardly one-tenth this value. The question which is basic to the problem of the quasars is whether the large redshifts may be interpreted as cosmic redshifts in accordance with the law using the same value of the Hubble parameter which has been derived for galaxies. If this interpretation is allowed, the quasars are then at extreme distances, up to 500 mpc, and the energies that they emit in accordance with the inverse square law are of the order of $10^{65}$ergs. The sources of such large amounts of energy are completely unknown. The second interpretation has been proposed for the redshifts that they may be due to some other cause than the basic cosmic redshift. As for example, they may be gravitational redshifts, following a model which has recently been proposed by Hoyle and Fowler, in which case the quasars would not be at cosmic distances but may be only a few mpc away though still outside the galaxy. The energies involved are no longer so large as to require any special or unknown mechanism. The quasars form a very challenging and difficult problem. The implications of a solution to this problem may reach deep into the foundations of physics and astrophysics. We do not have time to discuss the quasars per se today, but we wish to look at their implications for cosmology. If the redshifts are interpreted as cosmic redshifts, then certainly the quasars would be extremely valuable for discriminating between the various $q_o$ curves. We would have points further out on these curves than any available from galaxies or radio sources by a factor of almost 10. So from the point of view of the m log z, Hubble Tollman test, what can be learned of cosmological interest from the quasars bearing in mind that we are assuming that the quasars follow the usual Hubble law. When the magnitudes of the quasars are plotted against the logs of the redshifts, we find a diagram with a very high degree of scatter as shown in the slide which is adapted from Hoyle and Berbiage. The points do not lie along a single line as in the case of the radio sources and the clusters of galaxies, but show the same sort of dispersion which is shown by nearby galaxies. It is evident that the quasars are not useful to discriminate $q_o$ curves on the m log z diagram. This has been a big disappointment, that in finding large redshifts, hopefully would resolve the $q_o$ selection problem. But of course, the discovery of objects with large redshifts may have far more profound and interesting meaning than that associated purely with the m log z curve. The resemblance of the distribution of the quasars to that of the nearby galaxies is one of the points in favor of the nearby hypothesis.

Very recently two new discoveries with regard to quasar redshifts cast large doubt over the interpretations of the redshifts as being purely of cosmic origin as associated with Hubble's law. These two discoveries are first, for all large redshifts greater than 2 for which absorption features are present, the absorption features are all very closely the same redshift, namely 1.96. The second property of the redshift is that recently Greenstein has found an object in which some of the lines have one redshift, and other lines have a second redshift. An object cannot be at one distance participating in one cosmic recession and show a split redshift of this sort. Finally, Streichnotter has shown that the distant quasars are closely grouped in two areas of the sky as though they constituted special systems of their own.

In addition to the discovery of the quasars, a second very exciting new observational check point has recently come to light. This is the recent discovery in 1965 by Pensius and Wilson that at a wavelength of 7.3 cm, the universe appears to have a background temperature of some 3° Kelvin. This had been predicted theoretically by Dicke and Peebles at about the same time as its observational discovery. A value also indicating a 3° temperature background was found at 3.2 cm by Rolle and Wilkinson in 1966. Field and Hitchcock in 1966, Thaddeus and Klauser in 1966, have also inferred a 3° Kelvin temperature at 0.26 cm from the rotational structure of the interstellar absorption bands of cn. This 3° Kelvin temperature background is being interpreted as the vestigial radiation from an initial fireball and that the primeval photons associated with a temperature phase of something of the order of $10^{11}$° Kelvin are now properly cooled to 3° K. The discovery of this radiation is taken as very strong evidence for the evolutionary theories regarding the origin of the universe and particularly to the Lemaitre type primeval atom.

One of the most important cosmogonic problems is the origin of the elements. The basic problem is to fit the observed abundances of elements in the solar system and the abundances derived from observations of stellar spectra making use of the nuclear reactions including their rates and energies as determined in the laboratory. The elements may have originated in one or more of three different ways; stellar synthesis, that is, in the interiors of hot stars; in super massive stars, such as quasars have been presumed by some to be, that is objects of the order of $10^8$ solar masses; or in a primeval fireball, in a big-bang evolutionary model. There are difficulties in deriving the heavier elements from stellar interior generation. The two favorite sources for building of heavier elements are the primeval fireball and super massive stars. One of the first problems concerns the origin of helium. In the sun about .27 of the mass is known to be helium, but this could not possibly have been generated in the sun, due to the carbon cycle or other processes going on in the generation of nuclear energy in the sun. A great portion of the initial helium must have been present when the sun was formed. Wagoner, Fowler, and Hoyle have shown that if helium is produced in a universal fireball, the mass fraction of helium which is produced lies between .2 and .3, which is determined using the present temperature 3° Kelvin. If the helium has been generated in super massive objects, then a much higher ratio, .4, could have been produced. It is hoped that by measuring the helium concentrations in different astronomical bodies it can be determined whether helium originated in the original fireball or in super massive objects. If the concentrations of helium are in general found to be as high as .4, this would favor the super massive objects as the site of the origin. If it could be shown, however, that the helium ratio is always near .27, as in the case of the sun, this would favor the universal fireball as a source of origin.

Wagoner, Fowler, and Hoyle find on the basis of fitting the observed abundances of deuterium, helium 3, helium 4, and lithium in the solar system that a model consistent with the 3° Kelvin temperature at the present epoch, and with a density of $2 \times 10^{31}$ gm/cm$^3$, turns out to be an open cosmology with a deceleration parameter in the neighborhood of $5 \times 10^{-3}$. This seems to be the best model for generating the observed abundances, although Wagoner, Fowler, and Hoyle restricted themselves to models with vanishing cosmological constant. The time since the original fireball, in this model is from 10 to 13 billion years, still somewhat short of the 20 billion years required by stellar evolution. This complicates the problem for Friedman universes. The problem is even further complicated by the recent discovery of some very old stars with very low helium content.

It was mentioned initially that the best theory of gravitation which we have available is Einstein's general theory of relativity. The Einstein theory was given observational verification through the three famous Schwarzchild tests; the advance in the perhelion of Mercury, the deflection of light rays passing near the sun, and the gravitational redshift of spectral lines. The latter two tests are inconclusive for establishment of the general theory of relativity because they are either only qualitative or as in the case of gravitational redshifts, they are common to a great many theories of gravity. The test which singles out Einstein's theory of general relativity as the best candidate for a theory of gravity is the advance in the perhelion of Mercury. Observations show that Mercury's perhelion rotates approximately 5600 seconds of arc per century. If one uses classical mechanics to compute the rotation and includes the perturbations of Venus, Jupiter, Earth, Saturn, etc., the result is about 5,556 seconds per century. The difference between observation and Newtonian theory is 43.1 seconds per century and this seemed to be in almost perfect agreement with Einstein's gravitational theory which predicts 43 seconds per century. Recently, Dicke at Princeton, has questioned our right to ignore the oblateness of the sun as a perturbation in causing the advance in the perhelion of Mercury. If the sun rotates, as its surface features suggest, then the oblateness is essentially zero and there would be no oblateness perturbation. But if the sun has a core which rotates rapidly, as do a great many other stars, then there may possibly be some oblateness which would affect the perhelion of Mercury. Dicke set out to observe whether or not there was such an oblateness to the sun using a very clever type of solar telescope, in which he was able to remove most systematic errors. Dicke found that the fractional difference between the equatorial and polar radii of the sun was $5 \pm 0.7 \times 10^{-5}$ which indicates that eight percent of the Mercury perhelion precession may be due to a solar quadripole moment. Dicke's oblateness implies an eight percent discrepancy in the Einstein value. The value to be explained is no longer 43 seconds per century and the general theory of relativity no longer explains the observed discrepancy. Dicke announced, "It wouldn't surprise me if general relativity is just plain wrong." Dicke has his own theory of gravity called a scaler-tenser theory in which one of the properties is that the gravitational coupling constant G changes with time. He finds that the eight percent discrepancy caused by the oblateness of the sun is in perfect agreement with his scaler-tenser theory. So it may be that we are going to question the general theory of relativity which has been substantially on the books for forty years and have to revise our basic approach to cosmology.

The central cosmological problem in relativistic homogeneous cosmology, as was pointed out at the beginning of the lecture, was to select which of the seven generic types of curves fits best the observed sample of the universe. After using the various Hubble, Tollman tests, the arguments based on the origin of the elements and arguments derived from recent physical experiments, and from the presence of the 3° Kelvin isotropic background temperature, we cannot conclude that either an oscillating or an expanding Friedman model satisfactorily fits the observations. It appears that if we are to use the general theory of relativity at all, we must introduce the cosmological constant, $\lambda$, and that it must not be equal to zero.

Perhaps it is possible to make an argument which will allow us to isolate which of the curves best represents R(t) purely from consistency. The three Schwarzchild tests for general relativity were derived from a special assumption which is similar to the assumption of homogeneity, namely a perfect fluid which is homogeneous and isotropic. The equating of the interior and exterior Schwarzchild solutions to the field equations results in the prediction that there exists a bound on the potential which any gravitating system may have. This potential bound $\frac{GM}{c^2R}$ must always be less than one-half. In addition, if we measure the gravitational potentials of bodies available for observation, we find indeed that the potentials of stars, galaxies, and clusters, and higher order clusters, all have about the same upper bound, which is less than the Schwarzchild limit. Thus both theory and observation suggest that a basic property of the universe is a bounded potential rather than uniform density. What implications then does a bounded potential have for the field equations? It can be shown in a very straight forward way that if k = 0 or -1, that is, if the universe is an open universe, then a bound potential demands that the density vanish. That is to say that such universes are empty universes and therefore, of no physical interest. This would be so except that Charlier has shown that it is possible to construct a universe with a vanishing mean density, yet have matter present. This can be done by constructing a hierarchy of cosmic bodies. That is to say, we continue the hierarchal structure started by the of stars into galaxies, galaxies into clusters, clusters into second-order clusters, by assuming that this type of clustering continues ad infinitum. Such a universe would be able to have all the matter observed and yet have vanishing mean density. We therefore conclude that if there is a bounded potential as implied by general relativity, then if the universe is open, it must be hierarchically structured with an infinite number of hierarchies.

On the other hand, if the universe is closed if k = +1, the argument is somewhat to make, but it can be shown that $\lambda$ must be greater than zero. This gives a fourth argument against Friedman universes, namely, there is an inconsistency between all Friedman universes and the existence of a Schwarzchild limit. It can further be shown subject to potential bounds equal to 8/9 or smaller that if k = +1, $q_o$ is less than -1, and the potential is decreasing with time. If the additional assumption is made that the only physically meaningful pressures lie between zero and the pressure of a photon gas, $\frac{\rho c^2}{3}$, then $\ddot{R}$ in the neighborhood of the present epoch must be positive, that is, $q_o$ must be negative. This leads us to the conclusion that $\ddot{R}$ must be positive for all future times and that the universe is accelerating in its expansion to infinity. The ultimate state of this universe is described in the limit as t gets very large the deceleration parameter goes to -1, the Hubble parameter will go to a quantity which is equal to the velocity of light times the $\sqrt{\frac{\lambda}{3}}$, the pressure will go to zero, and the density will go go zero, and the potential will continue to decrease. This is a universe consistent with the second law of thermodynamics.

In the available patterns of R(t) three have the property of accelerating expansion to infinity. One of these is a contraction to a minimum different from zero followed by an expansion. The second is the Lemaitre Eddington pattern which starts at a value different from zero and expands in an accelerated manner to infinity, and the third starts from zero, decelerates, then accelerates in its expansion to infinity. So on the basis of self-consistency, we have reduced the problem of the selection of cosmological models to which of these three cases best fits the observable and derived parameters. This is equivalent to deciding whether the cosmological constant is less than, equal to, or greater than the critical value of the cosmological constant which corresponds to the gravitational radius of the universe raised to the -2 power. We must thus decide whether the universe is open or closed on the basis of whether the number of hierarchies which exist are limited or infinite. If the number of hierarchies terminates we can then take k = to +1, if not, then k must be equal to zero. Observations show that if the present trend of the numbers of particles in each successive aggregate is continued, that there can be no more than third ordering clustering which would suggest that k = +1. If we make the additional assumption that the total mass of the universe remains constant, it is then possible to show that the universe which expands from a singular condition that is, radius zero, is ruled out and the only possible universes left to us are the Lemaitre Eddington universe expansion from an Einstein static universe, or the universe which contracts to a finite value and then re-expands.

Hence in any event, under the assumptions of the validity of the general theory of relativity and of consistency with the Schwarzchild solution to the general theory of relativity which implies a potential bound, and on the basis of a finite order of clustering, the future of the universe is uniquely determined. It will continue to expand monotonically and in an accelerated manner for all time. Two paths are available to us; contraction to a finite radius then expansion, or expansion from a state of finite radius, which the universe occupied for an indefinite time. Whereas the field equations may be valid for predicting the future, since gravity undoubtedly is a dominate force for universes of low density, the validity of the field equations in the past is open to serious question when other forces than gravity may have played a dominant role. So the cosmological problem, as far as homogeneous models go, can be considered solved.

SCHILD01.WPD DECEMBER 1, 2000

# THE SCHWARZSCHILD BOUND

The Schwarzschild bound, $M/R = c^2/G$, may be derived in four basic ways:

1) Balance of forces $GM^2/R^2 = c^4/G$ ==> $M/R = c^2/G$
The contractive gravitational force balancing the expansive space force

2) Equipartition of energy $GM^2/R = Mc^2$ ==> $M/R = c^2/G$
The gravitational energy equal the rest energy

3) Frequency resonance $R^3/GM = R^2/c^2$ ==> $M/R = c^2/G$
The Kepler density time equal to the motion time

4) Equality of radii $GM/c^2 = R$ ==> $M/R = c^2/G$
The gravitational radius equal to the geometric radius

All of these equations state that an object in the first quadrant will expand, actually accelerate; an object in the second quadrant will acceleratingly contract; an object on the bound will either be stable or expand at a constant rate or contract at a constant rate.
In addition to the above four, the criteria may be formulated in terms of a critical density

$\rho_c = H_o^2/G$ where $H_o$ is the Hubble parameter and $\rho_c = M/R^3$

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Five basic frequencies [or times] when equated [at resonance] give us the axes defining the basic octants. The basic times are:
1) $t = R/c$, 2) $\tau = (G\rho)^{-1/2}$, 3) $T = GM/c^3$, 4) $Z = \hbar/Mc^2$, 5) $B = \hbar R/GM^2$

1) = 2) gives the Schwarzschild bound 1) = 3) gives the Schwarzschild bound
1) = 4) gives the Heisenberg bound 1) = 5) gives the $M = m_o$ axis
2) = 3) gives the Schwarzschild bound 2) = 4) gives $MR^3 = G\hbar^2/c^4$ [6]
2) = 5) gives $M^3R = \hbar^2/G$ [7] 3) = 4) gives the $M = m_o$ axis
3) = 5) gives $M^3/R = \hbar c^3/G^2$ [8] 4) = 5) gives the Schwarzschild bound

[6] x [7] gives $MR = \hbar/c$, the Heisenberg bound [6]/[7] gives the Schwarzschild bound
[6] x [8] gives $M^4R^2 = \hbar^3/Gc$ {9} [6]/[8] gives $R^4/M^2 = G^3\hbar/c^7$ {10}
[7] x [8] gives the $M = m_o$ axis [7]/[8] gives the $R = l_o$ axis

{9} x {10} gives [6] {9} / {10} gives [8]

All axes, including [6],...{10} pass through the Planck particle as origin.

# THE HUBBLE PARAMETER AND FUNDAMENTAL CONSTANTS OF PHYSICS

REVISED

*Number is the infrastructure of everything.* –Pythagoras

*As above, so below.* –Hermes Trimegistius

From the Heisenberg and Schwarzschild inequalities it can be shown that,

$$\frac{V}{T} \geq \frac{G\hbar}{c^2} = c l_o^2 = \frac{l_o^3}{t_o}$$

where V has the dimensionality $[L^3]$, T has dimensionality [T], G, ħ, and c are respectively the gravitational constant, Planck's constant, and the velocity of light; $l_o$ is the planck length and $t_o$ the planck time. Hence,

$$\frac{T}{t_o} \leq \frac{L^3}{l_o^3}$$

In particular, if L is taken equal to $r_e$, the electron radius,

$$T \leq \frac{r_e^3}{l_o^3} t_o = (\alpha \mu S)^{\frac{3}{2}} t_o$$

where α is the fine structure constant, μ the proton to electron mass ratio, and S the coulomb to gravitational force ratio.

The $\log_{10}$ value of T becomes 17.345065 seconds, or $\log_{10}$ 9.956955 years, which is equal to 9.056387 billion years. The interesting thing about this maximum value of T is that it is close to modern approximations of the time since the big bang, or "age of the universe". Indeed, if we take recent values derived from observations of 800 cepheids in 18 galaxies out to 25 megaparsecs[1], the age of the universe comes out to be 9.18 billion years, (with a Hubble time of 13.77 billion years). This value is derived from a Hubble parameter = 71±7 km/sec/mpc.[1] When the above value of 9.056387 billion years is converted to a Hubble parameter, it turns out to be 71.977 km/sec/mpc. If this is not just a numerical coincidence, and the present value of the Hubble parameter is indeed 71.977 km/sec/mpc, then there are some disturbing implications.

Pursuing this line of investigation, we find that the above value of T arises also from other levels of the inequality.

$$T \leq \frac{r_e^3}{l_o^3} t_o; \quad T \leq \frac{l_a^{\frac{3}{2}}}{l_o^{\frac{3}{2}}} t_o; \quad T \leq \frac{l_U}{l_o} t_o$$

where $l_a$ is a stellar radius, and $l_U$ is the radius of the Hubble universe. In each case the value of T is 9.056387 billion years.

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[1]Key Project, Wendy Freedman et al. Physics Today Aug 1999, p 19

# THE HUBBLE PARAMETER AND FUNDAMENTAL CONSTANTS

It has been shown[1] that a joint implication of the Heisenberg and Schwarzschild inequalities is that the average rate, $\Delta V / \Delta T$, in increase of volume of an expanding mass system is greater than or equal to $\psi = G\hbar/c^2$. That is,

$$1) \qquad \Delta T \leq \frac{\Delta V}{\Psi} = \frac{V_f - V_o}{\Psi}$$

where $\mathbf{V_f}$ is the final volume and $\mathbf{V_o}$ is the initial volume. Interpretating $\Delta T$ as the time elapsed since the volume was equal to the initial value $\mathbf{V_o}$, a bound on the maximum age of the system is given by equation 1).

First, consider the case of the initial volume being that of the Planck particle,

$$V_o = \left(\frac{G\hbar}{c^3}\right)^{\frac{3}{2}}$$

which has the $\log_{10}$ value of -98.374635, and the final volume being that of a baryon,

$$V_f = r_e^3$$

which has the $\log_{10}$ value of -37.650204. $\mathbf{V_o}$ is negligible with respect to $\mathbf{V_f}$, hence,

$$\Delta T \leq \frac{r_e^3}{\Psi}$$

Using the $\log_{10}$ value, -55.106271, for $\psi$, gives $\log_{10} \Delta T = 17.456057$ seconds as the maximum time or age since the expansion of the system. This is equivalent to 9.056387 billion years.

What is of interest here is that this is remarkably close to the age of the universe from the big bang to the present. From determinations of the Hubble parameter using cepheids, Wendy Freedman et al find for the age since the big bang a value of 9.18 billion years (± 10%)[2]. Kirshner using type II supernovae derives a value of 8.93 billion years.[3]

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[1]See Scraps 1995 #82 and 1996 #27

[2]Physics Today, August 1999, p20

[3]Physics Today, May 1996, p19

The following table compares the Cepheid, Type II supernova, and "Heisenberg-Schwarzshild" values:

| | CEPHEIDS | II SUPERNOVAE | "H-S" |
|---|---|---|---|
| AGE OF SYSTEM | $9.18 \times 10^9$ years | $8.93 \times 10^9$ years | $9.056387 \times 10^9$ years |
| HUBBLE TIME | $13.77 \times 10^9$ years | $13.40 \times 10^9$ years | $13.58 \times 10^9$ years |
| HUBBLE CONSTANT | 71±7 km/s/mpc | 73±7 km/s/mpc | 71.977 km/s/mpc |
| UNCERTAINTY | 10% | 15% | < 1% |

It must be repeated here that the H-S determination is for a hypothetical universe, the others for the "Hubble Universe".

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The H-S derivation led to a value of $\log_{10}\Delta T = 17.456067$ seconds. Converting from seconds to Planck time units, $t_o$, ( $\log_{10} t_o = -43.268366$ seconds) gives $\log \Delta T = 60.724433$, which is a dimensionless quantity. One third of this value is 20.241477 which is equal to $\log_{10}\sqrt{(\alpha\mu S)}$. Where $\alpha$ is the fine structure constant, $\mu$ is the ratio of proton to electron mass, and S is the ratio of coulomb to gravitational force. We conclude:

$$\Delta T = (\alpha\mu S)^{3/2}\, t_o \text{ seconds}$$

Is this a fractal invariant, isomorphic between different scales, or a just a highly improbable numerical coincidence? It raises many questions!

TABLE OF VALUES OF $N^x n^y$

$N = \sqrt{S}$, where S is the ratio of coulomb to gravitational force;

$n = \sqrt{(\alpha\mu)}$, where $\alpha$ is the fine structure constant and $\mu$ is the ratio of baryon mass to electron mass.

All entries are $\log_{10}$ of cgs values.

| | $n^{-4}$ | $n^{-3}$ | $n^{-2}$ | $n^{-1}$ | $n^0$ | $n$ | $n^2$ | $n^3$ | $n^4$ |
|---|---|---|---|---|---|---|---|---|---|
| $N^4$ | 76.457612 | 77.021149 | 77.584686 | 78.148223 | 78.711760 | 79.275297 | 79.838834 | 80.402371 | 80.965908 |
| $N^3$ | 56.779672 | 57.343209 | 57.906746 | 58.470283 | 59.033820 | 59.597357 | 60.160894 | 60.724431 | 61.287968 |
| $N^2$ | 37.101732 | 37.665269 | 38.228806 | 38.792343 | 39.355880 | 39.919417 | 40.482954 | 41.046491 | 41.610028 |
| $N$ | 17.423792 | 17.987329 | 18.550866 | 19.114403 | 19.677940 | 20.241477 | 20.805014 | 21.368551 | 21.932088 |
| $N^0$ | -2.254148 | -1.690611 | -1.127074 | -0.563537 | 0 | 0.563537 | 1.127074 | 1.690611 | 2.254148 |
| $N^{-1}$ | -21.932088 | -21.368551 | -20.805014 | -20.241477 | -19.677940 | -19.114403 | -18.550866 | -17.987329 | -17.423792 |
| $N^{-2}$ | -41.610028 | -41.046491 | -40.482954 | -39.919417 | -39.355880 | -38.792343 | -38.228806 | -37.665269 | -37.101732 |
| $N^{-3}$ | -61.287968 | -60.724431 | -60.160894 | -59.597357 | -59.033820 | -58.470283 | -57.906746 | -57.343209 | -56.779672 |
| $N^{-4}$ | -80.965908 | -80.402371 | -79.838834 | -79.275297 | -78.711760 | -78.148223 | -77.584686 | -77.021149 | -76.457612 |

April 30, 1999

TABLE OF VALUES OF $N^x \mu^y$

$N = \sqrt{S}$, where S is the ratio of coulomb to gravitational force;

and $\mu$ is the ratio of baryon mass to electron mass.

All entries are $\log_{10}$ of cgs values.

| | $\mu^{-3}$ | $\mu^{-2}$ | $\mu^{-1}$ | $\mu^{0}$ | $\mu$ | $\mu^{2}$ | $\mu^{3}$ |
|---|---|---|---|---|---|---|---|
| $N^4$ | 68.920033 | 72.183942 | 75.447851 | 78.711760 | 81.975669 | 85.239578 | 88.503487 |
| $N^3$ | 49.242093 | 52.506002 | 55.769911 | 59.033820 | 62.297729 | 65.561638 | 68.825547 |
| $N^2$ | 29.564153 | 32.828062 | 36.091971 | 39.355880 | 42.689789 | 45.883698 | 49.147607 |
| $N$ | 9.886213 | 13.150122 | 16.414031 | 19.677940 | 22.941849 | 26.205758 | 29.469667 |
| $N^0$ | -9.791727 | -6.527818 | -3.263909 | 0 | 3.263909 | 6.527818 | 9.791727 |
| $N^{-1}$ | -29.469667 | -26.205758 | -22.941849 | -19.677940 | -16.414031 | -13.150122 | -9.886213 |
| $N^{-2}$ | -49.147607 | -45.883698 | -42.689789 | -39.355880 | -36.091971 | -32.828062 | -29.564153 |
| $N^{-3}$ | -68.825547 | -65.561638 | -62.297729 | -59.033820 | -55.769911 | -52.506002 | -49.242093 |
| $N^{-4}$ | -88.503487 | -85.239578 | -81.975669 | -78.711760 | -75.447851 | -72.183942. | -68.920033 |

PLNK2BN3.WPD April 30, 1999

see 1999#2

# PLANCK PARTICLE BARYON TRANSFORMATIONS

If we write N for $S^{1/2}$ and n for $(\alpha\mu)^{1/2}$, then the following relations between the Planck particle and the baryon obtain:

$$\text{Mass } \frac{m_o}{m_p} = \frac{N}{n}; \quad \text{Length } \frac{l_o}{r_e} = \frac{1}{Nn}$$

$$\text{v - time } \frac{t_o}{t_b} = \frac{1}{Nn}; \quad \rho \text{ - time } \frac{\tau_o}{\tau_b} = \frac{1}{N^2 n}$$

Note velocity time and density time are equal for the Planck particle and that $N\,t_b = \tau_b$ resonance?

$$\text{m - energy } \frac{E_o}{E_b} = \frac{N}{n}; \quad \text{G - energy } \frac{\varepsilon_o}{\varepsilon_b} = \frac{N^3}{n}$$

where $E = mc^2$ and $\varepsilon = Gm^2/l$

$$\text{t - action} \frac{\Omega_o}{\Omega_b} = \frac{1}{n^2}; \quad \tau - \text{action} \frac{\Omega_o}{\Omega_b} = \frac{N}{n^2}$$

where t-action is $ML^2/t$ and τ-action is $ML^2/\tau$, are the respective angular momenta.

$$\text{t - force} \frac{F_o}{F_b} = N^2; \quad \tau \text{ - force} \frac{F_o}{F_b} = N^4$$

where t-force is $ML/t^2$ and τ-force is $ML/\tau^2$.

$$\text{G - force} \frac{\Psi_o}{\Psi_b} = N^4; \quad \text{Density} \frac{\rho_o}{\rho_b} = N^4 n^2$$

where G-force is $GM^2/L^2$ and density is $M/L^3$

PLNK2BN4.WPD MAY 3, 1999

ELECTRIC CHARGE TRANSFORMATIONS

1995 values: ($\mathrm{Log}_{10}$ cgs) $e = -9.318\ 468\ 712$ $[\sqrt{(ML^3/T^2)}]$;
$e^2 = -18.636\ 937\ 424$ $[ML^3/T^2]$

$e^2 = \hbar\alpha c = -18.636\ 937\ 429$
$e^2 = m_e r_e c^2 = -18.636\ 937\ 4$
$e^2 = Gm_p m_e S = -18.636\ 937\ 6$

$S = 39.355880$
$N = \sqrt{S} = 19.677940$
$n = \sqrt{\alpha\mu} = 0.563537$

---

Planck Particle:

$$e_o{}^2 = m_o l_o{}^3/t_o{}^2 = -16.500\ 102 = e^2/\alpha = \hbar c$$

---

Proton:

$$e_{pt}{}^2 = m_p r_e{}^3/t_p{}^2 = -15.373\ 028 \qquad \frac{e_o{}^2}{e_{pt}{}^2} = \frac{1}{n^2} \quad -1.127\ 075 = -\alpha\mu$$

$$e_{p\tau}{}^2 = m_p r_e{}^3/\tau_p{}^2 = -54.728\ 908 \qquad \frac{e_o{}^2}{e_{p\tau}{}^2} = \frac{N^2}{n^2} \quad 38.228\ 806 = \frac{S}{\alpha\mu}$$

---

Electron:

** $$e_{et}{}^2 = m_e r_e{}^3/t_e{}^2 = -18.636\ 937 = e^2 \qquad \frac{e_o{}^2}{e_{et}{}^2} = \frac{1}{\alpha} \quad 2.136\ 835$$

$$e_{e\tau}{}^2 = m_e r_e{}^3/\tau_e{}^2 = -61.256\ 727 = Gm_e{}^2 \qquad \frac{e_o{}^2}{e_{e\tau}{}^2} = \frac{N^2\mu}{\alpha} = \frac{N^2 n^2}{\alpha^2} \quad 44.756\ 625$$

** $e_{et}{}^2 = e^2$ leads to the definition of e as the charge of the electron. ($\neq e_o{}^2$)

$$\frac{e_{ot}^2}{e_{o\tau}^2} = 1 \qquad \frac{e_{pt}^2}{e_{p\tau}^2} = N^2 \qquad \frac{e_{et}^2}{e_{e\tau}^2} = N^2\mu$$

PLNK2BN5.WPD MAY 3, 1999

# FORCES $[ML/T^2]$

The Planck Particle:

The gravitational force: $F_{go} = Gm_o^2/l_o^2 = 49.082\ 988$

$c^4/G = 49.082\ 989$ ; $\hbar/ct_o^2 = 49.082\ 989$

The electric force: $F_{eo} = e_o^2/l_o^2 = 49.082\ 988$ $F_{eo} = F_{go} = F_o$

Note that a Planck Particle's gravitational and electric forces are equal.

---

Proton:

The gravitational force: $F_{gp} = Gm_p^2/r_e^2 = -29.628\ 773$ $\quad \dfrac{F_{go}}{F_{gp}} = N^4$

The electric forces: $F_{ept} = e_{pt}^2/r_e^2 = 9.727\ 108$ $\quad \dfrac{F_{eo}}{F_{ept}} = N^2$

$F_{ep\tau} = e_{p\tau}^2/r_e^2 = -29.628\ 772$ $\quad \dfrac{F_{eo}}{F_{ep\tau}} = N^4$

---

Electron:

The gravitational force: $F_{ge} = Gm_e^2/r_e^2 = -36.156\ 591$ $\quad \dfrac{F_{go}}{F_{ge}} = N^4\mu^2 = \dfrac{N^4n^4}{\alpha^2}$

The electric forces: $F_{et} = e_{et}^2/r_e^2 = m_e r_e/t_e^2 = 6.463\ 199$ $\quad \dfrac{F_{eo}}{F_{eet}} = N^2\mu = \dfrac{N^2n^2}{\alpha}$

$F_{e\tau} = e_{e\tau}^2/r_e^2 = G\ m_e^2/r_e^2 = -36.156\ 591$ $\quad \dfrac{F_{eo}}{F_{e\tau}} = N^4\mu^2 = \dfrac{N^4n^4}{\alpha^2}$

Note that in the Planck particle, the proton, and the electron, the gravitational and τ-electric forces are equal.

PLNK2BN7.2PD MAY 5, 1999

cf 1999 # 17

# PLANCK PARTICLE ELECTRON TRANSFORMATIONS

If we write N for $S^{1/2}$ and n for $(\alpha\mu)^{1/2}$, then the following relations between the Planck particle and the electron obtain:

- 22.378 321 $$\text{mass } \frac{m_o}{m_e} = \frac{N\mu}{n}; \qquad \text{length } \frac{l_o}{r_e} = \frac{1}{Nn}$$ - 20.241 477

$$\text{v-time } \frac{t_o}{t_e} = \frac{1}{Nn}; \quad \rho\text{-time } \frac{\tau_o}{\tau_e} = \frac{1}{N^2 n\sqrt{\mu}}$$ - 41.551 372

Note velocity time and density time are equal for the Planck particle and that $t_e N\sqrt{\mu} = \tau_e$

$$\text{m-energy } \frac{E_o}{E_e} = \frac{N}{n}\sqrt{\frac{\alpha}{\mu}}; \qquad \text{G-energy } \frac{\varepsilon_o}{\varepsilon_e} = \frac{N^3\mu^2}{n}$$ 64.998 101

where $E = mc^2$ and $\varepsilon = Gm^2/l$, $\varepsilon_e = -48.706\,659$

$$\text{t-action } \frac{\Omega_o}{\Omega_{et}} = \hbar\alpha; \qquad \tau\text{-action } \frac{\Omega_o}{\Omega_{e\tau}} = \frac{N\sqrt{\mu}}{\alpha}$$ 23.446 729

where $\Omega_{e\tau} = -50.423\,653$ and
where t-action is $ML^2/t$, and $\tau$-action is $ML^2/\tau$, the respective angular momenta.

$$\text{t-force } \frac{F_o}{F_{et}} = N^2\mu; \quad \tau\text{-force } \frac{F_o}{F_{e\tau}} = \frac{N^4 n^4}{\alpha^2}$$

where t-force is $ML/t^2$ and $\tau$-force is $ML/\tau^2$. $F_o = 49.082\,989$

85.239 580 $$\text{G-force } \frac{F_o}{F_{ge}} = N^4\mu^2; \quad \text{Density } \frac{\rho_o}{\rho_e} = N^4 n^4 \mu$$ 83.102 746

where G-force is $GM^2/L^2$ and density is $M/L^3$

67a

FIGRUND1.WP6 November 17, 1996

cf. 1996-61
1996-65

*THE UNIVERSE CONSISTS OF TWO LEVELS,*
*A FIGURE AND A GROUND.*

- The Ground is a vast vibratory system, like a complex drum, capable of vibrating in many modes. The spacings of its nodes are determined by the three dimensionless numbers: $\alpha$, $\mu$, and S where
  - $\alpha$ is the fine structure constant = 0.007297353
  - $\mu$ is the mass ratio proton to electron = 1816.152701
  - S is the ratio of the coulomb to the gravitational force, = $2.269239 \times 10^{39}$

- The Figure is the material universe whose basic modules are action packets [dimensionally = $ML^2/T$ ] defined by the fundamental constants: $\hbar$, c, and G where
  - $\hbar$ is Planck's constant $[ML^2/T] = 1.054573 \times 10^{-27}$ cgs
  - c is the velocity of light $[L/T] = 2.997925 \times 10^{10}$ cgs
  - G is Newton's constant $[L^3/MT^2] = 6.672599 \times 10^{-8}$ cgs

The action packet, sometimes called the Planck particle, has the values:

$m_p = 2.176710 \times 10^{-5}$ grams
$l_p = 1.616050 \times 10^{-33}$ centimeters
$t_p = 5.390560 \times 10^{-44}$ seconds

The interaction of these two levels creates a universe. Many figures are possible with the same Ground. However, what actually occurs depends on the values of the constants $\hbar$, c, and G. The vibratory system which supports various dynamics may also be alterable, but whatever its structure, it provides the "theme" within whose template all "variations on the theme" take place.

Since material existence occurs at the nodes, the organization of the action modules and their transforms is governed by the locations of the nodes. The largest net of nodes is set by S or $\sqrt{S}$, giving a "fractal" structure to the universe. Small scale nets are determined by $\alpha$ and $\mu$ in various combinations. These several nets of nodes provide many templates by means of which all possible material entities are formed.

The two levels involved are those of the templates and those of the packets. These levels constitute a basic dualism underlying the universe. What can occur is defined by the Ground, what does occur is open but infected with what has already occurred. But beyond the necessity of this dualism lies the question of its sufficiency. Is a third element required to make it happen?

SOME SUPPLEMENTARY INPUTS:

- A dynamic sub-system of the cosmos evolves so as to maximize its options and potentialities. This evolution is counter to the second law of thermodynamics. cf. Gurdjieff's Cosmogony 1995 #25

- The cutting edge of such an evolving system gravitates toward a region rich in alternatives, resulting in existence occurring where the density of alternate possibilities is a maximum. (usually at some interface or interstice) (How does this jibe with matter occurring at nodes?)

- The universe does not march to the beat of a single drummer. The clock rate at any locality varies inversely with the square root of the local density. Change or evolution is most rapid where the mass density is greatest.

- The world consists of many facets (or domains) separated by fault lines (~ nodes?) These facets are multiplexed in many ways across the fault lines (boundaries)

Metaphor of drum head

- What evolves is the result of the interplay of homogonizing forces (such as gravity and the 2nd law of thermodynamics) with a general uniqueness principle. Either emergence, complexity, organization occurs or extinction ensues.

Is the inflationary universe explicable alternatively by a time rate of change?

# THE KOSMOS ACCORDING TO PYTHAGORAS

## I Pythagoras and Planck

Somewhere around 600 B.C.E., at the beginning of the present age, Pythagoras held that the natural integers themselves sufficed as building blocks for constructing the universe. He was set back and dismayed when real numbers like $\sqrt{2}$ intervened. Even before his death the continuum of real numbers began to philosophically intrude and came to dominate physical thought until the beginning of the 20th century. Then at the beginning of the present age, Max Planck found that discreteness must be re-introduced. The continuum, as well as the integers, was found wanting. Pythagoras was somewhat justified when Planck showed that basic physical realtionships were governed by discrete rather than contiuous, quantities. Of course, Pythagoras' misinterpretation was that it was the integers themselves that sufficed, when it was discreteness, one of the properties of the integers that was the essence. Today as digital replaces analog, Pythagoras is firmly back in business.

Sometimes many centuries intervene between the writing of the first sentence of a worldview and the writing of the second, with many by-paths being explored in the while. Today it seems possible to add to what Pythagoras began since there have been several contributions to his approach in recent years. It is quite appropriate to call such modern natural philosophers as Planck, Eddington and Dirac followers of Pythagoras, since parts of their work are clearly "Pythagorean". They have taken number to be the ultimate basis of reality.

## II The Planck Particle

Today Pythagoreanism begins with the so-called fundamental constants of physics. It might be said that: In the beginning God created the numbers $\hbar$ ,G, and c, and from these all else followed. If these constants had had different values, even slightly different values, then the universe would have been quite different. In fact we might not even be here to contribute the feedback consciousness that references the universe. Planck, in addition to re-introducing the discrete, took the fundamental constants, h, G, and c and dimensionaly derived a system of "natural units" with which to describe the universe. When translated into these Planckian units relations between the masses, sizes, and life times of physical entities were seen to reveal symmetries and patterns that bring to mind Pythagoras' earlier patterns of tones and their harmonics.

Physicists have come to feel that the dimensionalities of mass (M), length (L), and time (T) are the basic descriptors of most observed physical phenomena. In terms of M, L, and T, the dimensionalities of the fundamental constants sre,

$$[\hbar] = [ML^2/T], \quad [G] = [L^3/MT^2], \quad [c] = [L/T]$$

When mass, length, and time are expressed explicitly in terms of ħ, G, and c, we find,

$$m_o = \sqrt{\frac{\hbar c}{G}} \quad l_o = \sqrt{\frac{\hbar G}{c^3}} \quad t_o = \sqrt{\frac{\hbar G}{c^5}} \tag{1}$$

This set of values is taken as the definition of a virtual particle, having the mass $m_o$, the radius $l_o$, and the characteristic time $t_o$, called the "Planck Particle". The $\log_{10}$ cgs values of the fundamental constants and the Planck Particle parameters are given in Table I,

all value ħ

Table I Fundamental Values (cgs)

| CONSTANT | symbol | dimensionality | $LOG_{10}$(VALUE) |
|---|---|---|---|
| Planck's constant | $\hbar$ | $ML^2/T$ | -26.9769235 |
| gravitational constant | G | $L^3/MT^2$ | -7.1757050 |
| velocity of light | c | L/T | 10.4768207 |
| Planck mass | $m_o$ | M | -4.6621994 |
| Planck length | $l_o$ | L | -32.7915452 |
| Planck time | $t_o$ | T | -43.2683661 |
| fine structure constant | $\alpha$ | 1 | -2.1368346 |
| proton/electron mass ratio | $\mu$ | 1 | 3.2639088 |
| coulomb/gravity force ratio | S | 1 | 39.3558802 |
| proton mass | $m_p$ | M | -23.7766019 |
| electron mass | $m_e$ | M | -27.0405107 |
| electron charge | e | $\sqrt{(ML^3/T^2)}$ | -9.3184687 |
| electron radius | $r_e$ | L | -12.5500681 |
| Bohr radius | $a_o$ | L | -8.2763988 |

$\sqrt{S} = 19.67794$

$\alpha\mu = 1.127074$

$\sqrt{\alpha\mu} = 0.563537$

$\frac{\alpha}{\mu} = -5.400744$

$\sqrt{\frac{\alpha}{\mu}} = -2.700372$

27a

See 1995 #82

# THE HUBBLE PARAMETER AND THE HUBBLE TIME

SOME FUNDAMENTAL VALUES

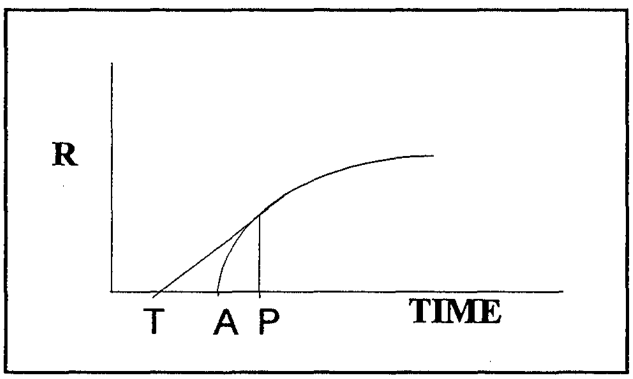
| | ITEM | VALUE | $LOG_{10}$VALUE |
|---|---|---|---|
| 1 | SECONDS IN SIDEREAL YEAR | 3.1558150 X $10^7$ | 7.499112 |
| 2 | VELOCITY OF LIGHT cm/sec | 2.9979246 X $10^{10}$ | 10.476821 |
| 3 | ASTRONOMICAL UNITS/PARSEC | 206,264.807 | 5.314425 |
| 4 | THE ASTRONOMICAL UNIT cm | 1.495985 X $10^{13}$ | 13.174927 |
| 5 | LIGHT YEAR cm **1 X 2** | 9.460896 X $10^{17}$ | 17.975932 |
| 6 | PARSEC cm **3 X 4** | 3.085691 X $10^{18}$ | 18.489352 |
| 7 | LIGHT YEARS/PARSEC **6 ÷ 5** | 3.261521 | 0.513420 |
| 8 | MEGAPARSEC km | 3.085691 X $10^{19}$ | 19.489352 |

H, the Hubble parameter (or constant), is usually expressed in km/sec/mpc, kilometers per second per megaparsec. It has the dimensionality of [1/T]. The reciprocal, 1/H, is called the Hubble time and is usually expressed in billions of years. A value of H = 1 km/sec/mpc is equivalent to a T of 19.489352 seconds (log value) [from **8** above]. This is equivalent to 11.990240 years (log value) [**8 - 1**] or 2.990240 billion years (log value), or to 977.777 billion years.

$H = 1 \sim$
$f = 10^{-19.489352}$ hertz

$$T = 978/H$$

Thus we have the Hubble time in billion years is 978 divided by the Hubble parameter in kilometers per second per megaparsec.




RADIUS VS. TIME

In the diagram, P is the present; A is the time at which expansion began; P - A is the so-called age of the universe; and P - T is the Hubble time. In any model in which the expansion is slowing the Hubble Time will be greater than the actual age.

The "critical" value for closing the universe

$AP = \frac{2}{3} TP$

# A TABLE OF HUBBLE TIME T vs HUBBLE PARAMETER H

$T = \frac{978}{H}$

H in kilometers per second per megaparsec; T in billions of years

| H | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|
| T | 196 | 98 | 65 | 49 | 39 | 33 | 28 | 25 | 22 | 20 |

| H | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| T | 18 | 16 | 15 | 14 | 13 | 12 | 11.5 | 10.9 | 10.3 | 9.8 |

See 1996 #24 and many others on 2-times

# WHY IS EVERYTHING SPEEDING UP ?

In this essay we will find it useful to make a distinction between **dimensionality** and **dimension.** Physicists are usually concerned with dimensionalities such as mass M, length L, and time T. We here specify that dimensionalities become dimensions through the operation of measurement; that is, through the operation of comparing two quantities of the same dimensionality one of which is a standard which defines a unit. While a measurement, the ratio of two quantities of the same dimensionality, is actually a pure number, having no dimensionality, we proceed to assign a unit to this pure number restoring its dimensionality and calling it a dimension. Time, for example, will be the ratio of two durations, one of which is a standard, such as the rotation period of the earth, in which case the resulting ratio, a pure number, will be labeled so many days. Thus the ratio of two dimensionalities is a dimension and the ratio of two dimensions is a pure number.

Measurement, the comparison of two quantities, one being a standard providing a unit, is sort of a special case of figure and ground. This in the sense that ground is a standard that provides, not a unit, but meaningfulness to the figure. We might even say that it requires both figure and ground for there to be existence itself. Here we want to consider some possibilities of placing two kinds of time in a figure/ground relationship.

Let us assume that what we call time is really a ratio of two time dimensionalities, t--Aristotle's time derived from motion, and τ--Kepler's time derived from density. These two times are related as figure and ground. That is what we experience as time is really the ratio t/τ. The τ time provides a cosmic standard interval against which various local t times are configured.

Aristotle's time t is given by

horizontal motion

$$t = \cancel{\frac{c}{L}}\ \frac{L}{C}$$

Kepler's time τ is given by

ground, density

$$\tau = 2\pi\frac{L^{3/2}}{\sqrt{GM}}$$

Dividing, we find for fixed M,

$$\cancel{\frac{t}{\tau} \propto \frac{1}{\sqrt{L^5}}} = \cancel{\frac{C\sqrt{GM}}{2\pi L^{5/2}}}$$

This ratio tells us that if L increases the apparent interval between two events will decrease. For an expanding universe as a whole, L, the measure of the size of the universe is increasing, hence the ground period is increasing and this causes the figure period to appear to decrease. Hence everything appears to speed up. On the other hand in the neighborhood of a black hole L is decreasing and the local or figure time will ~~de~~crease in. As one moves into a black hole everything slows down.

Expressing the time ratio in terms of the density, ρ, we have,

$$T = \frac{t}{\tau} \propto \frac{\sqrt{\rho}}{L}$$

From this equation we might have a resolution of the, "You can't be older than your mother", paradox. If L is the cosmic expansion, then the figure time is decreasing everywhere, but if in addition we are in a high density locality, such as a globular star cluster, the figure time will be even faster. Physical processes would run more rapidly and stellar evolution could take place in shorter times. So, "You can't be older than your mother", is true only if you and your mother have the same clock.

Redo

This is in error

---

If we use proper time $T = 1$

synthesize to perform

then for $\rho\uparrow$ $T > 1$ slow motion in appearance

but much happening between frames

i.e. many events

Define: frame: recorded — frame interval $= t$ — rate as frequency $\frac{1}{t} = f$

event: happened — event interval $= \tau$ — $\frac{1}{\tau} = \nu$

$T = \frac{t}{\tau}$

slow motion: many frames per event ~~t~~ $t < \tau$, $T < 1$

time lapse: many events between frames $t > \tau$, $T > 1$

Slow motion $N t = \tau$ $N > 1$ $T = \frac{t}{\tau} < 1$

Time lapse $n \tau = t$ $n > 1$ $T = \frac{t}{\tau} > 1$ $\rho\uparrow$

i.e. in a high density domain

$T > 1$ many events occur

~~few~~ proper time / projection rate

clock beat, $t = 1$

If $\rho\downarrow$, then $T < 1$ and proper time clock beat $t = 1$

and events appear in slow motion

$\Rightarrow$ less time to get anything done

This entire scrap must be redone

TIMEFGR.WP6 96/03/14 rev: 96/04/28

# WHY ~~IS~~ DOES EVERYTHING APPEAR TO BE SPEEDING UP ?

SOME PRELIMINARIES:

Measurement consists of the comparison of two quantities, one being the immediate specific object being measured the other being a standard which provides a unit; e.g. the length of a table compared to a standard meter. Measurement thus is a special case of **figure and ground** in the sense that ground is a context that provides, not only scale, but also meaningfulness to figure. Indeed it may well be asserted that both figure and ground are required in order for either meaningfully to have existence. see 96#24

The concepts implicit in measurement, in addition to units, standards, figure and ground, also involve **dimensionality ~~and dimension~~.** Physicists, for example, are usually concerned with the dimensionalities: mass M, length L, and time T. In the operation of measurement the quantity measured and the standard must have the same dimensionality. Their comparison results in the ratio, (object ÷ standard), which is a pure number, having no dimensionality. Yet after reduction to a pure number dimensionality is restored by labeling the resulting ratio a mass of so many grams or a length of so many centimeters, etc. We thus see that dimensionalities retain dimensionality in the operation of measurement in spite of becoming a pure numbers since a dimensional unit is afterwards assigned to the ratio. Time, for example, will be the ratio of two durations, one of which is a standard, such as the rotation period of the earth. In this case the resulting ratio, though a pure number, will be labeled so many days.

FIGURE TIME AND GROUND TIME:

In this section we shall consider some possibilities in placing two kinds of time in a figure/ground relationship. For any measurement the rule is that the two quantities being compared must have the same dimensionality and that what we label time is really a ratio of two time intervals. Let us note two physical functions both which have the dimensionality of time. The first of these is derived from motion or velocity, and since Aristotle felt that all time and change was an inference of motion, we shall call this "Aristotle Time". Specifically, Aristotle's time t is given by

$$t = \cancel{\frac{c}{L}}\ \frac{L}{c}$$

Where L is a length and c a velocity.

The second function having the dimensionality of time depends on mass density and since it is really a special case of Kepler's third law, we shall call it "Kepler Time", and designate it by the Greek letter τ. Specifically

$$\tau = 2\pi \frac{L^{3/2}}{\sqrt{GM}}$$

Where L is a length, M is a mass, and G is a constant with dimensionality, $\left[\frac{L^3}{MT^2}\right]$

If these two times are related as figure and ground, that is what we experience as time is really the ratio $T = t/\tau$, then the τ time provides a cosmic standard interval against which various local t times are configured.

proper time?

$$T = \frac{t}{\tau} \propto \frac{\sqrt{\rho}}{L}$$

wrong

This ratio tells us that if L increases the apparent interval between two events will decrease. For an expanding universe as a whole, L, the measure of the size of the universe is increasing, hence the ground period is increasing and this causes the figure period to appear to decrease. Hence everything appears to speed up. On the other hand in the neighborhood of a black hole L is decreasing and the local or figure time will decrease. As one moves into a black hole everything slows down.

COSQUAD1.WP6 August 3, 1997

# THE FOUR PHYSICAL COSMOLOGICAL QUADRANTS
## PART I

The Heisenberg inequality, $ML \geq \hbar/c$, and the Schwarzschild inequality, $M/L \leq c^2/G$, define four quadrants: In the first quadrant both of these inequalities hold and the result is the familiar universe of direct observation consisting of planets, stars, galaxies, clusters, etc. In the second quadrant the Schwarzschild inequality is reversed. This is the domain of black holes. In the third quadrant both the Schwarzschild and the Heisenberg inequalities are reversed, a possible domain of dark matter. In the fourth quadrant only the Heisenberg inequality is reversed. Inhabitants of this domain could have unlimited size but only minimal mass.

In the diagram the Schwarzschild and Heisenberg axes mark the divisions into the four quadrants. The intersection of the two axes marks the position of the Planck particle, a virtual particle whose mass, size, and characteristic time are determined by the values of the three fundamental dimensional constants of physics, the velocity of light c, Newton's gravitational constant G, and Planck's constant $\hbar$.

| | | |
|---|---|---|
| | $M/L > c^2/G$, $ML > \hbar/c$ | $M/L < c^2/G$, $ML > \hbar/c$ |
| | Mass > 10^-4.662 gm | Size > 10^-32.791 cm |
| | No size bounds | No mass bounds |
| | DOMAIN OF BLACK HOLES | UNIVERSE OF STARS, GALAXIES |
| NO PARTICLES ? | No atoms, no molecules | |
| | $M/L > c^2/G$, $ML < \hbar/c$ | $M/L < c^2/G$, $ML < \hbar/c$ |
| | Size < 10^-32.791 cm | Mass < 10^-4.662 gm |
| | No mass bounds | No size bounds |
| Could be appearance + extinction $\leq 10^{-43}$ sec lifetime any mass | DOMAIN OF DARK MATTER? | LOW MASS ENTITIES OF ANY SIZE? |
| | No atoms, no molecules | photons, gravitons ? |

If the inequalities hold for all particles and all aggregates, then there can be no atoms to the left of the Schwarzschild Limit. What is the relation of the particles of the Standard Model to these quadrants?

COSQUAD2.WP6 August 15, 1997

# THE FOUR PHYSICAL COSMOLOGICAL QUADRANTS
## PART 2.

As shown in Part 1. the Heisenberg inequality, $ML \geq \hbar/c$, and the Schwarzschild inequality, $M/L \leq c^2/G$, define four quadrants. In Part 2 the values of energy, force, and pressure in these four quadrants are investigated.

Pressure is defined as force/unit area, which is dimensionally equivalent to energy/unit volume.

$$P = \frac{Force}{unit\ area} = \frac{Energy}{unit\ volume} = \frac{M}{LT^2}$$

$$P = \frac{ML}{T^2} \cdot \frac{1}{L^2} = \frac{ML^2}{T^2} \cdot \frac{1}{L^3} = \frac{M}{LT^2}$$

The <u>total</u> <u>energy</u> of a mass M is equal to $Mc^2$, and the negative or outward pressure resulting from the total energy will be

$$P_T = \frac{Mc^2}{L^3} = \rho c^2$$

where $\rho$ is the mass density. The <u>gravitational</u> <u>energy</u> of a mass M with size L is equal to $GM^2/L$, and the positive or inward pressure resulting from the gravitational energy will be

$$P_G = \frac{GM^2}{L^2} \cdot \frac{1}{L^2} = \frac{GM^2}{L^4} = G\rho^2 L^2$$

The ratio of the gravitational pressure to the total pressure is

$$\frac{P_G}{P_T} = \frac{\frac{GM^2}{L^4}}{\frac{Mc^2}{L^3}} = \frac{GM}{c^2 L}$$

Since $GM/c^2L = 1$ on the Schwarzschild Limit, $P_G$ will equal $P_T$ on this boundary. In the first quadrant, (the observable universe), the outward pressure $P_T$ will be greater than the inward pressure $P_G$. The net effect will thus be expansion. In the second quadrant, (realm of black holes), inward pressure $P_G$ will be greater and the net effect will be contraction or collapse.

COSQUAD3.WP6 August 15, 1997

# THE FOUR PHYSICAL COSMOLOGICAL QUADRANTS
## PART 3.

As shown in Part II, in the first quadrant the total energy exceeds all other energies including the gravitational energy, this assures that $P_T$, the outward or expansive pressure will dominate. It is consequently expected that all first quadrant bodies should expand. However, the question immediately arises: what makes it at all possible for entities in the first quadrant such as, planets, stars, galaxies,..to be stable, not to expand, even to exist at all?

When Einstein applied his general theory to cosmology, he was disturbed that his equations implied that the universe was either expanding or contracting. (This was before Hubble and Humason had detected that the local universe was actually expanding.) He instituted a "fudge factor", $\Lambda$, the so-called cosmological constant, to stabilize the universe. The sign of $\Lambda$ was chosen to neutralize either expansion or contraction. This factor was later seen to be unnecessary and Einstein called it the greatest blunder of his theory. But was it?

The equations of Part II lead to the same results as Einstein's equations in general relativity. In the first quadrant everything must expand unless countered by some other factor. What then allows astromomical bodies to exist? What is Einstein's fudge factor, $\Lambda$ ?

Possible answers to this question include:

- Primordial high density "seeds" created local regions where gravity dominated the overall expansive force. (dark matter?)

- Total energy is expended or consumed in some manner, (rotation, radiation,..?) reducing the expansive component to less than the pull of gravity.

- The action of other forces, particularly coulomb forces, create additional "Schwarzschild Boundaries" within the first quadrant, for example the $GM/c^2L \leq \alpha^2$ boundary governing 'normal' matter.

The various stages of stellar evolution, expansion through the red giant stage, novae, supernovae, collapse to dwarf stage, neutron star, etc. may result from alternating local dominance of $P_T$ and $P_g$ all contained within the first quadrant.



- The universe will expand forever see part IV

The conventional choice of sign for gravitational force has been the minus sign. Most likely this convention derived from the earth centered view that gravity acts to bring objects to a lower elevation, and since down has been traditionally associated with minus and up with plus, gravitational force received the minus sign. But this seems to be the wrong choice when the earth centered view is abandoned. It is more in accord with the equations to posit expansion as negative and contraction (gravity) as positive. To see this, consider the two first quadrant equations $F_x=Mc^2/R$, the expansive force, and $F_g=Gm^2/R^2$, the contractive gravitational force. If M/R in the expansion equation is taken as negative then $M^2/R^2$ in the contraction equation becomes positive. The usual assumption of contraction as negative precludes use of this mathematical convention.

Extending the convention of contraction as postitive and expansion as negative, we might consider coulomb forces as "orthogonal" to gravitational forces and could consistently write for positive and negative charge, ie and -ie respectively. Then the interaction of like charges would give:

$$ie \times ie = -e^2 \quad \text{repulsion or expansion}$$

$$\text{and } -ie \times -ie = -e^2 \quad \text{again repulsion}$$

while unlike charges give:

$$ie \times -ie = +e^2 \quad \text{attraction or contraction}$$

Energy in non-bonded form expands P-SPACE
Energy in bonded form (i.e. matter) contracts P-SPACE

Matter is energy bonded by one or more of the 4 forces

How does energy → matter, i.e. become bonded? fusion?
How does matter → energy, i.e. become un-bonded? fission?

See also 1997 #55, #58, and 1998 #50

PYTHCOS2.WP6 April 4, 1997, June 29, 1997

# MORE PYTHAGOREAN COSMOLOGY

In the past few years many relations between the age and size of the universe and the properties of the elemental particles and fundamental constants of physics have been found leading some to hold that cosmology has now become a branch of particle physics. But that is a reductionist view. Mach would have it that particle physics should be taken as a branch of cosmology. Maybe it would be best that particle physics-cosmology should be a single discipline postponing for now the question of the direction(s) of causality.

In both particle physics and cosmology the fundamental constants, c,G and h, and the dimensionless numbers $\alpha,\mu$ and S appear in many equations. The so called 'Planck Particle' defined by the values of c,G and h when augmented by appropriate powers of $\alpha,\mu$ and S appears to determine the dimensions of many other entities in the universe from baryons to stars. Without extensive knowledge of the physical processes that may be occurring in the unfolding of the universe, we can see from the identity of certain numerical values alone that there is a profound interplay between the micro-micro and the macro-macro.

In studying these equations we must drop our historical biases of identifying these constants solely with the relationships in which they were first discovered. For example, the dimensionless constant, S, was first measured as the ratio of coulomb force to gravitational force. But the powers of $\sqrt{S}$ appear in so many non-force relations that S is likely to have cosmological functions other than those arising solely from being a particular force ratio.

Likewise we must be prepared to accept as canonical other parameters than those which we at present take to be basic. In Newton's day, energy, a parameter we now consider to be most fundamental had not yet been recognized. The history of physics shows an evolution of concepts toward the more general and inclusive: mass, Lagrangians, Hamiltonians, and in the present century charge, strangeness, color, beauty, etc. The path consists of continual re-entification and re-conceptualization.

COSQUAD4.WPD December 30, 1998

THE COSMOLOGICAL QUADRANTS— PART IV

The four quadrants are both local and non-local. They apply to all positions and scales from fundamental particles to the universe. Wherever the total energy is locally greater than the gravitational energy, expansion results. Wherever the gravitational energy locally dominates, contraction results. The resulting behavior in any domain is the result of the averaged net energy over that domain. The universe, for example, will expand or contract according as to whether,

$$\frac{GM^2}{R} < Mc^2 \quad \text{or} \quad \frac{GM^2}{R} > Mc^2$$

For a constant mass, it follows that if R is increasing (expansion) that $GM^2/R$ will decrease and expansion will indefinitely continue. For expansion to cease, mass must be created at a greater rate than R increases and for a length of time sufficient for M/R to become greater then $c^2/G$. Only in domains where mass is rapidly coming into existence will there be contraction and hence the formation of material bodies. Without the operation of forces other than gravity, all existing objects would persist only when $M/R = c^2/G$. Otherwise they would either expand indefinitely or become black holes.

A second first-quadrant condition is that the product time x energy be greater than ħ. This condition in the case of gravitational energy or contraction is,

$$\frac{tGM^2}{R} > \hbar$$

If R is increasing then either the time period **t** or the mass must increase to preserve the inequality. A second way to view this is to note that a time related to density (rather than motion) must also slow with expansion. Density time or $\tau$ time is given by,

$$\tau = \sqrt{\frac{4\pi R^3}{GM}} \quad \text{or} \quad \tau \propto \rho^{-\frac{1}{2}}$$

A constant mass with R increasing effects a decrease in density which in turn demands that $\tau$ increase. This means that the tick of the clock slows down. In an expanding universe the rate at which physical processes operate will be slowing unless there is a large rate of increase in mass. This effect could well explain why the age of stars in high density regions appears to be older than the age of the universe. That is, local clocks could run at different rates at different epochs. Another aspect involving two kinds of time is that with the uniform rate "proper" time, **t**, preferred by cosmologists, inflation or an increase in dR/dt, would take the form of a constant dR/d$\tau$, where $\tau$ is decreasing in rate because of expansion.

In accord with the concept that the four quadrants are non-local, applying to all domains whatever their size, the expansion rates and times may be congruent. We may thus calculate these rates and times for first quadrant entities such as expansion from a Planck particle (corresponding to the big bang) to a baryon (corresponding to the present) and expect the same times to be reflected in other domains including the universe itself. Indeed the expansion time calculated for planck particle to baryon is 9.057 billion years[1] . This corresponds to a Hubble age of 13.59 billion years and a value of the Hubble parameter of 71.96 kilometers/ second per megaparsec. [Freedman et al based on observations of Cepheids find a time from the big bang of 8.53 billion years and a Hubble time of 13.40 billion years derived from a value of the Hubble parameter of 73 kilometers per second per megaparsec , with an uncertainty of 15%.][2]

Another question confronting present day cosmology is the apparent or real value of curvature being close to zero. That is, why is space-time flat? What physical (or mathematical) principle sustains the universe holding to flatness? At this stage we can only note that in flat spaces alone are shape and size independent. In other spaces with positive or negative curvatures change the size and the shape changes. Is there implied here some trade-off relation between information and and energy content?

Other scraps in this series include:
Part I 1997 #55, Part II 1997 #58, Part III 1997 #60

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[1] See items 1995 No. 82 and 1996 No. 27

[2]Spectra, Publication of the Carnegie Institution of Washington, June 1996

PYTHCHEM.WPD October 13, 1998; October 20, 1998; June 5, 2000

# ON AVOGADRO'S NUMBER

In the nineteenth century chemists found all gases under standard conditions of pressure and temperature, when taken in amount equal to their molecular weight in grams, would contain the same number of molecules. For example, under standard conditions of pressure and temperature, 2.015 grams of Hydrogen (whose molecular weight is 2.015) would contain the same number of molecules as 4.003 grams of Helium (whose molecular weight is 4.003), would contain the same number of molecules as 39.948 grams of Argon (whose molecular weight is 39.948), etc. This fact led to the concept of "mole" or gram molecular weight, defined as the amount of a substance whose weight is equal to the molecular weight of the substance measured in grams. And the number of molecules in a mole, Avogadro's Number, named after the Italian chemist Avogadro, was found to be: $N_A = 6.022\ 136\ 7 \times 10^{23}$ particles per gram molecular weight. [$N_A$ has the dimensionality 1/M and the $\log_{10}$ value of 23.779 751]

This value of $N_A$ is based on the chemists' 1960 definition that $^{12}C = 12$, or that the $\log_{10}$ mass of a proton, $m_p = -23.779\ 751$ grams. Physicists, however, based on $^{16}O = 16$, use the $\log_{10}$ value of -23.776602 grams for the mass of the proton, leading to a value of $N_P = 5.978\ 629 \times 10^{23}$ particles per gram molecular weight. The ratio of these two values is 1.007277 (whose $\log_{10}$ value is 0.003149).

$$\frac{N_A}{N_P} = \frac{1.007277}{1.000000}$$

That is, the $^{12}C = 12$ value for atomic weights is 1.007277 times as great as the $^{16}O = 16$ values. For the physics value the number of particles (atoms, molecules, protons,...) per gram molecular weight becomes $\log_{10}(N_P) = 23.776602$.

It is useful from time to time, however, to remind ourselves that the gram is an anthropocentric measure of mass, devised by humans to facilitate such operations as business transactions and medical prescriptions. While the gram has been of great use in science its use may obfuscate some of the basic relationships that exist in the natural order. It would accordingly seem better to adopt a unit of mass that is implicit to nature and redefine Avogadro's number in such units. One such system of "natural units" is the Planck system based on the fundamental constants G, c, and $\hbar$. [Newton's gravitational constant, the velocity of light, and Planck's constant.] The Planck unit of mass is given by, $m_o = \sqrt{(\hbar c/G)}$, whose $\log_{10}$ value is - 4.662 199 grams. Converting the *physics* Avogadro number $N_P$ to Planck mass units we obtain: $N_{\text{P}} = N_P \times m_o = 1.301377 \times 10^{19}$ [with a $\log_{10}$ value of 19.114 403] particles per "planck molecular weight". That is, the mass ($m_o \times W$) of a substance will contain $N_{\text{P}}$ particles, where W is the atomic weight of the substance.

Note 1: Dimensionally the Planck number, $N_{\text{P}}$, is a mass times a reciprocal mass and is a pure number.

Note 2: The planck molecular weight, 19.114 403 is equal to $(S/\alpha\mu)^{1/2}$

Note 3: If the $^{12}C$-12 value is used for conversion to planck units,

$N_{A\text{P}} = N_A \times m_o = 1.310844 \times 10^{19}$ [whose $\log_{10}$ value is 19.117 551 ]

19.117 551 - 19.114 403 also leads to the ratio of 1.007 277

3 many errors here

# TABLE of TIME
# FOR RESONANCE COMMUNICATION

| | t | τ | T |
|---|---|---|---|
| Ω | -100.940471 | -120.618445 | -61.584592 |
| Pl | -42.071096 | -42.071096 | -42.071096 |
| $m_e$ | -22.228710 | -0.918814 | -64.848499 |
| $m_p$ | -22.228710 | -2.550769 | -61.584592 |
| H | -17.955040 | 3.859617 | -61.584354 |
| ⊕ | -0.874431 | 3.704106 | -10.031505 |
| Θ | 1.163843 | 4.000703 | -4.509878 |
| $S_w$★ | -2.715270 | -2.715271 | -2.715270 |
| $\alpha^2$★ | 1.558401 | 3.695235 | -2.715270 |
| $S_w$G | 7.278198 | 7.278198 | 7.278198 |
| $\alpha^2$G | 11.551868 | 13.688703 | 7.278198 |
| $S_w$U | 17.127170 | 17.127170 | 17.127170 |
| $\alpha^2$U | 21.400840 | 23.537675 | 17.127170 |

all times are in resonance at R

$\frac{⊕}{H} = .7$

$$t = 2\pi R/c \qquad \tau = 2\pi\sqrt{\frac{R^3}{GM}} \qquad T = 2\pi GM/c^3$$

MATRICS

III. TABLE OF T-TIME RATIOS Column/Row

| | Universe | ★ | Planck | baryon | Ω |
|---|---|---|---|---|---|
| Universe | 1 | $kS^{-1/2}$ | $kS^{-3/2}$ | $S^{-2}$ | $S^{-2}$ |
| ★ | $k^{-1}S^{1/2}$ | 1 | $S^{-1}$ | $k^{-1}S^{-3/2}$ | $k^{-1}S^{-3/2}$ |
| Planck | $k^{-1}S^{3/2}$ | S | 1 | $k^{-1}S^{-1}$ | $k^{-1}S^{-1}$ |
| baryon | $S^2$ | $kS^{3/2}$ | kS | 1 | 1 |
| Ω | $S^2$ | $kS^{3/2}$ | kS | 1 | 1 |

$k = \sqrt{(2\pi/\alpha\mu)}$

# SOME BASIC VALUES

many errors here

| | RADIUS | MASS |
|---|---|---|
| Ω | -91.261830 | -23.776604 |
| Pl | -32.392455 | -4.263110 |
| $m_e$ | -12.550068 | -27.040503 |
| $m_p$ | -12.550068 | -23.776602 |
| H | -8.276399 | -23.776366 |
| ⊕ | 8.804210 | 27.776483 |
| ʘ | 10.842484 | 33.298110 |
| Sw★ | 6.693371 | 35.092718 |
| $\alpha^2$★ | 11.237041 | " |
| Sw𝔊 | 16.956839 | 45.086186 |
| $\alpha^2$𝔊 | 21.230509 | " |
| SwU | 26.805811 | 54.935158 |
| $\alpha^2$U | 31.079481 | " |

| | |
|---|---|
| S | 39.355880 |
| $S^2$ | 78.711760 |
| c | 10.476840 |
| G | -7.175705 |
| $2\pi/c$ | -9.678641 |
| $2\pi/\sqrt{G}$ | 4.386032 |
| $2\pi G/c^3$ | -37.807988 |

U = Universe
𝔊 = Galaxy
★ = Star
w = on Schwarzschild Limit
ʘ = sun, ⊕ = earth
H = Hydrogen atom
$m_p$ = b = baryon
$m_e$ = electron
Pl = Planck
Ω = Omega Particle

S = coulomb to gravity force ratio
c = velocity of light
G = Newton's gravitational constant

SWRZLIM1.WP6 October 27, 1995

# THE SCHWARZSCHILD LIMIT

THE BLACK SHIELD

The Schwarzschild limit is a gravitational potential bound that divides the universe as we experience it from the counter-intuitive realm of black holes, white holes and worm holes, from the realm of unimaginable densities, sizes, and times. It is represented by the equation:

(1) $$\frac{GM}{c^2R} = 1$$

where G is Newton's gravitational constant, c is the velocity of light and M and R are the respectively the mass and size of the body.

There are three important watersheds that occur at the bound:

1. The gravitational energy of a body is equal to its total energy.

(2) $$\frac{GM^2}{R} = Mc^2$$

the left member being the gravitational energy and the right member the total energy. On "our side" of the bound the total energy exceeds all other forms of energy, on the "black" side of the bound the gravitational energy is the greatest. This leaves us with a semantic paradox regarding the word total: In fact,"Total" energy, $Mc^2$, is but a label for a particular kind of energy.

2. The gravitational radius is equal to the metric radius,R.

(3) $$\frac{GM}{c^2} = R$$

On the experienced side of the bound the gravitational radius is always less than the metric radius; the situation is reversed on the black side.

3. The light travel time is equal to the density or Schuster time.

(4) $$2\pi\frac{R}{c} = 2\pi\frac{R^{3/2}}{\sqrt{GM}}$$

The brevity of c time compared to ρ time is reversed on the black side of the bound.

1996 #27

PYTHAGE1.WP6 October 27, 1995 REV October 19, 1996

# A PYTHAGOREAN AGE OF THE UNIVERSE

An alternate approach to determining the age of the Hubble universe is to assume that certain parameters that are functions of the fundamental constants may vary with time. Let us focus on extension. Beginning with the Planck particle, let us ask how long it might take the Planck particle to metamorphize into a baryon, e.g. for the Planck length $\sqrt{(Gh/c^3)}$ to expand to the proton radius, $r_e$.

The Heisenberg uncertainty principle provides us with the inequality,

$$\frac{ML^2}{T} \geq \hbar \qquad (1)$$

which places a lower bound on all action. The left member is equivalent to,

$$\frac{M}{L}\frac{L^3}{T} = \frac{M}{L}\frac{V}{T} \geq \hbar \qquad (2)$$

where V is volume. R or L

The Schwarzschild inequality $GM/c^2R \leq 1$, when substituted in equation (2) gives,

$$\frac{c^2}{G}\frac{V}{T} \geq \frac{M}{L}\frac{V}{T} \geq \hbar \qquad (3)$$

This says that the volume rate of expansion V/T is greater than $G\hbar/c^2$ whose $\log_{10}$ value is -55.106271 $cm^3/sec$. For convenience we shall label this value $\Psi$.

If we assume a uniform rate of expansion so that $V/T=\Delta V/\Delta T$ is constant, then $\Delta T \leq \Delta V/\Psi$. Now $\Delta V = (PL_R^3 - r_e^3)$, but $PL_R$,-32.392, is negligible compared to $r_e$, -12.550, therefore $\Delta T = r_e^3/\Psi$ , giving, $\Delta T \leq$ 9.057 billion years.

i.e. $10^{-32.4}$ vs $10^{-12.6}$

$$\frac{G\hbar}{c^2} = \Psi$$

$$\frac{Gh}{c^3} = \frac{\Psi}{c} = \ell_0^2$$

According to the current cosmological model, the Hubble age of the universe calculated from the value of the Hubble constant is 3/2 greater than the actual age. [That is at the critical density of matter that closes the universe ($\Omega = 1$), the Hubble Time is 3/2 the time elapsed since the big bang.] Observations made on cepheids by Wendy Friedman and associates of the Carnegie Institution, reported in the June 1996 Carnegie publication, Spectra, lead to a value of the Hubble constant of 73 with a 15% uncertainty. This gives a Hubble time of 13.40 billion years or a time since the big bang of 8.93 billion years. Sandage, also of the Carnegie Institution, reports in the same issue, a value of 57 km/sec/mpc with an uncertainty of 7%, based on type Ia supernovae. This corresponds to a Hubble age of 17.16 billion years or a time from the big bang of 11.44 billion years. When compared with the age of stars in globular clusters of 15 billion years, we have the problem of "being older than your mother", stars whose age is greater than that of the universe.

The following table compares the Pythagorean age with that calculated from cepheids and from type Ia supernove.

| | PYTHAGORAS | CEPHEIDS | SUPERNOVAE |
|---|---|---|---|
| HUBBLE CONSTANT | 71.96 k/s/mpc | 73 k/s/mpc | 57 k/s/mpc |
| HUBBLE AGE | 13.59 B.Y | 13.40 B.Y. | 17.16 B.Y. |
| TIME FROM BIG BANG | 9.057 B.Y | 8.93 B.Y. | 11.44 B.Y. |
| UNCERTAINTY | < 1 % | 15 % | 7 % |

Cepheids Science Aug 1999 71 ± 7 k/s/mpc

PYTHUNIV.WP6 October 8, 1995

# A PYTHOGOREAN UNIVERSE

I am a Pythagorean. I believe that ultimate reality is not matter, not vibrating waves, not thought, not spirit. The UR essence of the universe is number! Sir James Jeans once said that God is a mathematician. I would say that the Creator is mathematics itself. Underlying all the structure in the world are the attributes of number. The laws of physics, the values of fundamental constants, the multitude of archetypes governing all processes, are what they are because of the properties of number. While in his day Pythagoras restricted cosmography to the natural integers and was devastated by the intrusion of $\sqrt{2}$, today every disciple of Pythagoras is free to adopt with impunity what was once a heresy by including all numbers.

The occurrence of Pythagoreans in history is like the integers, discrete not continuous. There are sometimes gaps of centuries between their appearance: Pythagoras and his school in the sixth century B.C.E., followed by the apostles, Diaphantus, Kepler, Mendeliev, Eddington, Dirac, J.G.Bennett, and many lesser saints, all of whom contributed to Pythagorean Holy Writ by building structures directly on number. But there have also been false prophets who preach various numerologies. As in every discipline there must be criteria for discriminating the valid from the deceptive. The primary test is that more must come out than is put in.

The concern of the present paper is the number basis underlying the structure of the observed astronomical universe. We shall employ a structuralist approach in that we shall look at the relations between entities rather than focusing on what takes place within the entities themselves. Further, we shall consider the synchronic rather than the diachronic aspects of the structure, although in cosmology the synchronic must be inferred from the diachronic.

The structure will be built on the three dimensionless quantities $\alpha$,$\mu$, and S, being respectively the fine structure constant, the ratio of baryon to lepton mass, and the ratio of coulomb to gravitational force. The fundamental dimensioned constants, c,(velocity of light), G, (Newton's gravitational constant) and h, (Planck's constant) are used as a bridge to the usual observables L,(size), M,(mass), and T (time).

Throughout we shall use more significant figures than may be meaningful in a scientific sense. But in order to test whether results derived from different sources are the same, as much accuracy as is available must be employed. In the case of the fundamental constants, except for the value of G, six or more significant figures may be safely assumed.

In the beginning was the Planck Particle whose extension, mass and time are given by

$$R_p=\sqrt{\frac{Gh}{c^3}},\quad M_p=\sqrt{\frac{hc}{G}},\quad T_p=\sqrt{\frac{hc}{c^5}}$$

whose values are: $4.050837\text{x}10^{-33}$cm, $5.456203\text{x}10^{-5}$g, and $1.351287\text{x}10^{-43}$sec. The density of the Planck Particle, $\rho_P=c^5/hG^2$, is equal to $5.157\text{x}10^{93}$g/cm$^3$.
To display the relational structure of the objects in the universe, we shall need the extension, mass, and density times of various fundamental particles. The values and $\log_{10}$ values for the electron, proton, and hydrogen atom as well as for the Planck particle are given in Table I and Table II.

TABLE I cgs Values

| PARTICLE | RADIUS cm | MASS g | ρ-TIME sec |
|---|---|---|---|
| PLANCK (ħ) | $1.616050\text{x}10^{-33}$ | $2.176710\text{x}10^{-5}$ | $3.386989\text{x}10^{-43}$ ? |
| PLANCK (h) | $4.050837\text{x}10^{-33}$ | $5.456203\text{x}10^{-5}$ | $8.489922\text{x}10^{-43}$ ? |
| ELECTRON | $2.817941\text{x}10^{-13}$ | $9.109390\text{x}10^{-28}$ | 0.120555 |
| PROTON | $2.817941\text{x}10^{-13}$ | $1.672623\text{x}10^{-24}$ | 0.002813 |
| HYDROGEN ATOM | $5.291772\text{x}10^{-9}$ | $1.673534\text{x}10^{-24}$ | 7237.97 |

not $T_p$ above

TABLE II $\log_{10}$(cgs Values)

| PARTICLE | RADIUS cm | MASS g | ρ-TIME sec |
|---|---|---|---|
| PLANCK (ħ) | -32.791545 | -4.662199 | -42.470186 ? |
| PLANCK (h) | -32.392455 | -4.263110 | -42.071096 ? |
| ELECTRON | -12.550068 | -27.040511 | -0.918814 |
| PROTON | -12.550068 | -23.776602 | -2.550769 |
| HYDROGEN ATOM | -8.276399 | -23.776366 | 3.859617 |

not $T_p$ above

The ρ-Time, τ, is calculated from the equation,

$$\tau = 2\pi\sqrt{\frac{R^3}{GM}}, \qquad T_p = \frac{\tau}{2\pi}$$

The log values of the ratio of the Planck Particle(based on h) to the proton are:

| RADIUS | MASS | TIME |
|---|---|---|
| $19.842387 = k^{-1}S^{1/2}$ | $19.513492 = kS^{1/2}$ | $39.520327 = k^{-1}S$ |

S, the ratio of coulomb to gravitational force has the value
$\log_{10}S = 39.355880$
$k = \sqrt{(2\pi/\alpha\mu)}$, where $\alpha$ is the fine structure constant and
$\mu$ is the proton to electron mass ratio, has the value,
$\log_{10}k = -0.164447$

The following table of $\log_{10}$ S and k values is useful for identifying relationships.

| | x 1 | x k | x $k^{-1}$ |
|---|---|---|---|
| $S^{1/2}$ | 19.677940 | 19.513493 | 19.842387 |
| S | 39.355880 | 39.191433 | 39.520327 |
| $S^{3/2}$ | 59.033820 | 58.869373 | 59.198267 |
| $S^2$ | 78.711760 | 78.547313 | 78.876207 |

For negative values, change the signs of the exponents of both k and S.

Some other frequently used $\log_{10}$ values:
Planck M(h) -4.263110
Planck R(h) -32.392455
Planck T(h) -42.869276

c 10.476821 $2\pi$ 0.798180
G -7.175705
h -26.178744
h -26.976924
$\alpha$ -2.136835
$a_o$ -8.276399
$m_p$ -23.776602
$r_e$ -12.550068
$m_e$ -27.040511
e -9.318469
S 39.355880
$\mu$ 3.263909
k $-0.164447 = \sqrt{(2\pi/\alpha\mu)}$

AGERATE.WP6 September 8, 1995 also 1994 #54

# HOW TO BE OLDER THAN YOUR MOTHER

You cannot be older than your mother, common sense apodictically asserts. But we are finding stars that are older than mother universe herself. Recent more refined measurements of the rate of expansion of the universe lead to an age of from nine to twelve billion years, while old stars in certain globular clusters require something like 16 billion years to explain their life span. The difference between the genealogical case and the cosmogonic case is that ages of mother and offspring are measured by the same clock while the ages of stars and the universe are measured by different clocks. The star-universe paradox may be easily dissolved if we can show the clocks run at different rates.

Games with time, clocks, and clock rates have been popular since Einstein brought out his special theory of relativity in 1905. There is, for example, the famous twin paradox of one twin staying on earth, the other twin taking a high speed space voyage of a few years duration and returning to earth to find his twin had died of old age decades ago. Relative clock rates in special relativity depend on relative velocities. So herein might lie a contribution to the star-universe paradox. But there are other clock games. For example, there are these fascinating objects called **black holes**. According to Einstein's general theory of relativity clocks behave differently in the presence of matter than in empty space. And in the presence of highly condensed matter such as occurs in a black hole the clock rate almost drops to zero. Herein might lie another contribution to the star-universe age paradox.

Proper Time?

Relativity theory tells us it is wrong to assume that the clock governing the rates of physical phenomena runs everywhere at the same rate. Furthermore the rate may be changing, as for example with a change of local or global density. Considering the variations in matter density throughout space and the change of density occurring in the general expansion itself, it is indeed probable that our present numbers assigned to ages of objects ranging from stars to the observable universe may require some adjustments. The problem of age shifts from determinations based on the hypothesis of a universal "metaclock" governing the entire universe and its contents to reconciling the rates of a set of diverse clocks operating at local rates throughout the universe. The concept of proper time — the time of the meta-clock is like Newton's absolute space & time.

like Newton's absolute space

Cosmology is based on what is called "proper" time

GRAVBND1.W52 DISK:COSNUM May 10, 1994

# THE GRAVITATIONAL POTENTIAL BOUNDS

The general theory of relativity states that there exists a bound on the gravitational potential, Mass/Radius, of all gravitating bodies. This bound, known as the Schwarzschild Limit, is the locus of those bodies and particles for which the metric radius, R, is equal to the gravitational radius, $GM/c^2$, where G is the gravitational constant, M the mass of the body, and c the velocity of light. For bodies and particles consisting of uncollapsed matter, the bound states that:

(1) $$\frac{GM}{c^2 R} \leq 1$$

When gravitation collapses an object the Schwarzschild Limit is violated and matter leaves the visible universe entering the realm of black holes.

In addition to the Schwarzschild Limit there is also a second paralleling potential limit bounding all normal matter--electrically neutral atoms, molecules, and bodies composed of such matter, such as planets, main sequence stars, etc. The expression for the bound in this case is:

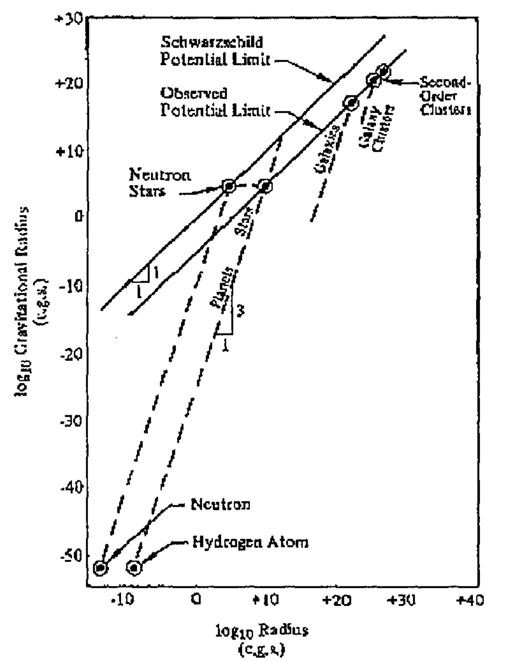


Figure 1 Mass and Size Relations Between Atomic and Cosmic Bodies

(2) $$\frac{GM}{c^2 R} \leq \alpha^2$$

Where $\alpha$ is the fine structure constant. This second limit is an observed limit governing all cosmic bodies composed of ordinary matter. No electrically neutral atom or composite body made of such atoms exceeds this limit. The zone between the two limits is occupied by white dwarf and neutron stars, and objects and particles of nuclear density.

COSMOGRAPHY

See also
NOVCOS02.WPW 05/11/93 #3

COSMODEL.P51 DISK:COSNUMBERS May 4, 1991

My speculative model of the universe agrees with the idea of the big bang and the expansion, but modifies the expansion from being monotone or inflated to being oscillatory. The first bang resulted in expansion, then after a certain amount of cooling, part of the kinetic energy of expansion was 'absorbed' being ~~locked~~ condensed into the 'packaging energy' of fundamental particles. The loss of kinetic energy was sufficient to allow gravity to overcome expansion and contraction began. The contraction continued until a close-packed density of the fundamental particles was reached. At this point the collisions of the particles led to release of the packaging energy of a portion of the particles and a second bang occurred with expansion beginning again. The principal modules at this point were the fundamental particles.

This process was iterated, with successive modules—atoms, molecules, stars, galaxies,,,— being formed at each alteration of expansion and contraction. Each module marks a moment of maximum expansion, while the distributions of the modules are vestiges of the configurations imposed at maximum contraction. There is evidence of a recent contraction in a distribution pattern of galaxy clusters resembling that of close packed polyhedra.

We are now observing an expanding phase in which the largest modules are clusters ~~of galaxies~~. Bubbles defined by "great walls" of galaxies

This process creates a fractal-like universe.

SCIENCE

SCIFIWN.P51 DISK:ESSAYS1-P51 August 14, 1991

# SCIENCE FICTION WITH NUMBERS

Every vital area of human endeavor possesses a penumbra of speculation. However, the relation between the hard core of a discipline and its penumbral ~~sunyata~~ foam varies from the sharply defined orthodox/heresy relation in theology to the fuzzy non-fiction/fiction frontier in literature. In general, the more blurred the boundary the more vital the area.

In the case of science, the relation between its hard core of what-is-science and its penumbra of speculation is unique. Science idealizes open endedness so it proclaims to have no orthodoxy. But through its traditional publication procedures, it supports a powerful curia of journal editors with almost absolute control of imprimatur. [insert Max Planck's quote and the cold fusion story here] How then, does science maintain its vitality? Rather than with unrestricted commerce across a broad fuzzy frontier, science maintains a symbiotic trade relation, mostly export with occasional reluctant imports, with a second carefully defined but distinctly separate discipline called science fiction. In effect science has created a medieval castle protecting itself within the walls of the keep and insulated further from the outside by the bailey of science fiction. Except for occasional missiles hurled over the walls by the catapults of mathematics research [e.g. fractals] and technology, does anything get into the keep that has not passed through the bailey.

cf Quakers and the Friends Serv. Committee

Perhaps this description explains why speculative ideas such as those of Fred Hoyle, who is both a scientist and a science fiction author (as many scientists are), receive negative notice. Hoyle finds there is no place to stand between the bailey and the keep. Science's limited relationship with speculation--speculation must be kept private--has restricted its progress as much as theology's love affair with the orthodox has limited it. Science needs a domain for speculation other than that of science fiction. It needs a non-private respected publishing domain.

able

∃ a journal for this area

cf Einstein on imagination

COSM

# Who First Called Kepler's Laws "Laws"?

(From the American Astronomical Society Newsletter)

Not Isaac Newton, who in 1686 wrote Halley: "Kepler knew ye Orb to be not circular but oval & guest it to be elliptical." Surely the ellipticity of the planetary orbits could not be established on the basis of observation alone. Newton himself deduced it in Prop. 13 of Book III of the "Principia" from his inverse-square law of gravitation.

As for Kepler's area rule, Newton did not give Kepler credit for having established it, but took its approximate truth to be inferable "from the Phenomena. " That circumsolar planets move in slightly eccentric near-circles --slightly more rapidly at perihelion than at aphelion -- was an approximate verification of the rule. It indicated to Newton (but not to Kepler) that forces act on the planets in the direction of the Sun.

Newton acknowledged Kepler's discovery of the third (harmonic) law, that the square of the orbital period is proportional to the cube of the semimajor axis. But some of his disciples felt more general credit should go to Kepler. "The sagacious Kepler," said David Gregory, "had got the Scent of" the Celestial Physics, that Newton then "brought to such a Pitch, as surprises all the world." William Whiston called Kepler "the Parent of Newtonian Philosophy." But neither called Kepler's rules "laws."

The first to do so was Voltaire. In his "Elements of the Philosophy of Newton" (1738) he wrote of the area rule: "This Law inviolably observed by all the Planets... was discovered about 150 Years ago by Kepler, who has merited the name of Legislator in Astronomy, notwithstanding his Philosophical Errors... The extreme Sagacity of Kepler discovered die the Effect, of which the Genius of Newton has found out the Cause."

Similarly, Voltaire called the third Keplerian rule a "law," and added that "Kepler, who found this Proportion, was very far from finding the Reason of it..." As for the ellipticity of the orbits, Voltaire, without calling it a "law," posed it as one of three empirical premises implying the inverse-square law of gravitation (the other two were the third Keplerian rule, and the comparison of the Moon's acceleration to that of a falling stone on Earth). In taking the ellipticity of the orbits as an empirical premise implying inverse-square law, Voltaire was relying on a passage from Henry Pemberton's "A view of Sir Isaac Newton's Philosophy" (1728). Pemberton having been Newton's editor for the third edition of the "Principia" should have known better.

Why "Laws?" The idea of natural law was medieval; it signified the divine decrees whereby different things received their natures. In the seventeenth century, with the advent of the mechanical philosophy, it came to mean "those rules of motion, and that order amongst things corporeal," that God had established (Boyle). Such were Newton's "Axiomata sive Leges Motus. " Laws in this usage were fundamental principles.

Voltaire's application of this term to Kepler's rules caught on. D'Alembert in the "Encyclopedie" (175 1) spoke of two such laws, area rule and the harmonic rule, and added that these two laws "guided Newton in his system."

The first explicitly to number three such laws appears to have been Robert Small in his "An Account of the Astronomical Discoveries of Kepler" (1804). Small saw Kepler's discovery of his laws as exemplifying Baconian method; Kepler's laws, being empirically established, "were the foundations of the whole theory of Newton " Through the nineteenth century, Englishmen like John Hershel, David Brewster and J. S. Mill plumped for the Baconian interpretation of Kepler's laws as results of "induction from pure observation."

All this would have surprised Kepler, who knew that physical hypothesis was central to his enterprise. (His claim in Chapter 58 of the "Astronomia nova" to have shown the unintenability of orbital shapes other than the elliptical was a delusion, as D.T. Whiteside pointed out in 1974.) He had replaced a two-thousand-year-old tradition of epicycles and eccentrics, And achieved planetary tables embodying elliptical orbit and area rule, more accurate than any achieved before. But this revolution rested on a dynamics that Newton and we have to reject. Given Newton's Leges Motus, the facts required a radical reinterpretation; Newton supplied it,

COSM

NOVCOS02.WPW DISK:WORKDISK02 May 11, 1993

# NOVUM COSMOLOGIUM

We experience the world as a flat euclidian space. We find that objects of any given form may exist in different sizes. However, this property of form and size independence is peculiar to flat spaces, those with curvature $\kappa = 0$. In non-flat spaces, those in which the curvature $\kappa \neq 0$, a change in size of the object effects a change in form. For example, in such spaces there could be no such thing as similar triangles, the angles of an equilateral triangle would depend on the size of the triangle.

there is another relation between inform and energy

In non-flat spaces if one wished to have an object of different size with the same form as a specified object, the **scale** of the space would have to be changed, which is to say the curvature or its reciprocal, the radius of curvature would have to be changed. For example, if we wanted an equilateral spherical triangle of twice the size but having the same angles, the radius of the sphere would have to be doubled. On an expanding sphere, if objects were to remain the same size their forms would have to change or if they were to preserve the same form their size would have to change. For spaces with $\kappa \neq 0$ form, size, and scale are interdependent.

⇒ form has to do with information content

⇒ same info

⇒ ∴ size increases

- Energy of Expansion
- Negentropy Form

In an expanding non-flat universe the shapes of galaxies would have to change if their size did not remain proportional to the universe' radius of curvature. Co-moving coordinates are used in describing expanding models. In these models, form is preserved because everything is assumed to "co-move", i.e. to expand. But if this assumption is wrong, morphology would depend on the scale of the universe. We traditionally interpret a change of form as being caused by the action of forces. Thus scale change may be what underlies force. [All of this is sort of like coming to the general theory of relativity through the back door. The dynamics of the universe are manifestations of its geometry, with the force involved being gravity.]

Another example of a form that changes with scale in an expanding non-flat universe, is a sine wave or some other cyclical form. The wave-length, like the sides of a triangle, would change with scale. How ~~does~~ is this ~~explain~~ related to the red-shift? ✕

Does the universe expand simply because $\kappa > 0$ ? Is there some imperative to preserve form?

An imperative to preserve form could cause a $K \neq 0$ universe to be unstable.
e.g. information seeking to preserve itself.

Can we decide $K>0$, or $K<0$ on the basis of how form changes as size increases?
In a closed space (e.g. on a sphere) as $R\uparrow$,

Is the octant triangle an exception? A property of orthogonality

see also COSMODEL.P51
DISK COSNUMBERS
05/04/91
#69

✕ This is now recognized as the cause of the redshift
— 03-10-30

20b

CLASSIC CALVIN AND HOBBES Bill Waterson

COSM



ALIENINT.WPW March 5, 1993

See also #3-93

For several decades there have been afoot projects designed to search for extra-terrestrial intelligence. Most of these are predicated on the premise that what we are looking for is very much like us, derived from an anthropocentric notion of intelligence. The logic says, We belong to the class Intelligent, Those who belong to this class must therefore belong to the class human-like. This is of course nonsense. The class intelligent is bigger than the class humans and human-like. We cannot say that all that lies within the class intelligent must also lie within the class human-like.

In practice, the SETI (Search for Extraterrestrial Intelligence) people are not looking for alien intelligence, they are looking for alien radio engineers. Further, there are alien intelligences here on earth. These range from plant life to teenagers. We would do well to encounter and communicate with the local aliens before searching for extra-terrestrials.

What are some general clues to use in a search for extraterrestrial intelligence (as contrasted with such anthropocentric specifics as they will use the 21cm band).

- ☐ Whereas the cosmos itself may be intelligent, we are looking for <u>local</u> intelligences. This means we are looking for local anomalies, departures from structures and processes that seem to be global, which we call the laws of nature. We are looking for the existence of local complexities (or simplicities) that appear to be at variance with natural or global phenomena. For example, we are looking for localities where the Second Law of Thermodynamics seems to be subverted. Or since the natural order appears to be built on the infrastructure of 1/f noise. Local departures from 1/f patterns either in the direction of simplicity or complexity could suggest the presence of local intelligence, something besides nature alone operating.
- ☐ Higher forms and complexity seem to occur along the interfaces of two regimes. On the surface of density discontinuities, along fault lines, along sea shores, wherever two diverse domains juxtapose. We should therefore expect anomalies such as life and intelligence to occur in the interstices. edge

The Cosmological Principle: "What is local is global" refutes the above

If not true, we only see our own local in the cosmos

TIME

historical $\frac{dP}{dt} \propto P$

cyclical $\frac{d^2P}{dt^2} \propto P$

HISTCYCL.P51 January 29, 1993

All processes of change contain two components: a linear or historical component and a cyclical or archetypal component.

Journey Engine

Cycles have been conventionally represented in electrical theory by vectors. The length or magnitude of the vector representing amplitude, the direction or angle representing phase. One common way of representing a vector is in the exponential form:

$$V=e^{(\alpha t+i\omega t)}$$

In the complex number, $\alpha t+i\omega t$, the real part represents the linear or historical facet of the process while the imaginary part represents the the cyclical or archetypal facet of the process. The period or duration of the cycle is given by $t = 2\pi/\omega$. For the "historical" portion of the change to be actually linear, $\alpha t$ must be equal to $\ln(At)$, that is

$$V=Ate^{i\omega t}$$

This equation may be generalized by replacing the linear functions $\alpha t$ and $\omega t$ with the general functions $\alpha(t)$ and $\omega(t)$. Thus

$$V=e^{[\alpha(t)+i\omega(t)]}$$

represents the general equation of change.

The historical rate of change will be the real part of the derivative,

$$\dot{\alpha}(t)\,[e^{\alpha(t)}+\cos\omega(t)]-\dot{\omega}(t)\sin\omega(t)$$

The archetypal rate of change will be the imaginary part of the derivative,

$$\dot{\omega}(t)\,[e^{\alpha(t)}+\cos\omega(t)]+\dot{\alpha}(t)\sin\omega(t)$$

Ratio of the length of the $\frac{\text{Journey cycle}}{\text{Engine Cycle}} = \mathcal{Q}$

In our experience $\mathcal{Q} >> 1$

but can we find cases of $\mathcal{Q} < 1$?

Perhaps what we see as Zero Design cases of $\mathcal{Q} < 1$

COSM

01/22/93

SCIAMER1.P51
From Scientific American, February 1993 p20

See also #20-93

# What If They Don't Have Radios?

" Are mathematical theorems and theories of physics universal truths, likely to be discovered by any beings given to pondering the nature of things? Or are they inventions, as much products of our idiosyncratic heritage and needs as eyeglasses or toasters?

This old conundrum could be put to a test of sorts by the National Aeronautics and Space Administration's ambitious new search for intelligent life elsewhere in the universe. Called the High Resolution Microwave Survey (the old name, the Search for Extraterrestrial Intelligence, or SETI, was scrapped because it was thought to evoke science fiction rather than science), it involves scanning the heavens for alien radio signals.

So far NASA has dedicated two telescopes to the effort. The 305-meter fixed dish at Arecibo, Puerto Rico, is tuning in to a select group of stars within 100 light-years of the earth, and a 34-meter movable dish at Goldstone, Calif., is sweeping broad swaths of the sky. NASA hopes to continue the effort for at least 10 years, for a total cost of $ 100 million.

Why would workers expect either instrument to detect signs of intelligent life? Because, explains Frank D. Drake, a physicist at the University of California at Santa Cruz and a veteran SETI researcher, intelligent extraterrestrial beings would have "basically the same" systems of mathematics and physics that we have. "Many human societies developed science independently through a combination of curiosity and trying to create a better life," he notes, "and I think those same motivations would exist in other creatures."

Inevitably, he argues, alien scientists would discover gravity, electromagnetism and other fundamental physical phenomena. It follows that they would develop technologies such as radio communications. Drake also thinks intelligent aliens are likely to discover such esoteric concepts as the theory of general relativity, quantum-field theory and even superstrings.

This view is "infinitely parochial," argues Nicholas Rescher, a philosopher, at the University of Pittsburgh. "It's like saying they would have the same legal or political system that we do." Rescher contends that our science, mathematics and technology are unique outgrowths of our physiology, cognitive makeup and environment. Indeed, the whole SETI enterprise is "a waste of time, money and energy," Rescher says. "It's perfectly possible that there are other civilizations, and it's perfectly possible that they communicate in some way. But that they communicate in the same basic way we do is about as likely as it would be that they communicate in English."

An intermediate point of view is offered by John D. Barrow, an astronomer at the University of Sussex in England. Barrow, author of a new book, Pi in the Sky, that explores the issue of whether mathematics is discovered or invented, believes aliens may well share some basic ideas underlying mathematics and physics, such as the concepts of counting or of cause and effect. "There are certain aspects of the world that press themselves on us," he says. But as science becomes more removed from everyday reality, Barrow notes, its development may become more serendipitous. The theory of relativity, for example, became accepted only after observations of a solar eclipse confirmed Einstein's prediction about the bending of light. Those ob- servations were possible because the sun and the moon, as seen from the earth, are almost exactly the same size. Actually, Barrow is more concerned about the ethics of little green men than about their science. If we meet aliens, will they have the equivalent of the Golden Rule: Do unto others as you would have them do unto you? "

— John Horgan

COSM

2a

4MODEMOV.WP6 JANUARY 30, 1998

# ALTERNATIVE MODES OF MOVEMENT

In a culture resentful of any restrictions and limitations on freedom, and especially resentful of speed limits, the Einstein velocity limit, $v \leq c$, where c is the velocity of light, has posed a major challenge. This has been met by both scientific (tachyons) and science fiction (warp speed) alternatives. Since we propose to let neither Einstein nor the highway patrol have the last word, additional approaches on how to get there more quickly are outlined here. But first, a review of the most familiar mode, that of Aristotle as refined by Sir Isaac Newton.

I. The Newtonian Mode:

This is the traditional mode of movement from place to place, based on terrestrial experience and projected onto all cosmic motions. It assumes that space everywhere, both empty and occupied by matter, is essentially the same. Motion through this space is given by the equation, distance equals velocity times time. (And as already noted all velocities are bounded by the velocity of light). We term this kind of motion as being "totally horizontal" in the sense that the distances and times are locked to a single value of a scale parameter.

II. The Fractal Mode:

This hypothetical mode is suggested by certain brands of map software that provide the display of maps on various scales ranging from a city block to an entire hemisphere. In the operation of this software, I may be looking at the neighborhood of the Capitol building in Washington D.C. and wish to see where my congressman's home office is located in my own city. To go from Washington to home, I do not have to move in the Newtonian mode across a single scale map of the United States. Instead I zoom out from the city block scale to the continental scale and move horizontally from Washington to home on this low scale map. I then zoom in to my home city and fine tune horizontally on a high scale map.

The essence of fractal mode movement between places is first to move vertically (zoom out) from our ordinary space level to a low scale space level, then move horizontally on this low scale space level to the neighborhood of our destination, then move vertically (zoom in) to the original space level and finally move horizontally to the exact destination. (The process, however, is not restricted to two scale levels; more than two may be involved).

Say we wanted to travel to the neighborhood of the interesting star Eta Carinae which is about 7500 light years distant. If we were to travel in the Newtonian mode, even at maximum velocity, some 7500 years would be involved If we adopt the fractal mode we would zoom out to the galaxy scale level in which our map would cover the entire milky way system; move horizontally (Newtonially) across the galaxy to near Eta Carinae, zoom partially in, correct horizontally, zoom in again, correct horizontally, etc, until we reach the desired location in the neighborhood of Eta Carinae.

In all of this, first, we do not know how to zoom, to move vertically, nor do we know what vertical velocities are possible. Second, we do not know what a scale change would do to Einstein's bound on horizontal velocities. Third, if fractal mode movement is not possible for physical bodies, is it possible for the movement of information?

An important model using the concept of vertically zooming up and down is based on the idea of a "wormhole", a tunnel from our universe to some other universe. In this model our universe is viewed as being at one space-time level and other universes as having different space-time levels. The concept of zooming or vertical motion translates into passing through a wormhole. Again, for example, say we want to go to Eta Carinae. We would enter a nearby wormhole, leaving our universe and entering some other universe. If this new universe possessed an appropriate lower scale value, then we could briefly move within it horizontally to another suitable wormhole, pass through it back into our own universe, and if we selected our wormholes well, be in the neighborhood of Eta Carinae.

III. The Local/Non-local Mode:

If macro bodies, like micro bodies, can alter between two states (local ≈ particle and non-local ≈ wave), then another hypothetical mode of movement is suggested. In this mode an object in the local state of being here and now, first diffuses (transforms) into its non-local state becoming everywhere and everywhen. Second, it selects where and when it wants to "un-diffuse" and finally transforms back to its localized state at its selected new position in space and time. This mode allows for time travel as well as space travel.

IV. The Depackaging/Repackaging Mode:

In modern communication practice, for example CDMA, a message is broken into parts. The parts are assigned a code name and are then transmitted by various routes at various times, (along with the transmission of the suitably encoded parts of other messages), and all reassembled in the correct order at their respective destinations. Perhaps the "Beam me up Scotty" mode is a special case of CDMA.

COSM

COSNOTE1.P51 DISK:COSNUMBERS June 7, 1991

Reality is a consensus derived from temporal and spatial continuity. But all continuity, both temporal and spatial is illusory. Hence, to think about the universe at all we must consider its *measure*. Where by measure is meant, something like Lebesgue measure.

granular

Both space and time are dyadic in nature. Space is divided into extension and separation, time is divided into duration and interval ("while and until"). If these dyads are viewed with higher resolving power, the concept of density is involved. In the case of physical space, matter density, $\rho$. When $\rho = 0$, there is pure separation, when $\rho > 0$, there is some sort of extension. Similarly with time. The Kepler-Newton law, present

**(1)**
$$T = 2\pi \frac{R^{3/2}}{\sqrt{GM}}$$

cf. Einstein re empty space $\Lambda=0$

states that time $\propto \rho^{-1/2}$. Thus when $\rho = 0$, T is infinite. Spatial separation is associated with infinite time or eternity. But when $\rho > 0$, time is finite having duration and space possesses extension.

Aristotle based the idea of change on motion, in fact holding they were equivalent. (What about color change?) Assuming he is right, then all change is related to velocity, which is space/time.

**(2)**
$$\frac{SPACE}{TIME} = \frac{\rho}{\rho^{-1/2}} = \rho^{3/2}$$

But this quantity is assumed in relativity theory to be bounded. In particular linear velocities are bounded by c, the velocity of light. We conclude that $\rho^{3/2}$ is bounded by some appropriate power of the velocity of light.

3) $\frac{GM}{c^2R} < 1$

$G\rho < \left(\frac{c}{R}\right)^2$ or $\frac{R}{c}$, $T < \frac{1}{\sqrt{G\rho}}$

$R < \frac{c}{\sqrt{G\rho}}$

$R^2 < \frac{c^2}{G\rho}$ $\rho < \frac{1}{G}\left(\frac{c}{R}\right)^2$

Reality is a front #15

$\rho^{3/2} < \left(\frac{c}{R}\right)^3 \cancel{G}^{-3/2}$

as a velocity $\rho^{3/2} < c^3$

Vol. $\rho^{3/2} < \left[\frac{c}{\sqrt{G}}\right]^3$

[velocity]

COSM

REL/THEO

25a

GURDCOSM.WP6 April 6, 1995 rev April 14, 1995

# GURDIEFF'S APPROACH TO COSMOGONY

APOPHASIS or VIA NEGATIVA

Gurdieff posits a cosmogony consisting of successive stages of ~~of~~ liberation instead of successive stages of creation.

0.) Prior to the first creation there was total and universal potential. Then there was the formulation of constraints, the making of the laws. that is, In the beginning was the word.

1.) The first creation was subject to all of the laws. It was the creation of inorganic matter and was subject to impermanence and decay. (Maxwell-Boltzman statistics?)

2.) The second creation was that of systems free of the Second Law of Thermodynamics. These were systems effecting mutual sustainability, living systems that locally violated the second law. (Fermi-Dirac statistics?)

3.) The third creation was that of systems free of determinism, systems that could make choices.

{[4.) The fourth creation: Systems with the ability to create situations and objects of choice.

This Gurdieff cosmogony results in the usual morphological scala. However, it is not given in terms of evolution of acquired attributes, but rather in terms of loss of constraints. Initially, the total potential was universally present, then there was the creation of constraints and then the stepwise liberation from the constraints. In this view creation takes on new meaning. **Creation** is the process of delimiting potentiality by the making of constraints. **Evolution** is the stepwise liberation from constraint.

We may modify this as follows:
1) Vairacona effects an emergence from the Sunyata, which is the the repository of infinite potential, by establishing constraints. The process follows from [1-$\alpha$] rather than from $\alpha$, that is by negation. Here 1 stands for infinity, everything.

2) A stepwise removal of constraints by Aksobya. Actualization

3) Testing of consistency and harmoniousness by Ratna Sambhava.

4) Exploring the possibilities, uniqueness and spontaneity by Amitaba.

5) Modifications (actions) by Amoga Siddhi.

Liberation here can be equated to the idea of sacralization. With each liberation, the world is sacralized. The final goal is the return to the original pre-constraint condition. The world will be completely sacralized when total potential is regained.

While Siva is called the destroyer, he is in reality the creator in that what he destroys are the previously imposed constraints. Vishnu/Krishna is the preserver/corrector

We may also think of the crucifixion and resurrection as constraint and liberation. The deeper symbolism of the bread and wine is constraint and liberation.

Much the same process is followed in quantum mechanics. The quantum world corresponds to the Sunyata. Whenever an observation or measurement is made, the wave function collapses and a wave or particle is created. Observation and measurement are the placing of constraint. Actualization is the process of localizing the global.

> *In the experiments about atomic events we have to do with things and facts, with phenomena which are just as real as any phenomena of daily life. But the atoms or elementary particales are not as real; they form a world of potentialities or possibilities rather than one of things or facts.*
>
> *Heisenberg*
>
> from Polkinghorne's "Quantum World" p81

---

- The three bodies:

| | | |
|---|---|---|
| Dharmakaya | pure, clear, empty body | Vairachona |
| Sambhogakaya | blissful, harmonious body | Ratna Sambava |
| Nirmanakaya | varied, unique body | Amitaba |

cf

| | |
|---|---|
| astral body | global, infinite potential |
| etheric body | semi-global, eternal, exist for others |
| physical body | local, manifested in spacetime matter |

The New Jerusalem is not a constructed world-image but a pre-existent archetype which reveals itself

— John Michell: "The Dimensions of Paradise" p207

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THEOSCI2.P51 DISK:THEO2 December 16, 1991

THE ANTHROPIC PRINCIPLE

As and illustration of an area that is filled with problems that concern both science and theology, and whose understanding is enhanced with the viewpoints of both, I would like to give a brief summary of what scientists are calling "The Anthropic Principle".

Anthropic principles have their origin in the fact that there are some highly improbable numerical relations between the values of the fundamental constants of nature, such as the velocity of light, Newton's gravitational constant, Planck's constant of action, the value of the charge of the electron and proton, the value of the mass of the proton, and some others; most importantly these constants turn out to have values, within very tight limits, which are just, right for the occurrence of the biological basis of life and hence, of consciousness. The universe appears to have been 'fine tuned' for evolution toward the existence of a rational species capable of observing and theorizing about it. It is uncontraversial that if the values of these constants had been ever so slightly different, life and consciousness as we know it could not have existed. This is what is known as the 'weak anthropic principle'.

Even slight changes in the values of c, h, and e cause huge changes in the structures of atoms and atomic nuclei. Even when changes are slight, most atomic nuclei are unstable and cannot exist. This would result in the universe having little more than hydrogen, with therefore the impossibility of earth like planets and the impossibility of such biologically important elements as carbon, nitrogen and oxygen.

Slight changes in c, G, h, e, and the masses of the sub-atomic particles would cause huge changes in the structure and evolution of stars. With slightly different values, the universe would not contain stars at all, or only non-luminous stars, or stars that burn out so quickly that there would be no time for bio-evolution.

Life forms depend for their complexity on the existence of a variety of elements. Life requires a habitable environment, such as a planet warmed by a long-lived star. These requirements are met only when the values of the fundamental constants are essentially what they are. Slightly different values would render important elements, stars, planets, and life impossible. Our universe would not exist if the fundamental physical constants had different values.

Theologians should have no trouble with the idea that the properties of the universe are precisely such that life, intelligence, and consciousness should come into being. There is a simple explanation. <u>God designed the universe so that this would happen.</u>

The matter is not so simple, however, for the scientific world view that limits itself to models in which all causes are contained within the system. No external agencies are allowed. Science must explain the high improbability of the values of the constants being just right for life, in terms of a universe that is a self-organizing, self-operating and self-contained system. The idea of design is off-limits for science. So science must decide whether these very sensitive values of the constants are just due to chance or is there some physical explanation yet to be discovered that makes these values necessary.

A third hypothesis has been proposed to avoid the cop-out of 'it's a matter of chance' and to sustain the non-design approach under the uncertainty of whether or not there may exist some physical explanation for the values of the constants. This hypothesis is the 'multi-world' hypothesis. It posits that there exist myriads of universes, not just the one that we know and live in. In this ensemble of worlds, the values of the fundamental constants may take on any value. In some of the worlds not even atoms will ever form; in others, atoms and molecules will come into existence but stars and planets will never form. In others, stars will be too short lived for bio-evolution to take place; in still others stars will be too cool to support life. There are thousands of possibilities for the multi-worlds to take on. But there is included in the ensemble the extremely rare [illegible] worlds in which the conditions are just right for life, intelligence, and consciousness to evolve. And we live in such a world. [illegible]

There are many scientists who argue that all of this hypothesizing is unscientific. It cannot be checked empirically and tells us nothing useful. It is all for the purpose of satisfying the requirements that the universe be a system that is self-contained, ~~have~~ has no director or manager, and causality must be goal free, always operating from past to future, never from future to present. We thus have an example of the box in which scientific thinking still must take place.

But the theologians also have a problem with the values of the fundamental constants. This is the problem of the unsustainability of omnipotence under any act of creation. An omnipotent God can design a universe or universes anyway God wishes. But after the first elements of the design are in place, does God have the freedom to ignore them? Before God selected the particular set of values of the fundamental constants that brought into existence the particular world in which we live, God must previously have set up the relationships between the values of the fundamental constants and their potentialities. Once these relationships were in place, God was free to select particular values for the constants, but without erasing all and starting over, God was constrained by what was previously established in the relationships. That is to say that at every stage of creation, the omnipotence of God, through his own actions, was diminished.

The "cracks" in the world are due to God's tampering

This is not a new theological problem. It is a root of the problem of evil. This latest formulation of the omnipotence problem, however, affords an example of what Pope John Paul II referred to as science presenting "an opportunity to bring out of Christian belief some of the possibilities that have not yet been realized, informing those parts of the theological enterprise that bear on the relation of nature, humanity, and God."

In the rapidly changing world of the late twentieth century, businesses frequently have to ask themselves the question, "What business are we really in?" Those who fail to do this find themselves obsolete and overtaken by more flexible competitors. The railroads are a prime example, they thought they were in the railroad business, never realizing until it was too late that they were in the transportation business. I feel that today the Church has to ask itself the question, "What is the real business of the Church?" It is clear that in certain areas the Church and Science are in the same business. The business of finding answers to those fundamental questions of meaning. Who are we, where are we, why are we here, and what is our role in the universe? It is also clear that the theological and scientific answers to these questions need not be contradictory. If both disciplines can perceive their prejudices and limitations, realize their special competencies, and maintain a dialogue in areas of common concern, both can be in the business of serving a great human need.

A New Heaven
and
A New Earth

See Physics, Philosophy, and Theology
The metaphor of the lake
We catch a fish 23.25..." exactly
We then discover this is the only size fish our apparatus can catch
Q
1) $?\exists$ only fish of this size — no other fish
2) $?\exists$ Many fish of all sizes (we catch only this size) multi world
3) $?\exists$

# A GENERALIZATION OF AVAGADRO'S NUMBER

The gram molecular weight of a substance is defined as the amount of a substance whose weight is equal to the molecular weight of the substance measured in grams. Avagadro's number, $N_A$, is the number of particles in a gram molecular weight. Chemists basing their definition on the assumption that $^{12}C=12$, obtained the value $N_A = 6.022\ 136\ 7 \times 10^{23}$, or $\log_{10} N_A = 23.779751$ . Physicists using the value of $\log_{10}(m_p) = -23.776602$, for the mass of the proton obtained the value $N_P = 5.978\ 629 \times 10^{23}$ (whose log value is 23.776602). When converted to Planck units these log values become,

Chemists: $N_A = 19.117552$ Physicists: $N_p = 19.114403$

The physicists' value, $N_p$, is precisely equal to the ratio of the Planck mass to the proton mass, [Which is also equal to $[S/\alpha\mu]^{1/2}$, where S is the ratio of the coulomb force to gravitational force, $\alpha$ is the fine structure constant, and $\mu$ is the ratio of the proton mass to the electron mass.]

The equality of the Avagadro number $N_p$ to the ratio of the Planck mass to the proton mass suggests a generalization of Avagadro's number, namely, that $N_p$ represents the number of "particles" of level n that will be found in an aggregate of level n+1. Thus, mass wise,

The number of protons contained in a Planck particle = $N_p$
The number of Planck particles contained in a third level particle $P_3 = N_p$ [1]
The number of $P_3$ particles contained in a star = $N_p$
The number of stars contained in the universe = $N_p$

where $N_p = 1.301377 \times 10^{19}$ and $\log_{10} N_p = 19.114403$ .

Using log values,

The baryon mass of -23.776602 g x $N_p$ gives the Planck mass of -4.662199 g
The Planck mass x $N_p$ gives the $P_3$ mass of 14,452204 g
The $P_3$ mass x $N_p$ gives a stellar like mass of 33.566607 g [ = about 2 solar masses]
The stellar mass x $N_p$ gives for the universe aggregate a mass of 52.681010 g

[These values approximate the mass values at each level, except for the proton/Planck ratio which is exact.]

Besides the mass ratio, a second Avagadro type number exists for size. This number is the ratio of the electron radius, $r_e = -12.550068$ cm to the Planck radius, $l_o = -32.791545$ cm [$\log_{10}$ values] and is $L_p = 20.241477$

The Planck size of –32.791545 cm x $L_p$ gives the baryon size of –12.550068 cm
The baryon size of -12.550068 cm x $L_p$ gives a stellar size of 7.691409 cm [2]
The stellar size of 7.691409 cm x $L_p$ gives for the size of the universe 27,932886 cm

[$P_3$ turns out to have the same size as a baryon and may be substituted for it in this series.]

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[1] $P_3$ represents a hypothetical aggregate that may be a candidate for dark matter.

[2] This size is typical of a neutron star.

SPMAFREQ.WPD MARCH 9, 2001

# SPACE, MATTER, AND FREQUENCY

Space and matter breathe, they are vibratory. Both oscillate at many frequencies and interact by resonating, interfering, and modulating. Space oscillates between expansion and contraction [expansion and contraction may even include changes in the number of dimensions]. Matter oscillates between fragmenting and merging; and space and matter together oscillate between existence and non-existence. Minkowski joined space with time to create "space-time". Einstein then showed that the existence of space-time depended on the existence of matter. Space-time is an attribute of matter and matter is an attribute of space-time, they are mutually causal. And an empty space-time would not exist.

The relations between the Planck particle and the baryon give us an example of interactions between space-time and matter. We shall here assume that the Planck particle, whose mass, $m_o = -4.662199$ gm, and whose size. $l_o = -32.791545$ cm , fragments into a baryon and three other particles. We take the mass of the proton to be $m_b = -23.776602$ gm; and the Radius to be $r_e = -12.550068$ cm (All values are $\log_{10}$ values)

TABLE I

| Particle | mass gm | size cm | M x R cgs | M/R cgs |
|---|---|---|---|---|
| [1] baryon | –23.776602 | –12.550068 | –36.326670 | –11.226534 |
| [2] mini black hole ? | +15.579276 | –51.905964 | –36.326670 | +67.485240 |
| [3] | –23.776602 | –51.905964 | –75.682566 | +28.129362 |
| [4] | +15.579276 | –12.550068 | +3.029208 | +28.129344 |

TABLE II

| Particle | MxR Planck values | M/R Planck values | Quadrant |
|---|---|---|---|
| [1] baryon | $\alpha\mu\hbar/c$ | $S^{-1}\, c^2/G$ | 1° |
| [2] mini black hole ? | $\alpha\mu\hbar/c$ | $S\, c^2/G$ | 2° |
| [3] | $S^{-1}\,\alpha\mu\hbar/c$ | $c^2/G$ | On S.B. 3°–4° |
| [4] | $S\,\alpha\mu\hbar/c$ | $c^2/G$ | On S.B 1°–2°. |

Where, $\hbar$ is Planck's constant, = –26.976924 cgs units; $\alpha$ is the fine structure constant, = –2.136835; $\mu$ is the proton/electron mass ratio = 3.263909; and S is the coulomb/gravitational force ratio = +39.355878. $\alpha$, $\mu$, and S are dimensionless constants.
S.B. = the Schwarzschild Boundary, where M/R = $c^2/G$ = +28.129362 cgs

## FOUR QUADRANTS

The cosmos may be divided into four quadrants according to the following rules:

| | S.B. | H.B. | |
|---|---|---|---|
| First quadrant: | $M/R < c^2/G$; | $MR > \hbar/c$ | (Normal matter, atoms, stars, etc) |
| Second quadrant: | $M/R > c^2/G$; | $MR > \hbar/c$ | (Black holes ) |
| Third quadrant: | $M/R > c^2/G$; | $MR < \hbar/c$ | ? |
| Fourth quadrant: | $M/R < c^2/G$; | $MR < \hbar/c$ | (photons, etc.) |

H.B. = the Heisenberg Boundary, where $\hbar/c = -37.453745$ cgs.

Baryons reside in the first quadrant, where those such as protons are relatively stable. Particle 2 resides in the second or black hole quadrant where it is relatively stable. However particle 3 and particle 4 lie <u>on</u> the Schwarzschild boundary, an unstable watershed, where a perturbation into the first quadrant would result in expansion or into the second quadrant ~~resulting in~~ with contraction.

## ENERGY

TABLE IIIa The $Mc^2$ or Mass Energy [1,0]

| Particle | $Mc^2$ cgs | $Mc^2$ Planck units | $Mc^2$ Planck values |
|---|---|---|---|
| [1] baryon | −2.822960 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [2] mini black hole | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| [3] | −2.822960 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | +67.419912 | + 2.254144 | $(\alpha\mu)^2$ |

$c^2 = 20.953642$ cgs units   The brackets [p,q] refer to the exponents $M^p$ and $R^q$

TABLE IIIb The $\hbar c/R$ or Space Energy [0,−1]

| Particle | $\hbar c/R$ cgs | $\hbar c/R$ Planck units | $\hbar c/R$ Planck values |
|---|---|---|---|
| [1] baryon | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| [2] mini black hole | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [3] | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [4] | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911656 | −2.254144 | $(\alpha\mu)^{-2}$ |

$\hbar c = -16.500102$ cgs units

ENERGY (continued)

TABLE IIIc The $\hbar c^3/GM$ Energy [−1,0]

| Particle | $\hbar c^3/GM$ cgs | $\hbar c^3/GM$ Planck units | $\hbar c^3/GM$ Planckvalues |
|---|---|---|---|
| [1] baryon | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [2] mini black hole | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| [3] | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [4] | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911656 | −2.254144 | $(\alpha\mu)^{-2}$ |

$\hbar c^3/G = +\,11.629246$ cgs units

TABLE IIId The $c^4R/G$ Energy [0.1]

| Particle | $c^4R/G$ cgs | $c^4R/G$ Planck units | $c^4R/G$ Planckvalues |
|---|---|---|---|
| [1] baryon | 36.532921 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| [2] mini black hole | −2.822975 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [3] | −2.822975 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | 36.532921 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | 67.419892 | 2.254144 | $(\alpha\mu)^2$ |

$c^4/G = 49.082989$ cgs units

From the above four tables, we have the first order energy sums for the four particles:

$Mc^2$ or [1,0] energy = $(\alpha\mu)^2$; $\hbar c/R$ or [0,−1] energy = $(\alpha\mu)^{-2}$;

$\hbar c^3/GM$ or [−1,0] energy = $(\alpha\mu)^{-2}$; $c^4R/G$ or [0,1] energy = $(\alpha\mu)^2$

The total of these four energies = 0; and since the total energies of the Planck particle are zero, we conclude that in the decay of the Planck particle into a baryon and particles [2], [3], and [4], energy has been conserved.

However, there are numerous 'higher order' energies, $\hbar\nu$, corresponding to all allowable frequencies, $\nu$, that involve additional integral and fractional exponents [p,q], $M^p$ and $R^q$. From symmetry considerations, all of these may be paired, [p,q] with [-p,-q], so that the energies sum to zero. Thus the decay of the Planck particle into the four above described particles obeys the first law of thermodynamics for all energies. An additional example showing paired energies is given in TABLE IIIe [2,-1], and in TABLE IIIf [-2,1].

Example of [p,q] energy symmetry:

TABLE IIIe The $GM^2/R$ or Gravitational Energy [2,–1]

| Particle | $GM^2/R$ cgs | $GM^2/R$ Planck units | $GM^2/R$ Planck values |
|---|---|---|---|
| [1] baryon | –42.178842 | –58.470284 | $(\alpha\mu S)^{-3/2}(\alpha\mu)^2$ |
| [2] mini black hole | +75.888810 | +59.597368 | $(\alpha\mu S)^{3/2}/(\alpha\mu)^{-1}$ |
| [3] | –2.822960 | –19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | +67.419912 | + 2.254144 | $(\alpha\mu)^2$ |

G = –7.175706 cgs units

TABLE IIIf The $c^5\hbar R/G^2M^2$ Energy [–2.1]

| Particle | $c^5\hbar R/G^2M^2$ cgs | $c^5\hbar R/G^2M^2$ Planck | $c^5\hbar R/G^2M^2$ values |
|---|---|---|---|
| [1] baryon | +74.761729 | +58.470286 | $(\alpha\mu S)^{3/2}(\alpha\mu)^{-2}$ |
| [2] mini black hole | –43.305931 | –59.597375 | $(\alpha\mu S)^{-3/2}/(\alpha\mu)$ |
| [3] | +35.405833 | +19.114389 | $(\alpha\mu/S)^{-1/2}$ |
| [4] | –3.950035 | –20.241479 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911596 | –2.254144 | $(\alpha\mu)^{-2}$ |

$c^5\hbar/G^2$ = 39.758593 cgs units

$[2,-1] + [-2,1] = (\alpha\mu)^2 + (\alpha\mu)^{-2} = 0$

SPACES4.WPD APRIL 9, 2001

# THE FOUR SPACES

We experience the world in two basic ways: through what we sense and by what we feel. We organize our experiences into the visible or sensed world and the invisible or felt world. The visible world is further subdivided into two "spaces": the space of position, motion and arrangement; and the space of shape, form, and pattern. The invisible world is also subdivided into two spaces: the space of forces [gravity, centrifugal, Coriolis, electric, etc], all of which are felt but never seen. And the space of invisible links or connections [relationships, bondings, attractions, aversions, etc], again which are felt but not seen.

| | FELT<br>INVISIBLE | SENSED<br>VISIBLE | |
|---|---|---|---|
| HYLETIC | PHYSICAL FORCES<br>$\frac{d^2x}{dt^2}, \frac{d^3x}{dt^3}$<br>K–SPACE | POSITION, MOTION<br>$x, \frac{dx}{dt}$<br>P–SPACE | CORPORAL |
| NOETIC | NON-PHYSICAL<br>LINKAGES<br>CONNECTIONS<br>DESIRES<br>AVERSIONS<br>B–SPACE | FORMS, SHAPES<br>PATTERNS<br>COLORS<br>SCALE<br>H–SPACE | EIDETIC |

Some experiences are both seen and felt, others may be neither seen nor felt. In addition to the spaces on the left being invisible, the relations and interactions between the four spaces are also invisible. In fact, they are neither seen nor felt. They must be detected indirectly by inference. Another factor is the role of time in each of the spaces. Positions and velocities in P space, accelerations and third derivatives in K space. But there may be totally different aspects of time operating in B and H space.

# PLANCK PARTICLE–BARYON MUTUALITIES PART I

It is the present hypothesis that existing entities come into being, not by uni-directional *causality*, but by some form of bi-directional *mutuality*. In the case of frequencies such mutualities are the well known phenomenon of resonance. But in other parameters some other form of ~~resolution~~ resonance may be operating. [all numbers are $\log_{10}$]

The Mass–Size Mutuality

| | P | | B | δ | |
|---|---|---|---|---|---|
| M | -4.662199 | \ | -23.776602 | -19.114403 | $= (\alpha\mu)^{1/2} S^{-1/2}$ |
| L | -32.791545 | / | -12.550068 | +20.241477 | $= (\alpha\mu)^{1/2} S^{1/2}$ |

This mutuality infers that in a one dimensional world $(\alpha\mu S)^{1/2}$ planck particles would space-wise fit into one baryon. In a two dimensional world $(\alpha\mu S)$ planck particles would fit into one baryon, and in a three dimensional world $(\alpha\mu S)^{3/2}$ planck particles would fit into one baryon. One approach to the resolution of this mutuality could be through some form of *completion*.

One-dimensional completion:
If we convert to planck units, taking the planck length as 1, the size of the baryon becomes the above, +20.241477. If this be taken as the diameter of a ring, R, the radius would be, +19.940447. The diameter of a planck particle located on a ring of radius R would subtend an angle of −19.940447 radians; $2\pi$ x this number = 20.738627, would be the number of planck particles that would complete the ring. The mass of this ring would be 16.076428 grams.

Two-dimensional completion:
A disk of radius R would have a planck area of $\pi R^2 = 40.378044$. The "cross section area" of a planck particle is $\pi/4 = -0.104910$, hence the number of planck particles in the disk would then be $40.482954 = \alpha\mu S$. This disk would have a mass of 35.820755 grams.
Alternatively, a two-dimensional completion could be obtained in a spherical shell. The area of such a shell would be $4\pi R^2$, four times the area of the above disk. This would require four times the number of planck particles or 41.085014 particles. This shell would have a mass of 36.422815 grams.

Three-dimensional completion:
A sphere of radius R would have a planck volume of $4\pi R^3/3$; the "volume" of a planck particle would be = $\pi/6$; hence the number of planck particles to complete the sphere would be $8R^3$, which is $= 60.724413 = (\alpha\mu S)^{3/2}$. The mass of this sphere would be 56.062214 grams.

The mass of the sphere is of the order of the estimated mass of the universe. The mass of the disk is of the order of maximum stellar mass. ( inferring $10^{20}$ stars in the universe). The mass of $10^{16}$ grams may be a clue to hypothetical dark matter.

NEWPYTH1.WPD JUNE 11, 2001

# THE PYTHAGOREAN UNIVERSE
## FORCE EQUILIBRIA

I. We consider four basic meso or macro forces, leaving thermal and micro forces for later.

| | | |
|---|---|---|
| Gravitation | $GM^2/R^2$ | attraction (+) |
| Centrifugal | $Mv^2/R$ | repulsion (–) |
| Electric | $\hbar c/R^2$ | both (+,–) |
| Planck | $c^4/G$ | (?) |

Assuming the Planck force to be repulsion, with the repulsion case of the electric force, we have:

TABLE I

| | Gravitation | Centrifugal | Electric | Planck |
|---|---|---|---|---|
| Gravitation | ----- | < Schwarzschild | –>Planck mass | M/R = R/M * |
| Centrifugal | $M/R=v^2/G<c^2/G$ | ----- | –> ∞ | –> ∞ |
| Electric | $M^2=\hbar c/G=m_o^2$ | both repel | ----- | –> ∞ |
| Planck | $M/R=\pm c^2/G$ | both repel | both repel | ----- |

Under the Table I assumptions, the interactions of the four forces lead to:
Grav-Cent –> a value of M/R < the value of the Schwarzschild bound.
Grav-Elec –> the Planck particle mass = $m_o$
*Grav-Planck –> a "dual" Schwarzschild boundary, with the properties:
$G^2M^2 = c^4R^2$ ; $GM/c^2R = c^2R/GM$ ; or in Planck units: $M/R = R/M$ , $\pm M = \pm R$
The other combinations do not lead to equilibria, but to continual expansion.

---

Assuming the Planck force to be repulsion, but taking the attraction case of the electric force, we have:

TABLE II

| | Gravitation | Centrifugal | Electric | Planck |
|---|---|---|---|---|
| Gravitation | ----- | < Schwarzschild | –> 0 | M/R = R/M * |
| Centrifugal | $M/R=v^2/G<c^2/G$ | ----- | > Heisenberg | –> ∞ |
| Electric | both attract | $MR=\hbar c/v^2>\hbar/c$ | ----- | –> Planck size |
| Planck | $M/R=\pm c^2/G$ | both repel | $R^2=G\hbar/c^3=l_o^2$ | ----- |

Under the assumptions of Table II, the changes from Table I are:
Grav-Elec –> both contractive –> 0
Cent-Elec –> equilibrium above $\hbar/c$, the value of the Heisenberg bound
Planck-Elec –> the Planck particle size = $l_o$

Assuming the Planck force to be attraction, taking the repulsion case of the electric force, we have:

TABLE III

| | Gravitation | Centrifugal | Electric | Planck |
|---|---|---|---|---|
| Gravitation | ----- | < Schwarzschild | –> Planck mass | –> 0 |
| Centrifugal | $M/R=v^2/G<c^2/G$ | ----- | –> $\infty$ | > Schwarzschild |
| Electric | $M^2=\hbar c/G=m_o^2$ | both repel | ----- | Planck size |
| Planck | both attract | $GM/c^2R=c^2/v^2>1$ | $R^2=G\hbar/c^3=l_o^2$ | ----- |

A contradiction is introduced under the assumptions of Table III, in the system being placed on both sides of the Schwarzschild boundary.

---

Assuming the Planck force to be attraction, taking the attraction case of the electric force, we have:

TABLE IV

| | Gravitation | Centrifugal | Electric | Planck |
|---|---|---|---|---|
| Gravitation | ----- | < Schwarzschild | –> 0 | –> 0 |
| Centrifugal | $M/R=v^2/G<c^2/G$ | ----- | > Heisenberg | > Schwarzschild |
| Electric | both attract | $MR=\hbar c/v^2>\hbar/c$ | ----- | –> 0 |
| Planck | both attract | $GM/c^2R=c^2/v^2>1$ | both attract | ----- |

The same contradiction occurs in Table IV as in Table III

We conclude that the Planck force, $c^4/G$, is a repulsion force. This force may be the $\Lambda$ force of general relativity. [ Its ($\log_{10}$) cgs value is 49.082989 ~~ergs~~ dynes.] From Tables I and II we infer that the inequalities, $M/R < c^2/G$ [< Schwarzschild] and $MR > \hbar/c$ [>Heisenberg] place all equilibria resulting from these four forces in the first quadrant. The first quadrant is the quadrant in which unlimited expansion can take place.

1a

MUSPHERS.WPD
~~UNIVWAVL.WPD~~ January 2, 2000

# MUSIC OF THE SPHERES PART I

It has been shown that the basic frequency associated with the Hubble universe is given by,

$$\nu_U = (\alpha \mu S)^{-3/2} / t_o$$

where $t_o$ is the Planck time, $\alpha$ is the fine structure constant, $\mu$ is the proton/electron mass ratio, and S is the coulomb/gravity force ratio. The wavelength associated with this frequency is

$$\lambda_U = c / \nu_U = (\alpha \mu S)^{3/2} l_o = 10^{27.932889} \text{ cm}$$

where $l_o$ is the Planck length = $10^{-32.791545}$ cm. The sizes and masses of various objects, from sub-atomic particles to clusters of galaxies, are given as sub-harmonics in the following table. (Values are $\log_{10}$) ; (3m = 2n) cf. Pythagoras $\left(\frac{3}{2}\right)^n$

| | # | n | $(\alpha\mu S)^n$ | m | $\lambda^m = (\alpha\mu S)^n l_o$ cm | $M = c^2/G\,\lambda^m$ gm | |
|---|---|---|---|---|---|---|---|
| | 1 | 3/2 | 60.724434 | 1 | 27.932889 | 56.062236 | Fifth |
| 7/5 | 2 | 5/4 | 50.603694 | 5/6 | 17.812149 | 45.941496 | Cl Cl |
| | 3 | 6/5 | 48.579547 | 4/5 | 15.788002 | 43.917349 | Gal |
| | 4 | 9/8 | 45.543324 | 3/4 | 12.751779 | 40.881126 | whole tone G Cl |
| | 5 | 1 | 40.482955 | 2/3 | 7.691410 | 35.820757 | Tone ☆ |
| | 6 | 9/10 | 36.434660 | 3/5 | 3.643115 | 31.772456 | |
| Third 4/5 | 7 | 3/4 | 30.362217 | 1/2 | -2.429328 | 25.700019 | fourth |
| | 8 | 3/5 | 24.289773 | 2/5 | -8.501772 | 19.627575 | |
| 2/5 | 9 | 1/2 | 20.241477 | 1/3 | -12.550068 | 15.579261 | = D |
| 1/6 | 10 | 0 | 0 | 0 | -32.791545 | -4.662198 | = e |

-23

Notes:

- The values in the mass column are given by two equations,
  $\lambda^m c^2/G$ or $(\alpha\mu S)^n m_o$ $\Rightarrow$ $Gm_o/\lambda^m c^2 = (\alpha\mu S)^{-n}$

- As in music, the even harmonics are repetitive while the odd harmonics represent innovations. Thus "octave" frequencies are not likely to manifest, only odd harmonics may support existence.

- Row 1. The values in this row are those of the Hubble universe. The fundamental wave length of 27.932889 cm is based on the characteristic time 17.456057 sec which is corresponds to a value of the Hubble parameter of 71.977 km/sec/mpc.

- Row 2. One light year = 17.975932 cm. This object is close to 1 l.y. in size (all sizes are those of Schwarzschild radii) and has a mass of 12.642 solar masses. (One solar mass = 33.299 gm) This mass suggests a galaxy.

- Row 3. Size is of the order of 100 astronomical units (1 A.U. = 13.174927 cm) Mass is of the order of $10^{10}$ solar masses. Globular cluster?

- Row 4. This value of $\lambda$ is close to the minor axis of the orbit of Mercury, which is equal to 12.753373. Apophasis involved here?

- Row 5. The value of $\lambda$ in this row is of the order of the size of a neutron star. Mass is of the order of 100 solar masses.
  $M = 35.820757$, $120 \times \odot_m = 35.378$ $\delta = 0.443$

- Row 6. Size < a kilometer, mass ~ earth like. Dark matter candidate?

- Row 7. An "octave"; probably non existant.

- Row 8. This value of $\lambda$ approximates that of the Bohr radius, $a_o$=-8.276399

- Row 9. This value of $\lambda$ is precisely equal to that of the electron radius, $r_e$. The value of the mass is anomalistic.

- Row 10. This is the Planck particle with $m_o\lambda = \hbar/c$ and $m_o/\lambda = c^2/G$.

VARIENG1.WPD
~~CONEXIST.WPD~~

January 9, 2000

# THE VARIETIES OF ENERGY

The Planck particle whose properties are defined by the basic physical constants, c, G, ħ, is the "stem cell" of the cosmos. Four basic energies associated with the Planck particle turn out to be identical:

| | | | |
|---|---|---|---|
| The Hertz wave energy, | $H = \hbar\nu$ | = | 16.291442 ergs = $\epsilon_o$ |
| The Einstein kinetic energy, | $E = mc^2$ | = | 16.291442 ergs = $\epsilon_o$ |
| The Volta electric energy, | $V = e^2/\alpha R$ | = | 16.291442 ergs = $\epsilon_o$ |
| The Newton gravitational energy, | $N = Gm^2/R$ | = | 16.291442 ergs = $\epsilon_o$ |
| If all are assumed positive, their total is | | = | 65.165768 ergs = $\epsilon_o{}^4$ |

A formula for the product HEVN, using the relation, $e^2 = \hbar\alpha c$, gives,

$$HEVN = \frac{GM^2}{R} * Mc^2 * \frac{\hbar c}{R} * \frac{e^2}{\alpha R} = \frac{GM^3}{R^3}\hbar^2 c^4$$

Using the definition of the Planck mass, $m_o = \sqrt{(\hbar c/G)}$, we may write,

$$HEVN = \left(\frac{GM}{R}\right)^3 m_o^4 c^2 = \left(\frac{GM}{c^2 R}\right)^3 m_o^4 c^8 = \left(\frac{GM}{c^2 R}\right)^3 \varepsilon_o^4$$

The quantity $GM/c^2R$ is dimensionless and has the value of unity when N = E. Hence all bodies having N = E will have HEVN = $\epsilon_o{}^4$ and will be located on the Schwartzschild boundary. In addition to the condition N = E which places a body on the Schwartzschild boundary, we note that if N = V (or N = H since V ≡ H) the mass of the body must be the Planck mass, $M = m_o$.

$$\frac{N}{V} = \frac{GM^2}{\hbar c} = \frac{M^2}{m_o^2}$$

And if E = V ( or E = H), then $MR = m_o l_o = \hbar/c$, which places the body on the Heisenberg boundary.

$$\frac{E}{V} = \frac{Mc^2}{\hbar c / R} = \frac{MR}{m_o l_o}$$

And for a body on the Heisenberg boundary:

$$HEVN = \left(\frac{GM^2}{c\hbar}\right)^3 \varepsilon_o^4 = \left(\frac{M}{m_o}\right)^6 \varepsilon_o^4$$

In summary: For any body on the Schwartzschild boundary, $HEVN = \epsilon_o^4$; For any body on the Heisenberg boundary, $HEVN = (M/m_o)^6\, \epsilon_o^4$. For the Planck particle, which fits both conditions, $M = m_o$ and $HEVN = \epsilon_o^4$.

Conservation of energy requires that the energies of derivative or metamorphosed bodies be the same as those of the Planck particle. If all four energies are taken as positive, then the universe should also exhibit $HEVN = \epsilon_o^4$. For the Hubble universe with mass $M = (\alpha\mu S)^{3/2}\, m_o$ and with radius $R = (\alpha\mu S)^{3/2}\, l_o$:

$$
\begin{aligned}
H &= \hbar c/R &&= -44.432991 \text{ ergs}\\
E &= M c^2 &&= +77.015877 \text{ ergs}\\
V &= e^2/\alpha R &&= -44.432991 \text{ ergs}\\
N &= GM^2/R &&= +77.015877 \text{ ergs}
\end{aligned}
$$

whose total $= 65.165772 = \epsilon_o^4$. This value precisely replicates that of the Planck particle indicating that energy is conserved.

Further, in the case of a neutron star with $M = Sm_o = 34.693681$ and $R = Sl_o = 6.564335$, the four energies are:

$$
\begin{aligned}
H &= -23.064438 \text{ ergs}\\
E &= +55.647322 \text{ ergs}\\
V &= -23.064438 \text{ ergs}\\
N &= +55.647322 \text{ ergs}
\end{aligned}
$$

with a total $= +65.165770 = \epsilon_o^4$, again the same as the Planck particle.

For other standard stars:

For $M = (auS)m_o = 35.820757$ and $R = (auS)l_o = 7.691910$ the energies are:

$H = V = -24.191513$ ergs and

$E = N = +56.774399$ ergs

with a total of $+65.165772 = \epsilon_o^4$

For $M = (S/\alpha\mu)m_o = 33.566607$ and $R = (S/\alpha\mu)l_o = 5.437261$ the energies are:

$H = V = -21.937364$ ergs and

$E = N = +54.520249$ ergs

with a total of $+65.165770$ ergs $= \epsilon_o^4$

In the above examples we see that two of the energies are negative and two positive. In the case of the Planck particle the four energies being equal suggests that if two were taken as negative the Planck energy would be equal to zero. If the Planck particle is indeed a "cosmic stem cell" initial zero energy would support the hypothesis of "creation ex nihilo". If we were to assign N as plus and E as minus and H as plus and V as minus, the Planck total energy would be zero and all of the above objects would also have a total energy of zero, still preserving energy conservation.

MASSRADS.WPD MAY 8, 2000

# MASSES AND RADII

The values in this table are for baryons.

| | minimum mass | mean | maximum mass |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{-1/2} m_o$=-24.903676 | $S^{-1/2}\, m_o$ = -24.340139 | $(S/\alpha\mu)^{-1/2}\, m_o$=-23.776602 |
| RADIUS | $(S/\alpha\mu)^{1/2}\, l_o$= –13.677142 | $S^{1/2}\, l_o$ = -13.113605 | $(\alpha\mu S)^{1/2} l_o$= -12.550068 |

The values in this table are for quasi dark matter

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{1/2} m_o$= 15.579278 | $S^{1/2}\, m_o$ = 15.015741 | $(S/\alpha\mu)^{1/2}\, m_o$= 14.452204 |
| RADIUS | $(\alpha\mu S)^{1/2} l_o$=-12.550068 | $S^{1/2}\, l_o$ = -13.113605 | $(S/\alpha\mu)^{1/2}\, l_o$=-13.677142 |

The values in this table are for neutron stars .

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\, m_o$ = 35.820755 | $S\, m_o$ = 34.693681 | $(S/\alpha\mu)\, m_o$= 33.566607 |
| RADIUS | $\alpha\mu S\, l_o$ = 7.691409 | $S\, l_o$ = 6.564335 | $(S/\alpha\mu)\, l_o$ = 5.437261 |

$M^*$ = max mass, M~ = mean mass, $M_*$ = min mass
$R^*$ = max radius, R~ = mean radius, $R_*$ = min radius

The values in this table are for normal stars . [$\alpha^2$ = - 4.273670]

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\, m_o$ = 35.820755 | $S\, m_o$ = 34.693681 | $(S/\alpha\mu)\, m_o$= 33.566607 |
| RADIUS | $(\alpha\mu S)\, l_o/\alpha^2$ = 11.965079 | $S\, l_o/\alpha^2$ = 10.838005 | $(S/\alpha\mu)\, l_o/\alpha^2$ = 9.710331 |

The values in this table are for the Hubble universe.

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{3/2}\, m_o$= 56.062232 | $S^{3/2}\, m_o$ = 54.371621 | $(S/\alpha\mu)^{3/2}\, m_o$= 52.681010 |
| RADIUS | $(\alpha\mu S)^{3/2}\, l_o$ = 27.932886 | $S^{3/2}\, l_o$ = 26.242275 | $(S/\alpha\mu)^{3/2}\, l_o$ = 24.551664 |
| TIME | $(\alpha\mu S)^{3/2}\, t_o$ = 17.456065 | $S^{3/2}\, t_o$ = 15.765454 | $(S/\alpha\mu)^{3/2}\, t_o$ = 14.074843 |

COSMFRM1.WPD APRIL 28, 2000

# COSMIC FRAME PART I

THE HUBBLE UNIVERSE FRAME The values in these tables are the allowed positions.

TABLE I [values are $\log_{10}$] [$\alpha^2 = -4.273670$]

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{3/2}\, m_o = 56.062232$ | $S^{3/2}\, m_o = 54.371621$ | $(S/\alpha\mu)^{3/2}\, m_o = 52.681010$ |
| RADIUS | $(\alpha\mu S)^{3/2}\, l_o = 27.932886$ | $S^{3/2}\, l_o = 26.242275$ | $(S/\alpha\mu)^{3/2}\, l_o = 24.551664$ |
| TIME | $(\alpha\mu S)^{3/2}\, t_o = 17.456065$ | $S^{3/2}\, t_o = 15.765454$ | $(S/\alpha\mu)^{3/2}\, t_o = 14.074843$ |

$M^*$ = max mass, $M\sim$ = mean mass, $M_*$ = min mass

$R^*$ = max radius, $R\sim$ = mean radius, $R_*$ = min radius

TABLE II [$S^3\, m_o l_o = 80.613896$ ]

| | |
|---|---|
| $M^*/R^* = m_o/l_o = c^2/G = 28.129346$ | $M^*R^* = (\alpha\mu)^3\, S^3\, m_o l_o = (\alpha\mu)^3\, S^3\, \hbar/c =$ |
| on the Schwarzschild bound | $= 83.995118$ |
| $M^*/R\sim = (\alpha\mu)^{3/2}\, m_o/l_o = 29.819957$ | $M^*R\sim = (\alpha\mu)^{3/2}\, S^3\, m_o l_o = 82.304507$ |
| in the second quadrant | |
| $M^*/R_* = (\alpha\mu)^3\, m_o/l_o = 31.510568$ | $M^*R_* = S^3\, m_o l_o = 80.613896$ |
| in the second quadrant | |
| $M\sim/R^* = (\alpha\mu)^{-3/2}\, m_o/l_o = 26.438735$ | $M\sim R^* = (\alpha\mu)^{3/2}\, S^3\, m_o l_o = 82.304507$ |
| in the first quadrant | |
| $M\sim/R\sim = m_o/l_o = c^2/G = 28.129346$ | $M\sim R\sim = S^3\, m_o l_o = 80.613896$ |
| on the Schwarzschild bound | |
| $M\sim/R_* = (\alpha\mu)^{3/2}\, m_o/l_o = 29.819957$ | $M\sim R_* = (\alpha\mu)^{-3/2}\, S^3\, m_o l_o = 78.923285$ |
| in the second quadrant | |
| $M_*/R^* = (\alpha\mu)^{-3}\, m_o/l_o = 24.748124$ | $M_*R^* = S^3\, m_o l_o = 80.613896$ |
| in the first quadrant | |
| $M_*/R\sim = (\alpha\mu)^{-3/2}\, m_o/l_o = 26.438735$ | $M_*R\sim = (\alpha\mu)^{-3/2}\, S^3\, m_o l_o = 78.923285$ |
| in the first quadrant | |
| $M_*/R_* = m_o/l_o = c^2/G = 28.129346$ | $M_*R_* = (\alpha\mu)^{-3}\, S^3\, m_o l_o = 77.232674$ |
| on the Schwarzschild bound | |

Deltas.wpd July 14, 2010

# COSMIC MASSES

SCAES

| | | |
|---|---|---|
| $\delta$ | = | 1.19463740625 |
| $16\,\delta$ | = | 19.114198500 |

$\delta$ = 1.265079538
$16\delta$ = 20.241272615

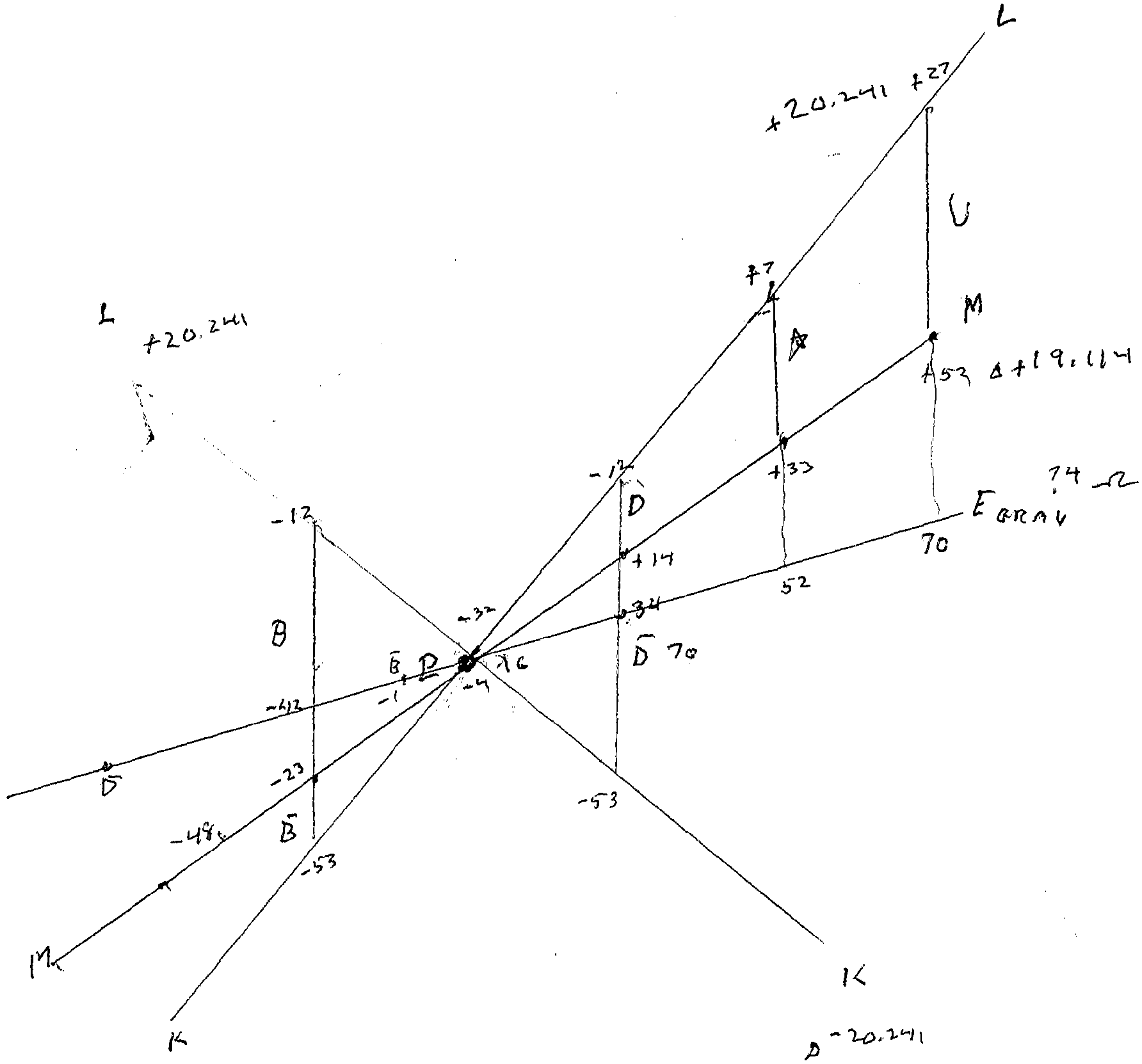
| | | |
|---|---|---|
| universe | 52.680191696 | |
| meta cluster | 51.48555428975 | Down 1 $\delta$ |
| galaxy cluster | 50.2909168835 | 2 $\delta$ |
| blue galaxy | 47.901642071 | 4 $\delta$ |
| red galaxy | 43.123092446 | 8 $\delta$ |
| star cluster | 38.344542821 | 12 $\delta$ |
| star | 33.565993196 | 16 $\delta$ |
| planet | 24.008893946 | 24 $\delta$ |
| dark | 14.451794696 | 32 $\delta$ |
| Planck | -4.662403804 | 48 $\delta$ |
| baryon | -23.776602304 | 64 $\delta$ |

U 27.932477

blue g 22.872159
red g 17.811841

STAR 7.691204

| | | | |
|---|---|---|---|
| star | 33.565993196 | star cluster | 38.344542821 |
| | 32.371355789 | | 37.149905414 |
| | 31.176718383 | | 35.955268008 |
| | 29.982080977 | | 34.760630602 |
| | 28.787443571 | star | 33.565993196 |
| | 27.592806164 | | |
| | 26.398168758 | | |
| | 25.203531352 | | |
| planet | 24.008893946 | | |




$E_{\Omega,V}$ 74

$-\frac{41.2}{74}$ $\frac{34}{74}$ $\frac{14}{-23}$

76

Deltas.wpd July 14, 2010

# COSMIC MASSES

$\delta$ = 1.19463740625
16 $\delta$ = 19.114198500 $\alpha^{-12}\mu^{-2} = \left(\frac{\alpha\mu}{5}\right)^{1/2}$

| | | |
|---|---|---|
| universe | 52.680191696 | |
| meta cluster | 51.48555428975 | Down 1 $\delta$ |
| galaxy cluster | 50.2909168835 | 2 $\delta$ |
| blue galaxy | 47.901642071 | 4 $\delta$ – largest aggregate |
| red galaxy | 43.123092446 | 8 $\delta$ |
| star cluster | 38.344542821 | 12 $\delta$ |
| star | 33.565993196 | 16 $\delta$ |
| planet | 24.008893946 | 24 $\delta$ |
| dark | 14.451794696 | 32 $\delta$ |
| Planck | -4.662403804 | 48 $\delta$ |
| baryon | -23.776602304 | 64 $\delta$ |

| | | | |
|---|---|---|---|
| star | 33.565993196 | star cluster | 38.344542821 |
| | 32.371355789 | | 37.149905414 |
| | 31.176718383 | | 35.955268008 |
| | 29.982080977 | | 34.760630602 |
| | 28.787443571 | star | 33.565993196 |
| | 27.592806164 | | |
| | 26.398168758 | | |
| | 25.203531352 | | |
| planet | 24.008893946 | | |

| | | $\bar{B}$ | | $B$ | | $P$ | | $D$ | | $\bar{D}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $M$ | | $-23.776602$ | $0$ | $-23.776602$ | $\Delta$ $19.114198$ | $-4.662404$ | $\Delta \left(\frac{S}{\alpha\mu}\right)^{1/2}$ $19.114198$ | $+14.451794$ | $0$ | $+14.451794$ |
| $L$ | | $= R_B$ $-51.905539$ | $S$ | $-12.550068$ $= r_e$ | $20.241273$ | $-32.791341$ | $20.241273$ $(\alpha\mu S)^{1/2}$ | $-12.550068$ $= r_e$ | $\alpha\mu$ | $-13.677143$ |
| $\frac{M}{L}$ | | $\frac{c^2}{G}$ | $\frac{1}{S}$ | $-11.226534$ $= \frac{1}{S}\frac{c^2}{G}$ | $S$ | $28.128937$ $= c^2/G$ | $\alpha\mu$ | $27.001862$ $= \frac{1}{\alpha\mu}\frac{c^2}{G}$ | $\frac{1}{\alpha\mu}$ | $\frac{c^2}{G}$ |
| $M \cdot L$ | | $-75.682141$ $\alpha\mu S^{-1}\frac{h}{c}$ | $\frac{1}{S}$ | $-36.326670$ $= \alpha\mu\frac{h}{c}$ | $\alpha\mu$ | $-37.453745$ $= \frac{h}{c}$ | $S$ | $1.901726$ $= S\frac{h}{c}$ | $\frac{1}{\alpha\mu}$ | $0.774651$ $\frac{S}{\alpha\mu}\frac{h}{c}$ |
| $R$ | $\frac{GM}{c^2}$ | $-51.905539$ | $0$ | $-51.905539$ $= S^{-1} r_e$ | $19.114198$ $\left(\frac{S}{\alpha\mu}\right)^{1/2}$ | $-32.791341$ | $19.114198$ $\left(\frac{S}{\alpha\mu}\right)^{1/2}$ | $-13.677143$ $= \frac{r_e}{\alpha\mu}$ | $0$ | $-13.677143$ |
| $\frac{M}{R}$ | | $\frac{c^2}{G}$ | $0$ | $\frac{c^2}{G}$ | $0$ | $\frac{c^2}{G}$ | $0$ | $\frac{c^2}{G}$ | $0$ | $\frac{c^2}{G}$ |
| $M \cdot R$ | | $\alpha\mu S^{-1}\frac{h}{c}$ | $0$ | $-75.682141$ $= \alpha\mu S^{-1}\frac{h}{c}$ | $\frac{\alpha\mu}{S}$ | $\frac{h}{c}$ | $\frac{S}{\alpha\mu}$ | $0.774651$ $\frac{S}{\alpha\mu}\frac{h}{c}$ | $0$ | $\frac{S}{\alpha\mu}\frac{h}{c}$ |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

$-75.682141 = \frac{\alpha\mu}{S}\frac{h}{c}$

$-74.907490$ $\left(\frac{h}{c}\right)^2$

$0.774652 = \frac{h}{c}\cdot\frac{S}{\alpha\mu}$

$-76.456794 = \left(\frac{\alpha\mu}{S}\right)^2$

$\bar{B}$, $P$, $\bar{D}$ are all on the Schwartzschild bound

$\bar{B}$

DARK MATTER

| | M | L | $\frac{M}{L}$ | ML |
|---|---|---|---|---|
| B | -23.776602 | -12.550068 | -11.226534 $= \frac{1}{S}\frac{c^2}{G}$ OK | -36.326670 $= \alpha\mu \frac{\hbar}{c}$ |
| $\bar{B}$ | -23.776602 | -53.032614 | +29.256012 $= \alpha\mu \frac{c^3}{G} \rightarrow$ BH | -76.809216 $= \frac{1}{S}\frac{\hbar}{c}$ |
| D | +14.451795 | -12.550068 | -27.001863 $= \frac{1}{\alpha\mu}\frac{c^2}{G}$ OK | +1.901727 $= S\frac{\hbar}{c}$ |
| $\bar{D}$ | +14.451795 | -53.032614 | +67.483909 $= S\frac{c^3}{G}$ BH | -38.580819 $= \frac{1}{\alpha\mu}\frac{\hbar}{c}$ |

-53.032614 = -12.550068
40.482545
$\alpha\mu S$
-62.004999

Conservation of Grav Energy?

~~GRAV ENG~~ $\frac{A^3}{B}$ A -23 $m_0$ B 14 $\frac{B^3}{A}$

MASS $M_B \cdot M_D = m_0^2$ 52.680192

-23 $\sqrt{\ } = m_0$ 14
$M_B$ $M_D$

$\frac{A^2}{B}$ -53 -32 -12 ~~-12~~
A B (7.691)
+27.932
SCALE $\frac{B^2}{A}$
-93.515160

$\frac{M}{L}$ -62.004999
-93.515160
+31.510161
BH
$= \frac{c^3}{G}(\alpha\mu)^3$ $\sqrt{L_B \cdot L_{\bar{B}}} = l_0$

GRAV ENERGY $\sqrt{\frac{\hbar c^5}{G}}$ $\mathcal{E}$

B = -42.178432
$\mathcal{E}$ = 16.291238
$\frac{B}{\mathcal{E}} = -58.469670 = \left(\frac{\alpha\mu}{S}\right)^{3/2}\frac{1}{\alpha\mu}$

D = 34.278362
$\frac{D}{\mathcal{E}} = 17.987124 = \left(\frac{S}{\alpha\mu}\right)^{1/2}\frac{1}{\alpha\mu}$

$\frac{B}{\mathcal{E}} \times \frac{D}{\mathcal{E}} = -40.482 = \frac{1}{\alpha\mu S}$

$\frac{D/\mathcal{E}}{B/\mathcal{E}} = \frac{D}{B} = 76.457 = \left(\frac{S}{\alpha\mu}\right)^2$

or
$m_0 \rightarrow 4$
B, $\bar{B}$, D, $\bar{D}$

# $\mathcal{E}$ in Univ 52.680194
-4.662404
Number of $m_0$'s in universe → 57.342598 $= \left(\frac{S}{\alpha\mu}\right)^{3/2}$ → $M_B$, $M_D$

| $M_B$ | $M_D$ |
|---|---|
| 57.342 | 57.342 |
| -23.776 | 14.451 |
| 33.566 | 71.793 |

71.393
33.566
38.227 $= \frac{S}{\alpha\mu}$

Total mass of B = One ★ 33.565996 = $M_★$
TOTAL MASS of D $= \frac{S}{\alpha\mu}$ stars $= 10^{38}$ stars

+ = 105.359 = $2M_0$

Each ★ B : D
$\alpha\mu$ : S

Eq # of $B_0$ and $D_0$

# A CONSISTENT VALUE FOR NEWTON'S CONSTANT: G

Several basic physical quantities have been determined to accuracies better than eight places, but Newton's gravitational constant, G, has yet to be determined with certainty to more than five places. This in turn has limited the accuracy of those other constants involving G, such as the Planck mass, $m_o = \sqrt{(\hbar c/G)}$ and the Planck length, $l_o = \sqrt{(G\hbar/c^3)}$.

Here is presented a "consistency process" for determining G, $m_o$, $l_o$, etc to more places:
The present values of relevant constants are taken from CODATA 2006
The $\log_{10}$(cgs) values of those constants are given in TABLE I

TABLE I

| | | | |
|---|---|---|---|
| fine structure constant | $\alpha$ = | −2.136 834 672 | [0] |
| proton mass | $m_p$ = | −23.776 602 289 | [M] |
| electron mass | $m_e$ = | −27.040 511 078 | [M] |
| proton/electron mass ratio | $\mu$ = | 3.263 908 789 | [0] |
| electron radius | $r_e$ = | −12.550 068 213 | [L] |
| velocity of light | c = | 10.476 820 703 | [L/T] |
| Planck's constant | $\hbar$ = | -26.976 923 917 | [$ML^2/T$] |
| and | | | |
| Newton's constant | G = | −7.175 6 | [$L^3/MT^2$] |
| Planck mass | $m_o$ = | −4.662 2 | [M] |
| Planck length | $l_o$ = | −32.791 6 | [L] |

Using the values from TABLE I,

$$m_o/m_p = 19.114\,3 \quad [0] \qquad r_e/l_o = 20.241\,4 \quad [0]$$
$$m_p r_e/m_o l_o = 1.127\,1 \quad [0] \qquad \alpha\mu = 1.127\,074\,115 \quad [0]$$

The equality between the first four places of $m_p r_e/m_o l_o$ and $\alpha\mu$ suggests that the quantities are possibly equal, and that the other ratios may also be functions of $\alpha$ and $\mu$.

Calculating powers of $\alpha$ and $\mu$, we find that $\alpha^{-12}\mu^{-2} = 19.114\,198\,500$
Comparing and assuming $m_o/m_p = 19.114\,198\,500$ and using the value of $m_p$ from TABLE I, $m_o$ becomes = −4.662 403 789 But $m_o = \sqrt{(\hbar c/G)}$, or $G = \hbar c/m_o^2$
Using the values of $\hbar$ and c from TABLE I,

G becomes = −7.175 295 636

Again calculating powers of $\alpha$ and $\mu$, we find that $\alpha^{-11}\mu^{-1} = 20.241\,272\,615$
Similarly, assuming $r_e/l_o = 20.241\,272\,615$ and using the value of $r_e$ from TABLE I, $l_o$ becomes = −32.791 340 828, But $l_o = \sqrt{(G\hbar/c^3)}$, or $G = c^3 l_o^2/\hbar$,
Using the values of $\hbar$ and c from TABLE I,

G becomes = −7.175 295 630

Summarizing: The $\log_{10}$(cgs) values become:

| | | |
|---|---|---|
| Newton's constant | G = | −7.175 295 633 |
| Planck mass | $m_o$ = | −4.662 403 789 |
| Planck length | $l_o$ = | −32.791 340 828 |

The coulomb/gravity force ratio at the baryon level, $S = \hbar\alpha c/Gm_p m_e$ = +39.355 471 115 [0]

MASS

$\left(\frac{S}{\alpha\mu}\right)^{1/2} = \Delta = 19.114\ 198\ 500$

$\delta = 9.557\ 099\ 250$

$\sqrt{ML}$

SCALE

$(\alpha\mu S)^{1/2} = \Delta = 20.241\ 272\ 615$

$\delta = 10.120\ 636\ 307$

| | | M | $S\sqrt[n]{m_0 l_0}$ | L | | |
|---|---|---|---|---|---|---|
| +71.794 386 202 | $m_0^5/m_p^4$ | $\left(\frac{S}{\alpha\mu}\right)^2 m_0$ | $S^2\sqrt{m_0 l_0}$ | $(\alpha\mu S)^2 l_0$ | $r_e^4/l_0^3$ | +48.173 749 632 |
| +62.237 291 952 | $(m_0^9/m_p^7)^{1/2}$ | $\left(\frac{S}{\alpha\mu}\right)^{7/4} m_0$ | $S^{7/4}\sqrt{m_0 l_0}$ | $(\alpha\mu S)^{7/4} l_0$ | $(r_e^7/l_0^5)^{1/2}$ | +38.053 113 325 |
| U +52.680 192 702 | $m_0^4/m_p^3$ | $\left(\frac{S}{\alpha\mu}\right)^{3/2} m_0$ | $S^{3/2}\sqrt{m_0 l_0}$ | $(\alpha\mu S)^{3/2} l_0$ | $r_e^3/l_0^2$ | +27.932 477 017 |
| +43.123 093 452 | $(m_0^7/m_p^5)^{1/2}$ | $\left(\frac{S}{\alpha\mu}\right)^{5/4} m_0$ | $S^{5/4}\sqrt{m_0 l_0}$ | $(\alpha\mu S)^{5/4} l_0$ | $(r_e^5/l_0^3)^{1/2}$ | +17.811 840 707 |
| ☆ +33.565 994 202 | $m_0^3/m_p^2$ | $\frac{S}{\alpha\mu} m_0$ | $S\sqrt{\ }$ | $(\alpha\mu S) l_0$ | $r_e^2/l_0$ | +7.691 204 400 |
| +24.008 894 952 | $(m_0^5/m_p^3)^{1/2}$ | $\left(\frac{S}{\alpha\mu}\right)^{3/4} m_0$ | $S^{3/4}\sqrt{\ }$ | $(\alpha\mu S)^{3/4} l_0$ | $(r_e^3/l_0)^{1/2}$ | −2.429 431 904 |
| D +14.451 795 702 | $m_0^2/m_p$ | $\left(\frac{S}{\alpha\mu}\right)^{1/2} m_p$ | $S^{1/2}\sqrt{\ }$ | $(\alpha\mu S)^{1/2} l_0$ | $r_e$ | −12.550 068 214 |
| +4.894 695 452 | $(m_0^3/m_p)^{1/2}$ | $\left(\frac{S}{\alpha\mu}\right)^{1/4} m_0$ | $S^{1/4}\sqrt{\ }$ | $(\alpha\mu S)^{1/4} l_0$ | $(r_e l_0)^{1/2}$ | −22.670 704 521 |
| P −4.662 403 798 | $m_0$ | $\left(\frac{S}{\alpha\mu}\right)^0 m_0$ | $S^0\sqrt{m_0 l_0}$ | $(\alpha\mu S)^0 l_0$ | $l_0$ | −32.791 340 828 |
| −14.219 503 049 | $(m_0 m_p)^{1/2}$ | $\left(\frac{S}{\alpha\mu}\right)^{-1/4} m_0$ | $S^{-1/4}\sqrt{\ }$ | $(\alpha\mu S)^{-1/4} l_0$ | $(l_0^3/r_e)^{1/2}$ | −42.911 977 135 |
| $\bar{B}$ −23.776 602 304 | $m_p$ | $\left(\frac{S}{\alpha\mu}\right)^{-1/2} m_0$ | $S^{-1/2}\sqrt{\ }$ | $(\alpha\mu S)^{-1/2} l_0$ | $l_0^2/r_e$ | −53.032 613 442 |
| −33.333 701 554 | $(m_p^3/m_0)^{1/2}$ | $\left(\frac{S}{\alpha\mu}\right)^{-3/4} m_0$ | $S^{-3/4}\sqrt{\ }$ | $(\alpha\mu S)^{-3/4} l_0$ | $(l_0^5/r_e^3)^{1/2}$ | −63.153 249 749 |
| −42.890 800 804 | $m_p^2/m_0$ | $\left(\frac{S}{\alpha\mu}\right)^{-1} m_0$ | $S^{-1}\sqrt{m_0 l_0}$ | $(\alpha\mu S)^{-1} l_0$ | $l_0^3/r_e^2$ | −73.273 886 057 |
| | | | $\sqrt{m_0 l_0} = -18.726\ 872$ | 316 | | |

$(m_0 m_p)^{1/2}$

$\frac{M}{L} < \frac{c^2}{G}$

$\frac{M}{L} = \frac{c^2}{G}$

$\frac{M}{L} > \frac{c^2}{G}$

BLACK HOLES

B $\frac{M}{L} = -11 < \frac{c^2}{G}$

$$F\left(m_o, m_r, \left(\frac{s^{\gamma}}{\alpha\mu}\right)\right) = \frac{3}{2} m_o + m_p + \gamma$$

$M_V$ $F = 3$

$M_R$ $F = \frac{5}{2}$

$M_D$ $F = 2$

$M_P$ $F = \frac{3}{2}$

$M_B$ $F = 1$

MASS

| $m_0^5/m_p^4$ | $\left(\frac{S}{\alpha_M}\right)^{-1/2}$ | $\left(\frac{S}{\alpha_M}\right)^{-1/4}$ | $\left(\frac{S}{\alpha_M}\right)^{0}$ | $\left(\frac{S}{\alpha_M}\right)^{1/4}$ | $\left(\frac{S}{\alpha_M}\right)^{1/2}$ | $\left(\frac{S}{\alpha_M}\right)^{3/4}$ | $\frac{S}{\alpha_M}$ | $\left(\frac{S}{\alpha_M}\right)^{5/4}$ | $\left(\frac{S}{\alpha_M}\right)^{3/2}$ |
|---|---|---|---|---|---|---|---|---|---|
| $\left(m_0^9/m_p^7\right)^{1/2}$ | | | +62.237292 | | | | | | |
| U $m_0^4/m_p^3$ | | | U +52.680193 | | | | | | |
| $\left(m_0^7/m_p^5\right)^{1/2}$ | | | +43.123093 | | | | | | |
| $m_0^3/m_p^2$ | | | ☆ +33.565994 | | U V | | | | |
| $\left(m_0^5/m_p^3\right)^{1/2}$ | | | +24.008895 | | | | | | |
| $m_0^2/m_p$ | | | D +14.451796 | | ☆ | | V 52.680.193 | | |
| $\left(m_0^3/m_p\right)^{1/2}$ | | | +4.894695 | | | | 43.123092 | | |
| $m_0$ | B -23.776602 | | P -4.662404 | | D +14.451796 | | ☆ +33.565994 | | U +52.680.193 |
| $\sqrt{m_0 m_p}$ | | | -14.219503 | | | | | | |
| $m_p$ | | | B -23,776602 | | | | | | ☆ |
| $\left(m_p^3/m_0\right)^{1/2}$ | | | -33.333702 | | | | | | |

$M_U = \frac{M_\star^2}{M_D} = \frac{M_D^2}{M_B}$

if $m_0$, $m_p$ are the exponents and $\gamma$ = the exponent of $\frac{S}{\alpha_M}$
then $M = M_U$ when $\frac{3m_0}{2} + m_p + \gamma = 3$

$M = M_\star$ when $\left(+\frac{1}{2}m_p + m_0 + \gamma = 2\right)$
☆ or $\frac{3}{2}m_0 + m_p + \gamma = 5/2$

$M_P$ : $\frac{3}{2} m_0 + m_p + \gamma = \frac{3}{2}$

$M_B$ $\frac{3}{2} m_0 + m_p + \gamma = 1$

$M_D$ : $\frac{3}{2} m_0 + m_p + \gamma = 2$

ENERGIES.WPD December 3, 2010 January 26, 2011

$G := -7.175296 \quad c := 10.476821 \quad h := -26.9769$
$M := 52.680194 \quad L := 27.932478$

ENERGIES

**UNIVERSE:**

M = 52,680191 L = 27.932478 T = 17.455657 = L/c

$E = -44.432581 = \hbar/T$

$\Delta = 114.685195 = (S/\alpha\mu)^3$

$E = 70.252614 = GM^2/L$

$\Delta = 3.381222 = (\alpha\mu)^3$

$E = 73.633836 = Mc^2$

$\Delta = 3.381222 = (\alpha\mu)^3$

$E = 77.015056 = c^4L/G$

$\Delta = 121.447637 = (\alpha\mu S)^3$

$E = -44.432581 = \hbar/T$

$\Delta = 118.066417 = S^3$

$E = 73.633836 = Mc^2$

---

from above U value

E planck = 16.291238 = $\epsilon$

$h/T\epsilon = (\alpha\mu S)^{3/2}$

$GM^2/L\epsilon = S^{3/2} / (\alpha\mu)^{9/2}$

$Mc^2/\epsilon = (S/\alpha\mu)^{3/2}$

$c^4L/G\epsilon = (\alpha\mu S)^{3/2}$

12-8-10

9.557099

| Ratio $\sqrt{\frac{A}{B}}$ | $B$ | $\sqrt{AB}$ | P<br>$A$ | $\sqrt{\frac{A^3}{B}}$ | D<br>$\frac{A^2}{B}$ | $\left(\frac{A^5}{B^3}\right)^{1/2}$ | $\frac{A^3}{B^2}$ | $\left(\frac{A^7}{B^5}\right)^{1/2}$ | $\frac{A^4}{B^3}$ | $\left(\frac{A^9}{B^7}\right)^{1/2}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| MASS, $M$ | -23.776602 | -14.219503 | -4.662404 | 4.894695 | 14.451794 | 24.008893 | 33.565992 | 43.123091 | 52.680190 | 62.237289 |
| $R = \frac{GM}{c^2}$ | -51.905539 | -42.348440 | -32.791341 | -23.234242 | -13.677143 | -4.120044 | 5.437055 | 14.994154 | 24.551253 | 34.108352 |
| $T = \frac{G}{c^3}M$ | -62.382360 | -52.825261 | -43.268162 | -33.711063 ? | -24.153964 | -14.596865 | -5.039766 | 4.517333 | 14.074432 | 23.631531 |
| $t$ | -13.026889 | -12.906524 | -43.268162 | -33.147797 | -23.027432 | -12.907067 | -2.786702 | 7.333663 | 17.454028 | 27.574393 |
| RMD $L^{10,120}_{365}$ | -12.550068 | -22.670705 | -32.791341 | -22.670705 | -12.550068 | -2.429432 | 7.691205 | 17.811842 | 27.932478 | 38.053115 |
| $\tau = \sqrt{\frac{t^3}{T}}$ | | | 43.268162 | | | | | | | |
| $\frac{L}{R} = \frac{t}{T}$ | $S$ | $S\sqrt{\alpha\mu}$ | $(\alpha\mu)^0$ | $(\alpha\mu)^{1/2}$ | $(\alpha\mu)^1$ | $(\alpha\mu)^{3/2}$ | $(\alpha\mu)^2$ | $(\alpha\mu)^{5/2}$ | $(\alpha\mu)^3$ | $(\alpha\mu)^{7/2}$ |
| $\frac{M}{L}$ | $\frac{1}{S}\frac{c^2}{G}$ | | $\frac{c^2}{G}$ | | $\frac{1}{\alpha\mu}\frac{c^2}{G}$ | | | | | |
| $ML$ | $\alpha\mu\,\frac{\hbar}{c}$ | | $\frac{\hbar}{c}$ | | $S\frac{\hbar}{c}$ | | | | | |
| | | | | | | | | | | |

$\frac{t}{T} = \frac{L}{R}$ = S 1 $\alpha\mu$

SYMMETRY

| | B | D | | $\bar{B}$ | $\bar{D}$ |
|---|---|---|---|---|---|
| | -23 | +14 | M | -23.776 | +14.451 |
| | -12 | -12 | L | -51.905 | -13.677 |
| | | | | $\frac{M}{L} = \frac{c^2}{G}$ | $\frac{c^2}{c}$ |

$\frac{\hbar}{c} = -37.453745$

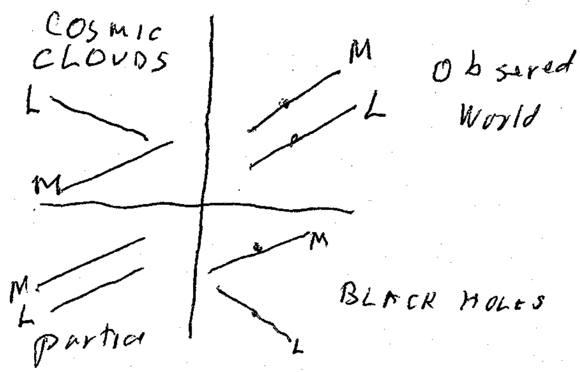
$\frac{c^2}{G} = 28.128937$

| | | | |
|---|---|---|---|
| L | -12 | -32 | -12 |
| R | -51 | -32 | -13 |
| ML | -36.326 $\frac{h}{c}\alpha\mu$ | $\frac{\hbar}{c} = -37$ | 1.1901 $\frac{h}{c}s$ |
| $\frac{M}{L}$ | -11.226 $S^{-1}\frac{c^2}{G}$ | $\frac{c^2}{G} = 28$ $\alpha\mu$ | 27.001 $\frac{1}{\alpha\mu}\frac{c^2}{G}$ |

NANANUMB.WPD July 5, 2011

# THE MATHEMATICS OF NATURE'S NUMBERS

We here discriminate two species of numbers which we shall call NATURAL NUMBERS and NARURE'S NUMBERS. NATURAL NUMBERS are the postive integers and all the other species of numbers derived from them by various inversions, symmetries, bounds, and limits. NATURE'S NUMBERS, on the other hand, are the numerical measurements made of various objects existing in the physical universe..




$$P = \frac{ML^2}{T^3} = \frac{E}{T} = Fc$$

| | | |
|---|---|---|
| | 16.291 | 49.083 |
| | 43.226 | 10.477 |
| | 59.517 | 59.566 |
| P | 16291237 | 49.082578 |
| | - 43.268162 | 10476821 |
| | + 59.559399 | 59.559399 |
| U | 73.633835 | 10.4768 |
| | 17.455657 | 45.7013 |
| | 56.178178 | ~~47.9324~~ |
| | | 56.1781 ✓ |

A cube of Planck Particles

Spheres?

$\mathcal{P}$: ~~length~~ $-32.791$

$L_U = 27.932$

Vol $-98.373$

Vol $83.796$

$\rho$ $-4.662$ $+93.711$

$-98.373$

# of $\mathcal{P}$ 182.169

Mass of 182.169 $\mathcal{P}$:

4.662

$M_{cube} = 177.507$ to $M_U = 52.680$

$\frac{M_{cube}}{M_U} = \frac{177.507}{52.680}$

177.507

$\rho_{cube}$ 83.796

$\rho = 93.711$

E lost

$124.827 \times c^2 = 145.780$

72.147

19.467 $\quad loss \frac{E}{V} = 61.984$

$-33.213$

---

$\mathcal{P}$

$-53.032$
$-23.776$
$+29.256$

$-23.776$
$-12.550$
$-11.226$

OK

$-53.032$
$+29.256$

BH

$-4.662$
$-32.791$

14.451
$-12.550$
$+27.001$

OK

$-53.032$

67.483

BH

27.001 sum
11.226
38.227 sum ✓ $= \frac{S}{\alpha\mu}$

diff 15.775

$+29.256$
$+67.483$
96.739 sum

$> 38.227 = \frac{S}{\alpha\mu}$ ✓ diff

$114.685191 = \left(\frac{S}{\alpha\mu}\right)^3$

514

171

4 Species of Matter:

Ordinary $\quad$ Dark

Mim, BH $\quad$ Black hole

96.739
S 15.775
$\mathcal{P}$ 112.514
2.254 $\alpha\mu^2$
114.768

57.342595
56.257
1.086

80.964 ✓ $(\alpha\mu S)^2$

diff 40.482 ✓

U

$\frac{E}{V}$ =

$\frac{Grav}{L^2}$ = −13 ↓

$\frac{E}{V}$ −10 ↑ ∴ U ↑ $\Delta = (\alpha\mu)^3$

| | $\frac{Grav}{L^2}$ ↓ | $\frac{E}{V}$ ↑ | GRAV ↓ | $\frac{E}{V} L^2$ ↑ |
|---|---|---|---|---|
| U | −13 | −10 | 42 | 45 |
| ☆ | 29 | 31 | 44 | 46 |
| D | 71 | 73 | 46 | 48 |
| E | 114 | 114 | 49 | 49 |
| | exp dominate | | exp | |

B

$C^2 = \cancel{20.932}$ 20.953641 83.

73.633 835

G: −7.175296

m −4.662404
$C^2$ 20.953641
E 16.291237

16.291237 Ee
98.374023 Ve
114.665760 E/V

45.701358
42.320136
81222

46.177351
43.271942
2.905409

45.701358
43.320136
2.381222

43.320136
42.863024
457

E

~~93.744619~~
~~20.953641~~
~~113899260~~

93.711619 P
20.953641 $C^2$
114.665260 E/V

50.447216

49.082578
44.574244
4.508334

52.680
27.932
80.612
34.911
45.701

31.446001

$\left(\frac{M}{L}\right)^2 = 49.495432$
7.175296

$G\left(\frac{M}{L}\right)^2$ 612

49.052
46.828
2.234

52.680194
27.932478
24.747716 $\frac{M}{L}$
489.495432 $\left(\frac{M}{L}\right)^2$
7.175296
42.320136 Grav

42.863
45.972
3.109

41.257180
−5.571232
46.828412
45.701358
1.127054

27.932478 Lv
2
55.864956 $L^2$
42.320136 Grav
=13.544820 $\frac{\text{Grav}}{L^2}$ v

27.932478
$L^3$ 3
83.797434

v 27.932478
e 20.476821
Tv 17.455657

M 52.680194
$e^2$ 20.953641
Ev 73.633785
Vv 83.797434
−10.163651 $\left(\frac{E}{V}\right)_v$

$$\boxed{\begin{array}{l} -13.544820 \\ -10.163651 \\ 3.381169\ (4) \end{array}}$$

V

45.701358
43.320136 $\frac{E}{V}$
2.380622

| | | | | | | | $\frac{ML}{T^2}$ | $\frac{GM^2}{L^2}$ | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | E/V | FORCE | GRAVITY | TIME |
| U | | | | | | $\frac{P}{(\alpha\mu)^6 S^3}$ | $P/(\alpha\mu)^3$ | $P/(\alpha\mu)^6$ | $\frac{P}{(\alpha\mu S)^{3/2}}$ |
| X | | | | | | | | | |
| S | | | | | | $\frac{P}{(\alpha M)^4 S^2}$ | $\frac{P}{(\alpha\mu)^2}$ | $P/(\alpha\mu)^4$ | $\frac{P}{\alpha\mu S}$ |
| D | | | | | | $\frac{P}{(\alpha M)^2 S}$ | $\frac{P}{\alpha\mu}$ | $\frac{P}{(\alpha M)^2}$ | $\frac{P}{(\alpha M S)^{1/2}}$ |
| P | | | | | | $P \doteq \left(\frac{S}{\alpha\mu}\right)^3$ | $C^4/G = P$ | $C^4/G = P$ | $P = t_c$ |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

$(\alpha\mu)^2 S = 41.609619$

SECOND QUADRANT FIRST QUADRANT

| | INUNIV | Y | Q | BARYON | P;ANCK | DARK | STAR | X | UNIVERS |
|---|---|---|---|---|---|---|---|---|---|
| MASS | | | | | -4.662404 | 14.4517796 | | | |
| LENGTH | | | | | -32.791341 | | | | |
| M/L | | | | | | | | | |
| AREA | | | | | | | | | |
| $M/L^2$ | | | | | | | | | |
| VOLUME | | | | | | | | | |
| DENSITY | | | | | | | | | |
| TIME L/c | | | | | | | | | |
| ENERGY | | | | | | | | | |
| E/V | | | | | | | | | |
| FORCE | | | | | | | | | |
| GRVITY | | | | | | | | | |
| $GM^2/L^4$ | | | | | | | | | |
| POWER | | | | | | | | | |

TEMP

$$\frac{Mc^2}{L^3} = \rho c^2$$

||

| | | $M/LT^2$ | $c^4/GL^2$ | $GM^2/L^4$ | | $\hbar c/L^4$ |
|---|---|---|---|---|---|---|
| | | | | | | |
| U | | −10. | | | | |
| | | | | | | |
| ~~A~~ | | | | | | |
| | | | | | | |
| S | | | | | | |
| | | | | | | |
| D | | | | | | |
| | | | | | | |
| P | | | | | | |
| | | 79. | | | | |
| B | | | | | | |
| | | | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | $M/LT^2$ | $\Delta$'s | $(\alpha\mu)^2 S$ | | |
| | | | | $= 41.609619$ | | |
| U | | $-10.163599$ | | | | |
| | | | | | | |
| A | | | 41.609610 | $(\alpha\mu)^2 S$ | | |
| | | | | | | |
| S | | 31.446011 | | | | |
| | | | 41.609629 | $(\alpha\mu)^2 S$ | | |
| D | | 73.055640 | | | | |
| | | | 41.609621 | $(\alpha\mu)^2 S$ | | |
| P | | 114.665261 | | | 114.685191 = | $\left(\frac{S}{\alpha\mu}\right)^3$ $\Delta = 0.019930$ |
| | | | 79.838017 | $\approx (\alpha\mu) S^2$ | | |
| B | | 34.827244 | | | | |
| | | | | $(\alpha\mu) S^2 =$ | | |
| | | | | 79.838016 | | |

Note change. $(\alpha\mu)^2 S \rightarrow (\alpha\mu) S^2$

WILSON

| | $\left(\frac{S}{\alpha\mu}\right)^{1/2}$ 19.114199 | $(\alpha\mu S)^{1/2}$ 20.241273 | $(\alpha\mu)^2$ 2.254148 | $S(\alpha\mu)^2$ 41.609617 | | $\frac{c^4/G}{Grav}$ ↑↓ Grav w $P = \frac{c^4}{G}$ = 49.082578 | |
|---|---|---|---|---|---|---|---|
| △ | $M$ | $L$ | $GM^2/L^2$ | $\rho$ | $\frac{M}{LT^2} = \rho c^2$ | | |
| U | 52.680194 | 27.932478 | 42.320136 | -31.117238 | -10.163597 | 6.756442 | w 6.762444 = $(\alpha\mu)^5$ ⇒ ↑ |
| | | | $(\alpha\mu)^2$ | | | | |
| K | | | | | | | |
| | | 55.814117 | | | | | |
| Y | | 12.795293 | | | | | |
| | | 45.586 - 32.791 | | | | | |
| ☆ | 33.565995 | 7.691205 | 44.574284 | 10.492381 | +31.446022 | 4.508294 | $=(\alpha\mu)^4$ ⇒ ↑ |
| | | | $(\alpha\mu)^2$ | | | | |
| D | 14.451796 | -12.550068 | 46.828432 | 52.102000 | +73.055641 | 2.254146 | $=(\alpha\mu)^2$ ⇒ ↑ |
| | | | $(\alpha\mu)^2$ | | | | |
| P | -4.662403 | -32.791340 | 49.082578 | 93.711617 | 114.665258 | = 1 | stable |
| | | | $S^2$ | $S^2(\alpha\mu)$ | | | |
| B | -23.776602 | -12.550068 | =29.628374 | +13.873602 | 34.827243 | + $S^2$ | ⇒ ↑ |
| | | | | | | | |
| Q | -42.890801 | +7.691205 | | -65.904414 | -45.010773 | | |
| | | | | | | | |
| Ū | -62.005000 | +27.932478 | | -145.802434 | -124.848789 | ✓ | |

79.838016

$S^2(\alpha\mu)$

-10.163597

-114.685192

$\left(\frac{S}{\alpha\mu}\right)^{3/2} = 114.665191$ ✓

$\frac{C^2}{G} = 28.128937$

| | M/L | $C^2/G$ / M/L | | | | |
|---|---|---|---|---|---|---|
| U | 24.747716 | $(\alpha M)^3$ | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| A | 25.874790 | $(\alpha M)^2$ | | | | |
| | | | | | | |
| D | 27.001864 | $(\alpha M)$ | | | | |
| | | | | | | |
| P | 28.128737 | 1 | | | | |
| | | | | | | |
| B | −11.226534 | S | | | | |
| | | | | | | |
| Q | | $S^2$ | | | | |
| | | | | | | |
| $\tilde{U}$ | −89.937478 | $S^3$ | | | | |

$G = -7.175296$ $C^2 = 20.953641$ $\rho_c$ 93.711619

$\frac{C^2}{G} = 28.128937$ $\frac{C^4}{G} = -49.082578$ $c^2\rho_p$ 114.665260

| | G | F | $\frac{F}{L^2}$ Ep PRESSURE | | | + Gp | Ep+Gp |
|---|---|---|---|---|---|---|---|
| | GRAV | $MC^2/L$ | $PC^2$ | P | $\frac{C^4}{G} + F$ | GRAV / $L^2$ | |
| U | 42.320136 | 45.701358 | −10.163597 | −31.117238 | $(\alpha\mu)^{-3}$ | −13.544820 | −23.708917 |
| | $(\alpha\mu)^2$ $(\alpha\mu)^3$ | $(\alpha\mu)$ | $\Delta$0 .329 | .329 | | | |
| ☆ | 44.574284 | 46.828434 | +31.446022 | 10.492381 | $(\alpha\mu)^{-2}$ | 29.191874 | 60.637896 |
| | $(\alpha\mu)^2$ | | | | | | |
| D | | | | | | | |
| | | | | | | | |
| P | | | | | | | |
| | | | | | | | |
| B | | | | | | | |
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| | | | | | | |
|---|---|---|---|---|---|---|
| | | $M/LT^2$ | $\Delta s$ | $(\alpha\mu)^2 S$ | | |
| | | | | $= 41.609619$ | | |
| U | | $-10.163599$ | | | | |
| | | | | | | |
| A | | | $41.609610$ | $(\alpha\mu)^2 S$ | | |
| | | | | | | |
| S | | $31.446011$ | | | | |
| | | | $41.609629$ | $(\alpha\mu)^2 S$ | | |
| D | | $73.055640$ | | | | |
| | | | $41.609621$ | $(\alpha\mu)^2 S$ | | |
| P | | $114.665261$ | | | | |
| | | | $79.838017$ | $\approx (\alpha\mu) S^2$ | | |
| B | | $34.827244$ | | | | |
| | | | | $(\alpha\mu) S^2 =$ | | |
| Q | | | | $79.838016$ | | |

Note change: $(\alpha\mu)^2 S \rightarrow (\alpha\mu) S^2$

| $\frac{Grav}{L^2}$ | | M<br>MASS | L<br>LENGTH | V<br>VOLUME | $\rho$ = M/V<br>DENSITY | $Mc^2$<br>ENERGY | $\rho c^2$<br>E/V | $\frac{ML}{T^2}$<br>FORCE | $\frac{GM^2}{L^2}$<br>GRAVITY | L/c<br>TIME | $\frac{EL^2}{V} = \frac{ML}{T^2}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -13.54482 | **U** | 52.680194 | 27.932478 | 83.797434 | -31.117240 | 73.633835 | -10.163599 | 45.701358 | 42.320136 | 17.455657 | 45.701357 |
| -2.364 | **X** | 48.011892 | 22.788283 | 68.364849 | -20.352957 | 68.965533 | 0.600604 | 46.177251 | 43.271922 | 12.311462 | |
| 29.191834 | **S** | 33.565995 | 7.691205 | 23.073615 | 10.492360 | 54.519616 | 31.445961 | 46.828412 | 44.574244 | -2.785616 | 46 |
| 71.928518 | **D** | 14.451796 | -12.550068 | -37650204 | 52.102 | 35.405437 | 73.055641 | 47.955605 | 46.828432 | -23.026888 | |
| 114.665259 | **P** | -4.662404 | -32.791341 | -98.374023 | +93.711619 | 16.291237 | 114.665260 | 49.082577 | 49.082578 | -43.268161 | 49.082 |
| | **B** | -23.776602 | -12550068 | | | | | | | | |
| | **Q** | | | | | | | | | | |
| | **Y** | | | | | | | | | | |
| | **Ū** | | | | | | | | | | |
| alt -3.182 | X | 48.041956 | 23.022796 | 69.068388 | -21.026432 | 68.995597 | 0.072791 | 45.972802 | 42.863624 | 12.545975 | |
| | | | | | | | | | | | |

DIMLANG.WPD

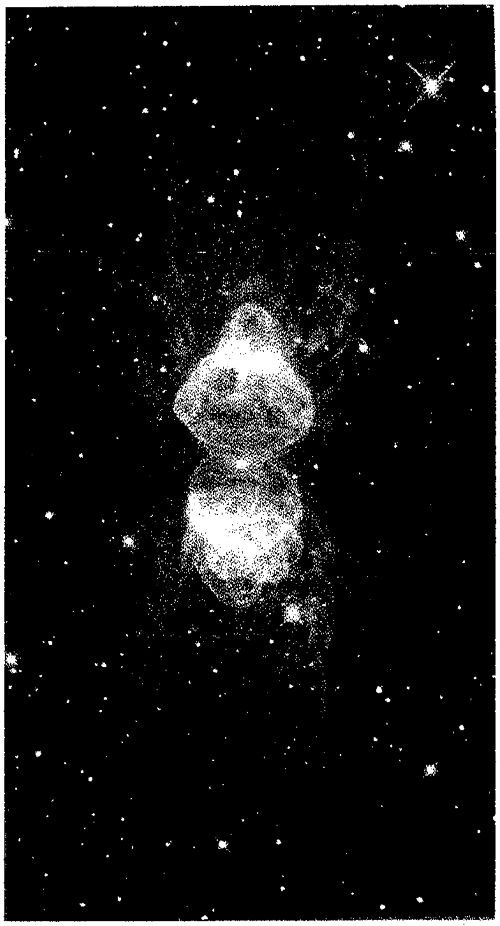
3 - 8 - 11

| NAME | M, L, T | BARYON | PLANCK | C, G, $\hbar$ | P − B ~~(B − P)~~ | P − B ~~(B − P)~~ |
|---|---|---|---|---|---|---|
| DIMENSIONALITY | | # | # | | # | $\alpha\mu$, S |
| MASS | M | −23.776602 | −4.662404 | $\left(\frac{\hbar c}{G}\right)^{1/2}$ | 19.114198 | $\left(\frac{S}{\alpha\mu}\right)^{1/2}$ |
| LENGTH | L | −12.550068 | −32.791341 | $\left(\frac{G\hbar}{c^3}\right)^{1/2}$ | 20.241273 | $(\alpha\mu S)^{1/2}$ |
| TIME | T | −23.026889 | −43.268162 | $\left(\frac{G\hbar}{c^5}\right)^{1/2}$ | 20.241273 | $(\alpha\mu S)^{1/2}$ |
| FORCE | $ML/T^2$ | +9.727107 | +49.082578 | $c^4/G$ | 39.355471 | S |
| ENERGY | $ML^2/T^2$ | −2.822961 | +16.291237 | $\left(\frac{c^5\hbar}{G}\right)^{1/2}$ | 19.114198 | $\left(\frac{S}{\alpha\mu}\right)^{1/2}$ |
| POWER | $ML^2/T^3$ | 20.203928 | +59.559399 | $c^5/G$ | 39.355471 | S |
| AREA | $L^2$ | −25.100136 | −65.582682 | $\frac{G\hbar}{c^3}$ | 40.482546 | $\alpha\mu S$ |
| VOLUME | $L^3$ | −37.650204 | −98.374023 | $\left(\frac{G\hbar}{c^3}\right)^{3/2}$ | 60.723819 | $(\alpha\mu S)^{3/2}$ |
| MASS DENSITY | $M/L^3$ | +13.873602 | 93.711619 | $c^5/G^2\hbar$ | 79.838017 | $S^2(\alpha\mu)$ |
| ENERGY/VOLUME FORCE/AREA | $M/LT^2$ | +34.827243 | 114.665260 | $c^7/G^2\hbar$ | 79.838017 | $S^2(\alpha\mu)$ |

# NOVO COSMO

COSVAJRA.WPD APRIL 9, 2001

# COSMIC VAJRAS



Nebula PK 331-1.1 in Norma

Nebula M2-9

HUBBLE SPACE TELESCOPE

# BRAHMAN

*When Brahma created the universe, Brahma posited Brahman, the Theme upon which all subsequent creation was to be based. Brahma knew the Alpha, the beginning and Omega, the ending of the Theme. But what Brahma did not know, and why he made Brahman, was to find out all the possible variations that could occur within the Theme. When the Theme and all the occurring variations have been played, then Brahma will create a new Theme. And on and endlessly on.*

We observe, experience, and create variations on Brahma's Theme, but we only have glimpses of the Theme itself. Mostly the glimpses come to us when we encounter a limit or a boundary. These limits tell us what can and cannot exist within the Theme. From our customary way of organizing experience, we are most likely to interpret the Theme in terms of vector–like elements and the rules by which they are to be combined. Where by **vector** is meant an element possessing both a magnitude [scale] and a direction [dimensionality].

Physics suggests that a probable set of elemental vectors would include:

$\hbar$, Planck's constant; **G**, Newton' gravitational constant; **c**, the velocity of light; and **S**, the electric/gravitation force ratio. The dimensionalities of these are:

$[\hbar] = [MR^2/T]$ ; $[G] = [R^3/MT^2]$ ; $[c] = [R/T]$ ; $[S] = [1]$ (i.e. dimensionless)

{Refinements may require the inclusion of $\alpha$, the fine structure constant, and $\mu$ the proton/electron mass ratio. Both are dimensionless.)

Two limits are held to be valid:[1]

1) The Einstein limit: All velocities are less than the velocity of light, $v \le \mathbf{c}$

2) The Heisenberg limit: The product of time and energy must be greater than the Planck constant. $E \times T > \hbar$ Or the product of momentum and position must be greater than the Planck constant. This is at root the "uncertainty principle".

From the Einstein limit may be derived two other limits: (numerical values are $\log_{10}$ )

Force: The maximum possible force has the value $\mathbf{c}^4/\mathbf{G}$ $[MR/T^2]$ = 49.082989 dynes

Power: The maximum possible power has the value $\mathbf{c}^5/\mathbf{G}$ $[MR^2/T^3]$ = 59.559810 watts[2]

These are predicated on the presumption that all velocities are < **c**, but may be formally derived. From 2) and the power limit, $\mathbf{c}^5/\mathbf{G}$, may be derived $T > \sqrt{(\hbar G/c^5)}$ = - 43.268366 seconds, which is the Planck time. Or for frequencies, $\nu < 43.268366$ hertz

[1]Also there is the Schwarzschild bound: $M/R = c^2/G$, more a watershed than a limit.

[2] The peak bolometric luminosities of supernovae have been observed to have a value close to this amount.

# The Meditations of Nagarjuna

*First, if there be but one value of an attribute, then that attribute ceases to exist. Second, if an entity has but a single attribute, then that entity ceases to exist.*

Consider the Planck Particle and its attributes of energy, force, extension, time, and mass.

What are the energies of the Planck particle?

There is $m_o c^2 = 16.291442$
There is $Gm_o^2/l_o = 16.291442$
There is $\hbar\nu = 16.291442$
There is $e^2/\alpha l_o = 16.291442$
There is $(\hbar c^5/G)^{1/2} = 16.291442$

According to the first proposition, since there is but one value for the attribute energy, the Planck particle does not possess energy.

What are the forces of the Planck particle?

There is $m_o c^2/l_o = 49.082989$
There is $Gm_o^2/l_o^2 = 49.082989$
There is $\hbar\nu/l_o = 49.082989$
There is $e^2/\alpha l_o^2 = 49.082989$
There is $c^4/G = 49.082989$

Again, since there is but one value for the attribute force, the Planck particle does not possess the attribute force.

Energy/Force = Extension. For each energy and every force, the quotient is $= -32.791547 = l_o$
It follows from the first proposition that the Planck particle does not possess the attribute size.

What are the times [or frequencies] of the Planck particle?

| | |
|---|---|
| There is $l_o/c = -43.268366$ | There is $(l_o^3/Gm_o)^{1/2} = -43.268366$ |
| There is $Gm_o/c^3 = -43.268366$ | There is $\hbar/m_o c^2 = -43.268366$ |
| There is $\hbar l_o/Gm_o^2 = -43.268366$ | There is $(m_o l_o^3/\hbar c)^{1/2} = -43.268366$ |
| There is $m_o l_o/\hbar = -43.268366$ | There is $G\hbar/l_o c^4 = -43.268366$ |
| There is $G^2 m_o^2/l_o c^5 = -43.268366$ | There is $(G\hbar/c^5)^{1/2} = -43.268366$ |

By the first proposition, the Planck particle does not possess the attribute time or frequency.

All Forces, $ML/T^2$, are identical; all extensions, L, are identical; all times, T, are identical; therefore all masses, M, are identical. If all masses are identical then by the first propostition the Planck particle does not possess mass. By similar arguments, the Planck particle does not possess density, power, or charge.

The Planck particle does not possess any of the attributes: Energy, Force, Size, Time, Mass, Density, Power, Charge. What attributes then does it have? If only one attribute, then by the second proposition, the Planck particle does not exist. If no attributes at all, then it "doubly" does not exist!.

# METACOSMOLOGY
## THE EDDINGTON-DIRAC NUMBERS

In honor of Eddington the reciprocal of the fine structure constant, whose value is 137.03559, will be called E, and in honor of Dirac the ratio of Coulomb to gravitational forces, whose value is 2.269239 x 10^39 will be called D.

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**NOTATION:**
The following notation will be used for exponents and hyper-exponents:

$a^b$ will be written a^b. $\qquad$ $a^{b^c}$ will be written a^(b^c)

Instead of having to write parentheses, an alternate notation for hyper-exponents can be used:

a^(b^c) can be written a ~ b^c or a ~ b ~ c

In general ^ is calculated left to right and ~ from right to left.

Examples:

a^a^a^a^a = a ~ a^4 $\quad$ and $\quad$ a ~ a ~ a ~ a = a^(a^(a^a))

A short hand for a^a^a^a^a will be a"^5 and for a ~ a ~ a ~ a will be a" ~ 4

Some formulae:

n ~ n ~ n = n"^(n+1) $\qquad$ (n^n)^(n^n) = n"^(n+2)

Exercise:

If H = 4 ~ 4^4^4 $\quad$ find x for H = 4"^x.

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2003 #7

BMATRIX1.WPD

# THE BARYON MATRIX

This matrix is derived from the TIME MATRIX, [T] = 1, by substituting the value of the proton mass, $m_p$ = -23.776602 for M, and the value of the electron radius, $r_e$ = -12.550068, for R. The table gives the values in Planck units. All entries are dimensionless quantities. To convert to time in seconds multiply entries by the Planck time, $t_o$ = –43.268366. S is the ratio of coulomb force to gravitation at the baryon level, = 39.355880. α is the fine structure constant = –2.136835. μ is the ratio of proton mass to electron mass = 3.263909 All quantities are given as $\log_{10}$ values.

| | -0.5 | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
|---|---|---|---|---|---|---|---|---|
| 3 | | $(\alpha\mu/S)^{3/2}$ | | $(\alpha\mu)^2/S$ | | $(\alpha\mu)^{5/2}/S^{1/2}$ | | $(\alpha\mu)^3$ |
| 2.5 | $\alpha\mu/S^{3/2}$ | | $(\alpha\mu)^{3/2}/S$ | | $(\alpha\mu)^2/S^{1/2}$ | | $(\alpha\mu)^{5/2}$ | |
| 2 | | $\alpha\mu/S$ | | $(\alpha\mu)^{3/2}/S^{1/2}$ | | $(\alpha\mu)^2$ | | $S^{1/2}(\alpha\mu)^{5/2}$ |
| 1.5 | $(\alpha\mu)^{3/2}/S$ | | $\alpha\mu/S^{1/2}$ | | $(\alpha\mu)^{3/2}$ | | $S^{1/2}(\alpha\mu)^2$ | |
| 1 | | $(\alpha\mu/S)^{1/2}$ | | $\alpha\mu$ | | $S^{1/2}(\alpha\mu)^{3/2}$ | | $S(\alpha\mu)^2$ |
| 0.5 | $1/S^{1/2}$ | | $(\alpha\mu)^{1/2}$ | | $S^{1/2}\alpha\mu$ | | $S(\alpha\mu)^{3/2}$ | |
| 0 | | 1 | | $(S\alpha\mu)^{1/2}$ | | $S\alpha\mu$ | | $(S\alpha\mu)^{3/2}$ |
| -0.5 | $1/(\alpha\mu)^{1/2}$ | | $S^{1/2}$ | | $S(\alpha\mu)^{1/2}$ | | $S^{3/2}\alpha\mu$ | |
| -1 | | $(S/\alpha\mu)^{1/2}$ | | S | | $S^{3/2}(\alpha\mu)^{1/2}$ | | $S^2\alpha\mu$ |
| -1/5 | $S^{1/2}/\alpha\mu$ | | $S/(\alpha\mu)^{1/2}$ | | $S^{3/2}$ | | $S^2(\alpha\mu)^{1/2}$ | |
| -2 | | $S/\alpha\mu$ | | $S^{3/2}/(\alpha\mu)^{1/2}$ | | $S^2$ | | $S^{5/2}(\alpha\mu)^{1/2}$ |
| -2.5 | $S/(\alpha\mu)^{3/2}$ | | $S^{3/2}/\alpha\mu$ | | $S^2/(\alpha\mu)^{1/2}$ | | $S^{5/2}$ | |
| -3 | | $(S/\alpha\mu)^{3/2}$ | | $S^2/\alpha\mu$ | | $S^{5/2}/(\alpha\mu)^{1/2}$ | | $S^3$ |

2003 #8

BMATRIX2.WPD

# THE BARYON MATRIX

This matrix is derived from the TIME MATRIX, [T] = 1, by substituting the value of the proton mass, $m_p$ = -23.776602 for M, and the value of the electron radius, $r_e$ = -12.550068, for R. The table gives the values in Planck units. All entries are dimensionless quantities. To convert to time in seconds multiply entries by the Planck time, $t_o$ = –43.268366. S is the ratio of coulomb force to gravitation at the baryon level, = 39.355880. $\alpha$ is the fine structure constant = –2.136835. $\mu$ is the ratio of proton mass to electron mass = 3.263909 All quantities are given as $\log_{10}$ values.

| | -3 | -2.5 | -2 | -1.5 | -1 | -0.5 | 0 | 0.5 |
|---|---|---|---|---|---|---|---|---|
| 3 | $1/S^3$ | | $(\alpha\mu)^{1/2}/S^{5/2}$ | | $\alpha\mu/S^2$ | | $(\alpha\mu/S)^{3/2}$ | |
| 2.5 | | $1/S^{5/2}$ | | $(\alpha\mu)^{1/2}/S^2$ | | $\alpha\mu/S^{3/2}$ | | $(\alpha\mu)^{3/2}/S$ |
| 2 | $1/(S^5\alpha\mu)^{1/2}$ | | $1/S^2$ | | $(\alpha\mu)^{1/2}/S^{3/2}$ | | $\alpha\mu/S$ | |
| 1.5 | | $1/(S^4\alpha\mu)^{1/2}$ | | $1/S^{3/2}$ | | $(\alpha\mu)^{1/2}/S$ | | $\alpha\mu/S^{1/2}$ |
| 1 | $1/(S^2\alpha\mu)$ | | $1/(S^3\alpha\mu)^{1/2}$ | | $1/S$ | | $(\alpha\mu/S)^{1/2}$ | |
| 0.5 | | $1/(S^{3/2}\alpha\mu)$ | | $1/(S^2\alpha\mu)^{1/2}$ | | $1/S^{1/2}$ | | $(\alpha\mu)^{1/2}$ |
| 0 | $1/(S\alpha\mu)^{3/2}$ | | $1/(S\alpha\mu)$ | | $1/(S\alpha\mu)^{1/2}$ | | 1 | |
| -0.5 | | $1/[S(\alpha\mu)^{3/2}]$ | | $1/(S^{1/2}\alpha\mu)$ | | $1/(\alpha\mu)^{1/2}$ | | $S^{1/2}$ |
| -1 | $1/[S(\alpha\mu)^2]$ | | $1/[S(\alpha\mu)^3]^{1/2}$ | | $1/\alpha\mu$ | | $(S/\alpha\mu)^{1/2}$ | |
| -1/5 | | $1/[S^{1/2}(\alpha\mu)^2]$ | | $1/(\alpha\mu)^{3/2}$ | | $S^{1/2}/\alpha\mu$ | | $S/(\alpha\mu)^{1/2}$ |
| -2 | $1/[S(\alpha\mu)^5]^{1/2}$ | | $1/(\alpha\mu)^2$ | | $S^{1/2}/(\alpha\mu)^{3/2}$ | | $S/\alpha\mu$ | |
| -2.5 | | $1/(\alpha\mu)^{5/2}$ | | $S^{1/2}/(\alpha\mu)^2$ | | $S/(\alpha\mu)^{3/2}$ | | $S^{3/2}/\alpha\mu$ |
| -3 | $1/(\alpha\mu)^3$ | | $S^{1/2}/(\alpha\mu)^{5/2}$ | | $S/(\alpha\mu)^2$ | | $(S/\alpha\mu)^{3/2}$ | |

# WHAT IS A UNIVERSE?

The usual concept of a universe is that entity which includes all that exists, with the additional property of possessing an overall interrelatedness among the parts that results in "oneness" of the whole. Apophatically, one could alternately say that outside the universe or besides the universe there is nothing. These same attributes are sometimes also assigned to the concept labeled God. Whether universe or God, it must be added that any entity with such attributes is totally alien to common experience.

But in our times the term universe has taken on different meanings and attributes. The term is one used by cosmologists and astronomers to refer to the totality of physical objects that exist, whether directly observable or inferred by theories. The attributes of totality and oneness have been maintained but restrictions are placed on the nature of the included objects. These are limited to those that possess some degree of physical energy, that is have mass, motion, and/or extension in some form or other. But while the concept of universe has retained its attributes of totality and oneness, the models used to describe the universe have evolved.

The Ancient idea of an earth centered universe consisting of a set of transparent spheres containing the planets or wanderers, culminating in a final sphere that contained the non-changing starry objects, has been modified time and again over the centuries. The center was moved to the sun, the starry sphere was replaced by three dimensional space filled with objects at various distances subsequently recognized as being other suns. More recently the universe became the Milky Way, billions of stars with the sun not even near the center, but orbiting planet like about the distant center with a period of some 200 million years. Then earlier in the present century came two radically major modifications. First that there were many galaxies, like but exterior to our milky way, and at greater distances than hitherto conceived. And second, these galaxies were all moving away from one another. If the ultimate physical denizens of the universe were galaxies, then the universe was expanding. Finally in recent decades it was observed that the universe was of a fractal nature, with the galaxies clustered and with the clusters themselves clustered, with great voids or gaps between the succesive orders of clustering.

Sometimes concept occurs before percept. Something is theoretically predicted then later observed. Such was the order of the arrival of black holes to the assemblage of known denizens of the universe. But these objects, informationally sealed off from their exteriors, challenge not only the traditional <u>models</u> of the universe but challenge the traditional <u>concept</u> of universe. It is now a completely new ballgame.

There is nothing in the foregoing three postulates that forbids the existence of more than two spaces. Another space that seems needed in order to fully explain the phenomenal universe is a space whose coordinates indicate the strength of the bonds or forces acting between entities. We shall here designate this SPACE as B-SPACE.

Consider an example: Competition between organisms increases with the degree of similarity between the organisms. The more alike they are the more competitive, that is, the higher the density in H-SPACE the greater the repelling force in B-SPACE. Contraction in H-SPACE leads to expansion or fragmentation in B-SPACE.

These examples show that there are relations between the internal happenings and conditions in one SPACE and what happens or is possible in another SPACE.

$$E^{R}_{n_1 \ldots n_k}(i \ldots t)$$

A universe traditionally consisted of all that existed, now it seems that a universe consists more properly of all that is informationally accessible. This idea leads to two views: a universe is all that is observable, or a universe is all that is knowable (by whatever means). The existance attribute must be abandoned. Kant long ago made similar distinctions, differentiating phenomena and noumena.

I. The phenomenal: experienced by the senses (or their instrumental extensions)

II. The quasi phenomenal: extrapolated from the phenomenal by rational or mathematical constructs.

III. The noumenal: exists, but is inaccessible to either our senses or our formal extrapolations. [An extrapolation of Gödel's results regarding axiomatic systems.]

[There is a curious dualism between the noumenal and human fantasy. The noumenal exists but is unknowable, fantasy does not exist but is knowable. It here becomes necessary to postulate orders of both knowledge and existence.] imagination + knowledge

levels

PYTHCOS2.WP6 April 4, 1997, June 29, 1997

# MORE PYTHAGOREAN COSMOLOGY

In the past few years many relations between the age and size of the universe and the properties of the elemental particles and fundamental constants of physics have been found leading some to hold that cosmology has now become a branch of particle physics. But that is a reductionist view. Mach would have it that particle physics should be taken as a branch of cosmology. Maybe it would be best that particle physics-cosmology should be a single discipline postponing for now the question of the direction(s) of causality.

In both particle physics and cosmology the fundamental constants, c,G and h, and the dimensionless numbers $\alpha,\mu$ and S appear in many equations. The so called 'Planck Particle' defined by the values of c,G and h when augmented by appropriate powers of $\alpha,\mu$ and S appears to determine the dimensions of many other entities in the universe from baryons to stars. Without extensive knowledge of the physical processes that may be occurring in the unfolding of the universe, we can see from the identity of certain numerical values alone that there is a profound interplay between the micro-micro and the macro-macro.

In studying these equations we must drop our historical biases of identifying these constants solely with the relationships in which they were first discovered. For example, the dimensionless constant, S, was first measured as the ratio of coulomb force to gravitational force. But the powers of $\sqrt{S}$ appear in so many non-force relations that S is likely to have cosmological functions other than those arising solely from being a particular force ratio.

Likewise we must be prepared to accept as canonical other parameters than those which we at present take to be basic. In Newton's day, energy, a parameter we now consider to be most fundamental had not yet been recognized. The history of physics shows an evolution of concepts toward the more general and inclusive: mass, Lagrangians, Hamiltonians, and in the present century charge, strangeness, color, beauty, etc. The path consists of continual re-entification and re-conceptualization.

67a

FIGRUND1.WP6 November 17, 1996

cf. 1996-61
1996-65

*THE UNIVERSE CONSISTS OF TWO LEVELS,*
*A FIGURE AND A GROUND.*

▸ The Ground is a vast vibratory system, like a complex drum, capable of vibrating in many modes. The spacings of its nodes are determined by the three dimensionless numbers: $\alpha$, $\mu$, and S where

$\alpha$ is the fine structure constant = 0.007297353
$\mu$ is the mass ratio proton to electron = 1816.152701
S is the ratio of the coulomb to the gravitational force, $= 2.269239 \times 10^{39}$

▸ The Figure is the material universe whose basic modules are action packets [dimensionsally = $ML^2/T$ ] defined by the fundamental constants: $\hbar$, c, and G where

$\hbar$ is Planck's constant $[ML^2/T] = 1.054573 \times 10^{-27}$ cgs
c is the velocity of light $[L/T] = 2.997925 \times 10^{10}$ cgs
G is Newton's constant $[L^3/MT^2] = 6.672599 \times 10^{-8}$ cgs

The action packet, sometimes called the Planck particle, has the values:

$m_p = 2.176710 \times 10^{-5}$ grams
$l_p = 1.616050 \times 10^{-33}$ centimeters
$t_p = 5.390560 \times 10^{-44}$ seconds

The interaction of these two levels creates a universe. Many figures are possible with the same Ground. However, what actually occurs depends on the values of the constants $\hbar$, c, and G. The vibratory system which supports various dynamics may also be alterable, but whatever its structure, it provides the "theme" within whose template all "variations on the theme" take place.

Since material existence occurs at the nodes, the organization of the action modules and their transforms is governed by the locations of the nodes. The largest net of nodes is set by S or $\sqrt{S}$, giving a "fractal" structure to the universe. Small scale nets are determined by $\alpha$ and $\mu$ in various combinations. These several nets of nodes provide many templates by means of which all possible material entities are formed.

The two levels involved are those of the templates and those of the packets. These levels constitute a basic dualism underlying the universe. What can occur is defined by the Ground, what does occur is open but infected with what has already occurred. But beyond the necessity of this dualism lies the question of its sufficiency. Is a third element required to make it happen?

SOME SUPPLEMENTARY INPUTS:

- A dynamic sub-system of the cosmos evolves so as to maximize its options and potentialities. This evolution is counter to the second law of thermodynamics. cf. Gurdjieff's Cosmogony 1995 #25
- The cutting edge of such an evolving system gravitates toward a region rich in alternatives, resulting in existence occurring where the density of alternate possibilities is a maximum. (usually at some interface or interstice) (How does this jibe with matter occurring at nodes?)
- The universe does not march to the beat of a single drummer. The clock rate at any locality varies inversely with the square root of the local density. Change or evolution is most rapid where the mass density is greatest.
- The world consists of many facets (or domains) separated by fault lines (~ nodes?) These facets are multiplexed in many ways across the fault lines (boundaries)

Metaphor of drum head

- What evolves is the result of the interplay of homogenizing forces (such as gravity and the 2nd Law of thermodynamics) with a general uniqueness principle. Either emergence, complexity, organization occurs or extinction ensues.

Is the inflationary universe explicable alternatively by a time rate of change?

Pythagoras and Planck

Back at the beginning of the present age around 600 B.C.E. Pythagoras felt that the natural integers themselves should suffice for constructing the universe. He was set back and dismayed when real numbers like $\sqrt{2}$ intervened. Even before his death the continuum of real numbers began to take over and prevailed until the beginning of the 20th century. Then at the beginning of the present age, Max Planck found that discreteness must be re-introduced. The continuum had failed. Pythagoras was justified when Planck showed that basic physical realtionships were governed by discrete, not contiuous, quantities. Of course, Pythagoras' misinterpretation was that it was the integers themselves that sufficed, when it was discreteness, one of the properties of the integers that was the essence. Today as digital replaces analog, Pythagoras is firmly back in business.

Sometimes many centuries intervene between the writing of the first sentence in a worldview and the writing of the second, with many by-paths being explored in the while. Today it might be possible to add to what Pythagoras began since there have been several contributions to his approach in recent years. It is fair to call such modern natural philosophers as Planck, Eddington and Dirac followers of Pythagoras, since parts of their work are clearly "Pythagorean". They have taken number to be the starting place of ultimate reality.

Today's Pythagoreanism begins with the so-called fundamental constants of physics. We might say that in the beginning God created the numbers h,G,and c, and from them all else follows. If the constants had had different values, then our universe would have been different. In fact we might not have even been here to contribute the consciousness feedback that gives the universe one of its modes of existence. In addition to re-introduction of the discrete, Planck took the fundamental constants, h,G, and c and using dimensional analysis derived a system of "natural units" with which to describe the universe. When translated into these units relations between the masses, sizes, and life times of physical entities were seen to reveal symmetries and patterns that bring to mind Pythagoras' own constructions of musical tones and their harmonics.

The dimensionalities that physicists feel best describe most phenomena are mass M, length L, and time T. Each of the fundamental constants possesses a dimensionality built up from these factors:

$$[h] = [ML^2/T],\ [G] = [L^3/(MT^2)],\ [c] = [L/T].$$

By suitably combining the fundamental constants, Planck defined units of mass, length, and time. In terms of cgs units the logarithms to base ten of these values are:

Planck mass = -4.263110 grams
Planck length = -32.392455 centimeters
Planck time = -42.869276 seconds

In Planck units, the values of h, G, and c are each 1.

# MUSIC OF THE SPHERES

It has been shown that the basic frequency associated with the Hubble universe is given by,

$$\nu_U = (\alpha\mu S)^{-3/2} / t_o$$

where $t_o$ is the Planck time, $\alpha$ is the fine structure constant, $\mu$ is the proton/electron mass ratio, and S is the coulomb/gravity force ratio. The wavelength associated with this frequency is

$$\lambda_U = c / \nu_U = (\alpha\mu S)^{3/2} l_o = 10^{27.932889}\,\text{cm}$$

where $l_o$ is the Planck length = $10^{-32.791545}$ cm. The sizes and masses of various objects, from sub-atomic particles to clusters of galaxies, are given as sub-harmonics in the following table. (Values are $\log_{10}$) ; (3m = 2n)

| # | n | $(\alpha\mu S)^n$ | m | $\lambda^m = (\alpha\mu S)^n l_o$ cm | $M = c^2/G\,\lambda^m$ gm |
|---|---|---|---|---|---|
| 1 | 3/2 | 60.724434 | 1 | 27.932889 | 56.062236 |
| 2 | 5/4 | 50.603694 | 5/6 | 17.812149 | 45.941496 |
| 3 | 6/5 | 48.579547 | 4/5 | 15.788002 | 43.917349 |
| 4 | 9/8 | 45.543324 | 3/4 | 12.751779 | 40.881126 |
| 5 | 1 | 40.482955 | 2/3 | 7.691410 | 35.820757 |
| 6 | 9/10 | 36.434660 | 3/5 | 3.643115 | 31.772456 |
| 7 | 3/4 | 30.362217 | 1/2 | -2.429328 | 25.700019 |
| 8 | 3/5 | 24.289773 | 2/5 | -8.501772 | 19.627575 |
| 9 | 1/2 | 20.241477 | 1/3 | -12.550068 | 15.579261 |
| 10 | 0 | 0 | 0 | -32.791545 | -4.662198 |

Notes:

- The values in the mass column are given by two equations, $\lambda^m c^2/G$ or $(\alpha\mu S)^n m_o$ => $Gm_o/\lambda^m c^2 = (\alpha\mu S)^{-n}$

- As in music, the even harmonics are repetitive while the odd harmonics represent innovations. Thus "octave" frequencies are not likely to manifest, only odd harmonics may support existence.

- Row 1. The values in this row are those of the Hubble universe. The fundamental wave length of 27.932889 cm is based on the characteristic time 17.456057 sec which is corresponds to a value of the Hubble parameter of 71.977 km/sec/mpc.

- Row 2. One light year = 17.975932 cm. This object is close to 1 l.y. in size (all sizes are those of Schwarzschild radii) and has a mass of 12.642 solar masses. (One solar mass = 33.299 gm) This mass suggests a galaxy.

- Row 3. Size is of the order of 100 astronomical units (1 A.U. = 13.174927 cm) Mass is of the order of $10^{10}$ solar masses. Globular cluster?

- Row 4. This value of $\lambda$ is close to the minor axis of the orbit of Mercury, which is equal to 12.753373. Apophasis involved here?

- Row 5. The value of $\lambda$ in this row is of the order of the size of a neutron star. Mass is of the order of 100 solar masses.

- Row 6. Size < a kilometer, mass ~ earth like. Dark matter candidate?

- Row 7. An "octave"; probably non existant.

- Row 8. This value of $\lambda$ approximates that of the Bohr radius, $a_o$=-8.276399

- Row 9. This value of $\lambda$ is precisely equal to that of the electron radius, $r_e$. The value of the mass is anomalistic.

- Row 10. This is the Planck particle with $m_o\lambda = \hbar/c$ and $m_o/\lambda = c^2/G$.

# A

# **COSMOLOGICAL**

# TEMPLATE

PYTHCOSM.WP6 October 24, 1995

# A PYTHAGOREAN COSMOLOGY

The relatavistic potential bound dividing "ordinary" matter from the nether world of black holes, known as the Schwarzschild Limit is given by,

(1) $$\frac{GM}{Rc^2} \leq 1$$

where M is mass, R is extension, G is the Newtonian constant, and c is the velocity of light. This boundary marks the value at which the gravitational energy of a body, $GM^2/R$, is equal to its total energy, $Mc^2$; and where the gravitational radius, $GM/c^2$, is equal to the metric radius, R. Equation (1) says that the gravitational energy is always less than or equal to the total energy. However, on the 'black hole side' of the boundary we have the paradox that the gravitational energy can exceed the total energy. This 'paradox' results from the somewhat chauvinistic use of the term total, rather than from the physics itself. If in the early stages of the evolution of the universe the ambient conditions are on the high potential side of equation(1), then the principle of conservation of energy would properly refer to the conservation of gravitational energy, $GM^2/R$, rather than to the conservation of total energy, $Mc^2$.

The following scenario is based on the principle of the conservation of gravitational energy:
Step 1. Postulate the initial condition of the existence of a single particle, $\Omega$, having a mass, $M_\Omega$, and a spatial extension $R_\Omega$.
Step 2. The $\Omega$ particle fragments into $N_1$ Planck particles while conserving gravitational energy.
Step 3 Each of the $N_1$ planck particles fragments into $N_2$ baryons, again conserving gravitational energy.
The resulting $N_1 x N_2$ baryons constitutes the matter in the present Hubble universe.

**In the following all numbers are the $\log_{10}$ values.**
We proceed by running the scenario backwards. The Hubble universe is assumed (with Eddington) to have a mass equivalent to that of $S^2$ or 78.711760 baryons = 54.935158 grams. This provides us with the end value,

(2) $$N_1 \times N_2 = S^2$$

The gravitational energy of a Planck particle is 16.690530 ergs; the gravitational energy of a proton is -42.178435 ergs. If gravitational energy is conserved, then one Planck particle can fragment into $N_2$ = 58.868965 (= $7.401538 \times 10^{58}$) baryons. Knowing $N_2$ we can now calculate $N_1$ from equation (2), $N_1 = S^2/N_2$ , which gives $N_1$ = 19.842387 (= $6.9561 \times 10^{19}$) baryons. We note that

$N_1 = k^{-1}S^{1/2}$ and $N_2 = kS^{3/2}$, where $k=\sqrt{(2\pi/\alpha\mu)}$.
Continuing backwards in time, we next follow the metamorphosis of a Planck particle into baryons. A single Planck particle under conservation of gravitational energy becomes 58.869373 baryons, each with a mass of -23.776604 grams. The total mass of all the baryons created will be 35.092718 grams. Converting to solar masses, [1 solar mass = 33.288 grams], this value is equal to $10^{1.805}$ or 63.8 solar masses, which is closely the maximum observed value for the mass of stars. We may hence conclude that each Planck particle metamorphizes into a proto-star, and that there can then be at least $N_1$ or 19.842387 stars in the universe.

Since we have already determined the value of $N_1$, we can now go to step 1) and derive the properties of the $\Omega$ particle. The gravitational energy of a single Planck particle is 16.690530 ergs, hence the total gravitational energy of $N_1$ Planck particles is 36.532880 ergs. This is the value of $GM_\Omega^2/R_\Omega$. However, a second condition is needed to isolate the values of $M_\Omega$ and $R_\Omega$. Here we can make some choices: For one, suppose we invoke symmetry. A Planck particle in metamorphizing to baryons goes from the Schwarzschild Limit, $M/R = c^2/G = 28.129308$ to $m_p/r_e = -11.226536$; a total shift in potential of 39.355881, which is numerically equal to S. If we assume that the shift in potential from the $\Omega$ particle to the Planck particle is also equal to S, this would give $M_\Omega/R_\Omega = 67.485226$ for the $\Omega$ particle. We now have the two equations,

$$\text{(3)} \qquad \frac{GM^2}{R} = g \quad \text{and} \quad \frac{M}{R} = p$$

where g = 36.532917 and p = 67.485226, whose solutions are,

$$\text{(4)} \qquad M = \frac{g}{Gp} \quad \text{and} \quad R = \frac{g}{Gp^2}$$

giving $M_\Omega = -23.776604$ grams and $R_\Omega = -91.261830$ cm. We note that the $\Omega$ particle has the same mass as the proton!

Recapitulating: In stage 1) the $\Omega$ particle of mass -23.776604 g metamorphizes under conservation of gravitational energy to $N_1 = 19.842387$ Planck particles, with a total mass of 15.579239 grams. In stage 2) each of the 19.842387 Planck particles of mass -4.263125 grams, metamorphizes under conservation of gravitational energy to $N_2 = 58.869322$ baryons which is equal to a stellar mass of 35.092718 grams or $63\odot$. This leads to the present Hubble universe of $N_1 x N_2 = 78.711686$ baryons with a total mass of 54.935082 grams.

The first method of designating an $\Omega$ particle derived from the proportion,

$$\frac{\left(\frac{M}{R}\right)_{\Omega}}{\left(\frac{M}{R}\right)_{PL}} = \frac{\left(\frac{M}{R}\right)_{PL}}{\left(\frac{M}{R}\right)_{p}} = S \tag{5}$$

This approach led to the values $M_\Omega = m_p = -23.776604$ grams and $R_\Omega = -91.261830$ cm.

A second approach to the designation of $\Omega$, which we will here designate with the symbol, $\omega$, derives from equating the value of MR to that of $GM^2/R$. This gives us the equations,

$$MR = \frac{GM^2}{R} = 36.532880 \tag{6}$$

from which we derive $R_\omega = 9.785738$ and $M_\omega = 26.747142$

The scenarios for both the particle $\Omega$, or the particle $\omega$, have first, metamorphizing into $N_1 = k^{-1}S^{1/2}$ Planck particles. Each Planck particle then metamorphizes into $N_2 = kS^{3/2}$ baryons. The end result is a universe of $N_1N_2 = S^2$ baryons. It is to be noted that $kS^{3/2}$ baryons is the maximum stellar mass and that the mass of $\Omega$ is the same as that of a baryon. The gravitational energy of the $\Omega$ particle and the $\omega$ particle is in both cases 36.532917 which is symmetric to the gravitational energies of the Planck particle = -36.655565 = h/c and the proton = -36.326672 = $k^{-2}$h/c.

PYTHCOSM.WPD DECEMBER 22, 2000

# PYTHAGOREAN COSMOLOGY

*Ultimate reality is number –Pythagoras*

> What is the Pythagorean power with which number holds sway above the flux?
> —Bertrand Russell

The "*Pythagorean*" approach to cosmology is predicated on the existence of a template that prescribes and proscribes what can and cannot physically exist. While the template tells what can and cannot be, it does not specify what actually is or will be. What is actualized, [reality], is but a sub-set of the set of what is possible. In this sense, the template bears the same relation to the actual cosmos that mathematics does to physics or in a general sense that software does to hardware. Moreover, this template not only describes the bounds or eigen-values of existence, but what processes and forces can or cannot exist. That is, it speaks both to **being** and to **becoming**.

In the Pythagorean approach the values of fundamental constants, such as G, c, and h, are assumed to be constants and are taken as a basic part of the template, number itself being the ur-basis of the template. [Hence, the label, *Pythagorean*.] However, there are several non-numerical supplementary assumptions regarding the structure of the template. These include certain symmetries between the "inside" and "outside" of every entity, especially the symmetry of mutual containment. In the outer order the whole [universe] contains all of the parts, while the inner of each part contains the entire outer order. [Similar to the phenotype containing all constituent cells and each cell containing the genotype of the phenotype.] [1] In addition it is assumed that the universal inner order contains a clock or zeitgeber that provides coherence among all entities. The inner order also contains a set of injunctions or a program that governs the changes taking place in and by each part.

One feature of the template approach is that it avoids the "horizon problem", how there can be coherence and uniformity without duplex communication. In all changes, entities follow built in injunctions rather than requiring exchanges such as the interaction of forces. Action at a distance is due to the each entity following its internal program. And this program is common to all entities, being updated through access to the shared or common internal template. The changes in the cosmos are thus like the coordinated movements of flocks of birds or schools of fish which depend on the internal programming of each entity rather than on explicit communication between them.

The fallacy in the Pythagorean approach is that our physical and mental processes, being conditioned by a particular limited set of experiences, are incapable of ~~modeling~~ such a template.
accepting

[1] The universe and all its parts is similar to what Bohm called the 'explicate order', and the common inner, the template, is like his 'implicate order'.

Redo using th

# A PYTHAGOREAN COSMOGRAPHY

| | R | M | M/R | MR | $GM^2/R$ | $GM/c^2$ | $GM/c^2R$ |
|---|---|---|---|---|---|---|---|
| $\Omega$ | -91.261830 | -23.776604 | 67.485226 | -115.038434 | 36.532917 | -51.905951 | 39.355889 |
| $\omega$ | 9.785738 | 26.747142 | 16.961404 | 36.532880 | 36.532841 | -1.382205 | -11.167943 |
| PL(h) | -32.392455 | -4.263110 | 28.129345 | -36.655565 | 16.690530 | -32.392457 | 0 |
| p | -12.550068 | -23.776602 | -11.226534 | -36.326670 | -42.178435 | -51.905949 | -39.355881 |
| $\Omega$ | | $m_p$ | | | | | S |
| $\omega$ | | | | | | | |
| PL(h) | $\sqrt{(Gh/c^3)}$ | $\sqrt{(hc/G)}$ | $c^2/G$ | h/c | | $\sqrt{(Gh/c^3)}$ | $S^0$ |
| p | $r_e$ | $m_p$ | | $k^{-2}h/c$ | | | $S^{-1}$ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $\Omega$/PL | -58.869375 | -19.513494 | 39.355881 | -78.382869 | 19.842387 | -19.513494 | 39.355889 |
| $\Omega$/p | -78.711762 | 0 | 78.711760 | -78.711764 | 78.711352 | 0 | 78.711770 |
| $\omega$/PL | 42.178193 | 31.010252 | -11.167941 | 0.122685 | 19.842311 | 31.010252 | -11.167943 |
| PL/p | -19.842387 | 19.513492 | 39.355879 | -0.328895 | 58.868965 | 19.513492 | 39.355881 |
| $\Omega$/PL | $k^{-1}S^{-3/2}=N_2$ | $k^{-1}S^{-1/2}$ | S | $k^{-2}S^{-2}$ | $k^{-1}S^{1/2}$ | $k^{-1}S^{-1/2}$ | S |
| $\Omega$/p | $S^{-2}$ | $S^0$ | $S^2$ | $S^{-2}$ | $S^2$ | $S^0$ | $S^2$ |
| $\omega$/PL | | | | | $k^{-1}S^{1/2}$ | | |
| PL/p | $kS^{-1/2}=N_1$ | $kS^{1/2}$ | S | $k^2$ | $kS^{3/2}=N_2$ | $kS^{1/2}$ | S |

Example of [p,q] energy symmetry:

TABLE IIIe The $GM^2/R$ or Gravitational Energy [2,–1]

| Particle | $GM^2/R$ cgs | $GM^2/R$ Planck units | $GM^2/R$ Planck values |
|---|---|---|---|
| [1] baryon | –42.178842 | –58.470284 | $(\alpha\mu S)^{-3/2}\,(\alpha\mu)^2$ |
| [2] mini black hole | +75.888810 | +59.597368 | $(\alpha\mu S)^{3/2}/(\alpha\mu)^{-1}$ |
| [3] | –2.822960 | –19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | +67.419912 | + 2.254144 | $(\alpha\mu)^2$ |

G = –7.175706 cgs units

TABLE IIIf The $c^5\hbar R/G^2M^2$ Energy [–2.1]

| Particle | $c^5\hbar R/G^2M^2$ cgs | $c^5\hbar R/G^2M^2$ Planck | $c^5\hbar R/G^2M^2$ values |
|---|---|---|---|
| [1] baryon | +74.761729 | +58.470286 | $(\alpha\mu S)^{3/2}\,(\alpha\mu)^{-2}$ |
| [2] mini black hole | –43.305931 | –59.597375 | $(\alpha\mu S)^{-3/2}/(\alpha\mu)$ |
| [3] | +35.405833 | +19.114389 | $(\alpha\mu/S)^{-1/2}$ |
| [4] | –3.950035 | –20.241479 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911596 | –2.254144 | $(\alpha\mu)^{-2}$ |

$c^5\hbar/G^2$ = 39.758593 cgs units

$[2,-1] + [-2,1] = (\alpha\mu)^2 + (\alpha\mu)^{-2} = 0$

# COSMOS– BY THE NUMBERS PART I

| OBJECT | LENGTH | VALUE (cm) | TIME | VALUE (sec) | $\sigma$ | $\gamma$ | $\delta$ | T (sec) |
|---|---|---|---|---|---|---|---|---|
| Planck particle | $l_o$ | -32.791545 | $t_o$ | -43.268366 | 0 | 3/2 | $\infty$ | 17.456067 |
| W particle | $l_w$ | -22.670802 | $t_w$ | -33.147623 | 1/4 | 5/4 | 6 | 17.456067 |
| baryon | $r_e$ | -12.550068 | $t_b$ | -23.026899 | 1/2 | 1 | 6/2 | 17.456067 |
| Q particle | $l_q$ | -2.429328 | $t_q$ | -12.906151 | 3/4 | 3/4 | 4/2 | 17.456067 |
| star | $l_a$ | 7.691310 | $t_a$ | -2.785412 | 1 | 1/2 | 3/2 | 17.456067 |
| star cluster | $l_c$ | 17.812049 | $t_c$ | 7.335329 | 5/4 | 1/4 | 6/5 | 17.456067 |
| Universe | $l_U$ | 27.932888 | $t_U$ | 17.456067 | 3/2 | 0 | 2/2 | 17.456067 |

NOTES:

1) The value of T = 17.456067 sec is equivalent to a Hubble parameter of 71.977 km/sec/mpc
2) The time values, $t_i$, are the light travel time = $l_i /c$
3) $\sigma_i$ is the exponent of $l_i / l_o$ or of $t_i /t_o$ ; $\gamma_i$ is the exponent of $(\alpha\mu S)$
4) $l_i = (\alpha\mu S)^{\sigma i}\, l_o$ ; $t_i = (\alpha\mu S)^{\sigma i}\, t_o$ ; $T = (\alpha\mu S)^{\gamma i}\, t_i = (\alpha\mu S)^{\sigma i+\gamma i}\, t_o$
5) $\sigma_i + \gamma_i = 3/2$ ; $\delta_i = 1 + \gamma_i /\sigma_i$ ; $\sigma_i \cdot \delta_i = 3/2$
6) If $\sigma$ represents scale and $\delta$ represents dimension, then [scale]·[dimension] is an invariant = 3/2.
7) Values:
   - c = 10.476821 cm/sec
   - $(\alpha\mu S)^{1/4}$ = 10.120738
   - $(\alpha\mu S)^{1/2}$ = 20.241477
   - $(\alpha\mu S)^{3/4}$ = 30.362216
   - $(\alpha\mu S)$ = 40.482954
   - $(\alpha\mu S)^{5/4}$ = 50.603690
   - $(\alpha\mu S)^{3/2}$ = 60.724431
   - 1 L.Y. = 17.975932 cm

$T \leq \left(\frac{t_i}{t_o}\right)^{\delta_i} t_o$ , $\frac{t_i}{t_o} = (\alpha\mu S)^{\sigma_i}$

$\frac{T}{t_o} \leq \left(\frac{t_i}{t_o}\right)^{\delta} = \left[(\alpha\mu S)^{\sigma}\right]^{\delta} = (\alpha\mu S)^{3/2}$

$\frac{T}{t_i} = (\gamma\mu S)^{\gamma_i}$

$\frac{T}{t_i} \cdot \frac{t_i}{t_o} = (\alpha\mu S)^{\gamma_i} \cdot (\alpha\mu S)^{\sigma_i} = (\alpha\mu S)^{\sigma+\gamma}$

$= (\alpha\mu S)^{3/2}$

# COSMOS– BY THE NUMBERS PART II

| OBJECT | LENGTH cm | TIME | VALUE (sec) | $\sigma$ | $\gamma$ | $\delta$ | |
|---|---|---|---|---|---|---|---|
| Planck particle 0 | -32.791545 | $t_o$ | -43.268366 | 0 | 3/2 | $\infty$ | |
| particle 1 | -27.731171 | $t_1$ | -38.207992 | 1/8 | 11/8 | 12/1 | |
| particle 2 | -22.670802 | $t_2$ | -33.147623 | 1/4 | 5/4 | 12/2 | |
| particle 3 | -17.610433 | $t_3$ | -28.087254 | 3/8 | 9/8 | 12/3 | |
| baryon | -12.550068 | $t_4$ | -23.026899 | 1/2 | 1 | 12/4 | |
| particle 5 | -7.489695 | $t_5$ | -17.966516 | 5/8 | 7/8 | 12/5 | |
| Tritone particle 6 | -2.429328 | $t_6$ | -12.906151 | 3/4 | 3/4 | 12/6 | |
| object 7 | 2.631043 | $t_7$ | -7.845778 | 7/8 | 5/8 | 12/7 | |
| neutron star 8 | 7.691310 | $t_8$ | -2.785412 | 1 | 1/2 | 12/8 | |
| max star 9 | 12.751781 | $t_9$ | 2.274960 | 9/8 | 3/8 | 12/9 | |
| star cluster 10 | 17.812049 | $t_{10}$ | 7.335329 | 5/4 | 1/4 | 12/10 | |
| galaxy 11 | 22.872519 | $t_{11}$ | 12.395698 | 11/8 | 1/8 | 12/11 | |
| Universe 12 | 27.932888 | $T=t_{12}$ | 17.456067 | 3/2 | 0 | 12/12 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| $(\alpha\mu S)^\sigma$ | $\sigma = 1/8$ | 5.060369 | $\sigma = 1/4$ | 10.120738 | $(\alpha\mu S)^{\sigma i}\, t_o = t_i$ | $c = 10.476821$ |
| | 3/8 | 15.181107 | ½ | 20.241477 | $(\alpha\mu S)^{\gamma i}\, t_i = t_{12} = T$ | $l_i = c \cdot t_i$ |
| | 5/8 | 25.301845 | 3/4 | 30.362216 | $(\alpha\mu S)^{\sigma i+\gamma i} = t_{12} = T$ | $T = (\alpha\mu S)\, r_e/c$ |
| | 7/8 | 35.422583 | 1 | 40.482954 | $\sigma_i + \gamma_i = 3/2$ | $T = (\alpha\mu S)^{3/2} \sqrt{(G\hbar/c^5)}$ |
| | 9/8 | 45.543321 | 5/4 | 50.603690 | $\delta_i = 1 + \gamma_i/\sigma_i$ | $H_o^{-1} = T = 71.977$ km/sec/mpc |
| | 11/8 | 55.664059 | 3/2 | 60.724431 | $\sigma_i \cdot \delta_i = 3/2$ | |

# MASSES AND RADII

The values in this table are for baryons.

| | minimum mass | mean | maximum mass |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{-1/2} m_o = -24.903676$ | $S^{-1/2}\, m_o = -24.340139$ | $(S/\alpha\mu)^{-1/2}\, m_o = -23.776602$ |
| RADIUS | $(S/\alpha\mu)^{1/2}\, l_o = -13.677142$ | $S^{1/2}\, l_o = -13.113605$ | $(\alpha\mu S)^{1/2} l_o = -12.550068$ |

The values in this table are for quasi dark matter

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{1/2} m_o = 15.579278$ | $S^{1/2}\, m_o = 15.015741$ | $(S/\alpha\mu)^{1/2}\, m_o = 14.452204$ |
| RADIUS | $(\alpha\mu S)^{1/2} l_o = -12.550068$ | $S^{1/2}\, l_o = -13.113605$ | $(S/\alpha\mu)^{1/2}\, l_o = -13.677142$ |

The values in this table are for neutron stars .

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\, m_o = 35.820755$ | $S\, m_o = 34.693681$ | $(S/\alpha\mu)\, m_o = 33.566607$ |
| RADIUS | $\alpha\mu S\, l_o = 7.691409$ | $S\, l_o = 6.564335$ | $(S/\alpha\mu)\, l_o = 5.437261$ |

$M^*$ = max mass, $M\sim$ = mean mass, $M_*$ = min mass
$R^*$ = max radius, $R\sim$ = mean radius, $R_*$ = min radius

The values in this table are for normal stars . $[\alpha^2 = -4.273670]$

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\, m_o = 35.820755$ | $S\, m_o = 34.693681$ | $(S/\alpha\mu)\, m_o = 33.566607$ |
| RADIUS | $(\alpha\mu S)\, l_o/\alpha^2 = 11.965079$ | $S\, l_o/\alpha^2 = 10.838005$ | $(S/\alpha\mu)\, l_o/\alpha^2 = 9.710331$ |

The values in this table are for the Hubble universe.

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{3/2}\, m_o = 56.062232$ | $S^{3/2}\, m_o = 54.371621$ | $(S/\alpha\mu)^{3/2}\, m_o = 52.681010$ |
| RADIUS | $(\alpha\mu S)^{3/2}\, l_o = 27.932886$ | $S^{3/2}\, l_o = 26.242275$ | $(S/\alpha\mu)^{3/2}\, l_o = 24.551664$ |
| TIME | $(\alpha\mu S)^{3/2}\, t_o = 17.456065$ | $S^{3/2}\, t_o = 15.765454$ | $(S/\alpha\mu)^{3/2}\, t_o = 14.074843$ |

FIGRUND1.WP6 November 17, 1996

cf. 1996-61
1996-65

*THE UNIVERSE CONSISTS OF TWO LEVELS,*
*A FIGURE AND A GROUND.*

- The Ground is a vast vibratory system, like a complex drum, capable of vibrating in many modes. The spacings of its nodes are determined by the three dimensionless numbers: $\alpha$, $\mu$, and S where
  - $\alpha$ is the fine structure constant = 0.007297353
  - $\mu$ is the mass ratio proton to electron = 1816.152701
  - S is the ratio of the coulomb to the gravitational force, = $2.269239 \times 10^{39}$

- The Figure is the material universe whose basic modules are action packets [dimensionsally = $ML^2/T$ ] defined by the fundamental constants: $\hbar$, c, and G where
  - $\hbar$ is Planck's constant [$ML^2/T$] = $1.054573 \times 10^{-27}$ cgs
  - c is the velocity of light [L/T] = $2.997925 \times 10^{10}$ cgs
  - G is Newton's constant [$L^3/MT^2$] = $6.672599 \times 10^{-8}$ cgs

The action packet, sometimes called the Planck particle, has the values:

$m_p = 2.176710 \times 10^{-5}$ grams
$l_p = 1.616050 \times 10^{-33}$ centimeters
$t_p = 5.390560 \times 10^{-44}$ seconds

The interaction of these two levels creates a universe. Many figures are possible with the same Ground. However, what actually occurs depends on the values of the constants $\hbar$, c, and G. The vibratory system which supports various dynamics may also be alterable, but whatever its structure, it provides the "theme" within whose template all "variations on the theme" take place.

Since material existence occurs at the nodes, the organization of the action modules and their transforms is governed by the locations of the nodes. The largest net of nodes is set by S or $\sqrt{S}$, giving a "fractal" structure to the universe. Small scale nets are determined by $\alpha$ and $\mu$ in various combinations. These several nets of nodes provide many templates by means of which all possible material entities are formed.

The two levels involved are those of the templates and those of the packets. These levels constitute a basic dualism underlying the universe. What can occur is defined by the Ground, what does occur is open but infected with what has already occurred. But beyond the necessity of this dualism lies the question of its sufficiency. Is a third element required to make it happen?

SOME SUPPLEMENTARY INPUTS:

- A dynamic sub-system of the cosmos evolves so as to maximize its options and potentialities. This evolution is counter to the second law of thermodynamics. cf. Gurdieff's Cosmogony 1995 #25

- The cutting edge of such an evolving system gravitates toward a region rich in alternatives, resulting in existence occurring where the density of alternate possibilities is a maximum. (usually at some interface or interstice) (How does this jibe with matter occuring at nodes?)

- The universe does not march to the beat of a single drummer. The clock rate at any locality varies inversely with the square root of the local density. Change or evolution is most rapid where the mass density is greatest.

- The world consists of many facets (or domains) separated by fault lines (~ nodes?) These facets are multiplexed in many ways across the fault lines (boundaries)

Metaphor of drum head

- What evolves is the result of the interplay of homogonizing forces (such as gravity and the 2nd Law of thermodynamics) with a general uniqueness principle. Either emergence, complexity, organization occurs or extinction ensues.

Is the inflationary universe explicable alternatively by a time rate of change?

PLNK2BN3.WPD April 30, 1999

See 1999 #21

# PLANCK PARTICLE BARYON TRANSFORMATIONS

If we write N for $S^{1/2}$ and n for $(\alpha\mu)^{1/2}$, then the following relations between the Planck particle and the baryon obtain:

$$\text{Mass } \frac{m_o}{m_p} = \frac{N}{n}; \quad \text{Length } \frac{l_o}{r_e} = \frac{1}{Nn}$$

$$\text{v - time } \frac{t_o}{t_b} = \frac{1}{Nn}; \quad \rho\text{ - time } \frac{\tau_o}{\tau_b} = \frac{1}{N^2 n}$$

Note velocity time and density time are equal for the Planck particle and that $N\, t_b = \tau_b$ resonance?

$$\text{m - energy } \frac{E_o}{E_b} = \frac{N}{n}; \quad \text{G - energy } \frac{\varepsilon_o}{\varepsilon_b} = \frac{N^3}{n}$$

where $E = mc^2$ and $\varepsilon = Gm^2/l$

$$\text{t - action} \frac{\Omega_o}{\Omega_b} = \frac{1}{n^2}; \quad \tau - \text{action} \frac{\Omega_o}{\Omega_b} = \frac{N}{n^2}$$

where t-action is $ML^2/t$ and $\tau$-action is $ML^2/\tau$, are the respective angular momenta.

$$\text{t - force} \frac{F_o}{F_b} = N^2; \quad \tau\text{ - force} \frac{F_o}{F_b} = N^4$$

where t-force is $ML/t^2$ and $\tau$-force is $ML/\tau^2$.

$$\text{G - force} \frac{\Psi_o}{\Psi_b} = N^4; \quad \text{Density} \frac{\rho_o}{\rho_b} = N^4 n^2$$

where G-force is $GM^2/L^2$ and density is $M/L^3$

PLNK2BN7.2PD MAY 5, 1999

cf 1999 # 17

# PLANCK PARTICLE ELECTRON TRANSFORMATIONS

If we write N for $S^{1/2}$ and n for $(\alpha\mu)^{1/2}$, then the following relations between the Planck particle and the electron obtain:

- 22.378 321 $$\text{mass } \frac{m_o}{m_e} = \frac{N\mu}{n}; \quad \text{length} \frac{l_o}{r_e} = \frac{1}{Nn}$$ - 20.241 477

$$\text{v-time } \frac{t_o}{t_e} = \frac{1}{Nn}; \quad \rho\text{-time} \frac{\tau_o}{\tau_e} = \frac{1}{N^2 n\sqrt{\mu}}$$ - 41.551 372

Note velocity time and density time are equal for the Planck particle and that $t_e N \sqrt{\mu} = \tau_e$.

$$\text{m-energy} \frac{E_o}{E_e} = \frac{N}{n}\sqrt{\frac{\alpha}{\mu}}; \qquad \text{G-energy} \frac{\varepsilon_o}{\varepsilon_e} = \frac{N^3\mu^2}{n}$$ 64.998 101

where $E = mc^2$ and $\varepsilon = Gm^2/l$, $\varepsilon_e$ = - 48.706 659

$$\text{t-action} \frac{\Omega_o}{\Omega_{et}} = \hbar\alpha; \qquad \tau\text{-action} \frac{\Omega_o}{\Omega_{e\tau}} = \frac{N\sqrt{\mu}}{\alpha}$$ 23.446 729

where $\Omega_{e\tau}$ = - 50.423 653 and
where t-action is $ML^2/t$, and $\tau$-action is $ML^2/\tau$, the respective angular momenta.

$$\text{t-force} \frac{F_o}{F_{et}} = N^2\mu; \quad \tau\text{-force } \frac{F_o}{F_{e\tau}} = \frac{N^4 n^4}{\alpha^2}$$

where t-force is $ML/t^2$ and $\tau$-force is $ML/\tau^2$. $F_o$ = 49.082 989

85.239 580 $$\text{G-force} \frac{F_o}{F_{ge}} = N^4\mu^2; \quad \text{Density} \frac{\rho_o}{\rho_e} = N^4 n^4 \mu$$ 83.102 746

where G-force is $GM^2/L^2$ and density is $M/L^3$

COSMPYTH.WPD January 16, 2000, revised January 31, 2000

# A PYTHAGOREAN COSMOLOGICAL MODEL

The Pythagorean approach is an attempt to construct a <u>template</u> which fits the observed universe rather than to describe the detailed physical steps by which the universe evolved. Its goal is to build a consistent net of nodes and links demonstrating how the various parts fit together. Recognition of the basic role that particle physics played in cosmology brought with it inferences of symmetries between the large and small, symmetries involving baryons and stars, the Hubble universe and the Planck particle. Hence it appears useful to explore the several symmetries and their implications by placing in juxtaposition the dimensions and magnitudes of the particles and constants of physics with those of various astronomical aggregates.

At the outset there is the difficulty of a basic asymmetry between the preciseness of the measurements in particle physics and of those in astrophysics. Whereas the former may in many cases reach accuracies exceeding eight significant figures, at present the latter usually have only order of magnitude accuracy. An exception to this is the recent improvement in the observed value of the Hubble parameter, which measures the rate of expansion of the universe, and can be used in conjunction with various cosmological models to give an age to the universe. The present Pythagorean model is based on this new value and on the best present values for fundamental constants and baryons. We thus have empirical data for the Planck level, the baryon level and the universe or "Hubble" level. There also exist a plethora of less precise measurements of masses and sizes of stars, but of sufficient accuracy to test the model at the stellar level, allowing us a basic four level model. Other aggregate levels exist and can possibly be explored using the best astronomical observations together with interpolations and extrapolations on the basic four level model.

Because of an inverted relation between the Planck particle and baryons, (Planck mass > baryon mass and Planck size < baryon size) we are led to a model consisting of two parts. The first part is constructed on size relations, the second on mass relations. Both parts are used to establish the basic frequencies that provide the resonances from which it is assumed all material bodies emerge. [It will be shown that resonances are alternatives to equilibria of forces.]

Before constructing any model it is important to note some properties of the Planck particle: The following six times (or alternately, frequencies) are all equal at the Planck level but diverge at other levels of size and mass. [All values are cgs given in $\log_{10}$ format]

TABLE 1

| $t$ | $\tau$ | $T$ | $Z$ | $\zeta$ | $\Phi$ |
|---|---|---|---|---|---|
| $L/c$ | $(L^3/GM)^{1/2}$ | $GM/c^3$ | $\hbar/Mc^2$ | $\hbar L/GM^2$ | $(ML^3\alpha/e^2)^{1/2}$ |
| −43.268366 | −43.268366 | −43.268366 | −43.268366 | −43.268366 | −43.268366 |

t τ T K

# COSMOLOGY IN THE TRADITION OF PYTHAGORAS

underlying

According to Pythagoras, behind astronomy, behind physics, even behind mathematics, lies number. The structures and processes of nature take their forms, directions and values ultimately from the properties of numbers. If this be so, then the properties of numbers create a *template* that both enables and delimits what exists and what happens. Such a template would govern both what *may* occur and what *must* occur: the domains of choice and necessity. Further, such a template would explain our questions regarding why mathematics allows us so well to describe the physical world~~, and permits that we both discover and invent mathematics~~.

Legend tells us that the Pythagoreans were dismayed at the discovery of $\sqrt{2}$. Such a number violated their belief in the absolute sovereignty of the natural numbers, ~~that is of~~ 1,2,3,... But since negative, rational, irrational, complex and other numbers all trace their ancestry to the natural numbers, the Pythagoreans should not have despaired. While the positive integers may not be the sovereigns, they are the undisputed ancestors of all other numbers. We may accordingly assert, without tracing all the mathematical genealogy of the intervening centuries, that Pythagoras is the legitimate ancestor of an approach to cosmology that is based on numbers and their properties. However, today we begin, not with 1,2,3... but with the fundamental constants of physics. These are indeed numbers and for the present purpose will also be assumed to be constants.

Seven of the fundamental physical constants turn out to play a significant role in the cosmic template. These are: **c**, the velocity of light; **G**, the gravitational constant; $\hbar$, Planck's constant; $\alpha$, the fine structure constant; $\mu$, the proton/electron mass ratio; $\mathbf{m_b}$, the proton mass; → use $m_e$ and $\mathbf{r_e}$, the electron radius. These constants provide a system of units, the Planck system, that unlike the SI, cgs, or English systems, is not an arbitrary fabrication, but takes its values directly from the natural order. The three constants **c**, **G**, and $\hbar$, can be put together to make units of mass, length, and frequency as follows:[1]

$$\sqrt{\frac{\mathbf{ch}}{\mathbf{G}}} = \mathbf{m_o} \qquad \sqrt{\frac{\mathbf{Gh}}{\mathbf{c^3}}} = \mathbf{l_o} \qquad \sqrt{\frac{\mathbf{c^5}}{\mathbf{Gh}}} = \nu_o$$

These values may be considered to be the mass, size, and frequency of a virtual particle, called the Planck particle. This "particle" might be said to have the same relation to the cosmos that a stem cell has to a living organism. The Planck particle is a "cell" from which the cosmos and its sub–structures can be derived. It is also usefully taken as the origin in all of the coordinate systems that constitute the cosmic template.

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[1]The $\log_{10}$ cgs values are: $\mathbf{m_o}$ = –4.662199 grams; $\mathbf{l_o}$ = –32.791545 centimeters; $\mathbf{v_o}$ = +43.268366 hertz

## THE SIZE RELATIONS

TABLE 2. Gives the sizes of the four levels based on an extrapolation of the ratio of the baryon size to the Planck size. $r_e/l_o = (\alpha\mu S)^{1/2}$, where $\alpha$ is the fine structure constant, $\mu$ is the proton/electron mass ratio, and S is the coulomb/gravitation force ratio, explicitly, $L_n = (\alpha\mu S)^n \, l_o$

TABLE 2.

| OBJECT | PLANCK | BARYON | STAR | UNIVERSE |
|---|---|---|---|---|
| FORMULA | $l_o = (G\hbar/c^3)^{1/2}$ | $r_e = (\alpha\mu S)^{1/2} \, l_o$ | $L_* = (\alpha\mu S) \, l_o$ | $L_U = (\alpha\mu S)^{3/2} \, l_o$ |
| VALUE | −32.791545 | −12.550068 | 7.691409 | 27.932886 |

## THE MASS RELATIONS

TABLE 3. Gives the masses of the four levels based on the formula, $M_n = (\alpha\mu S)^n \, m_o$, analogous to the size formulae, where $m_o$ is the Planck mass $(c\hbar/G)^{1/2}$.

TABLE 3.

| OBJECT | PLANCK | BARYON | STAR | UNIVERSE |
|---|---|---|---|---|
| FORMULA | $m_o = (c\hbar/G)^{1/2}$ | $m_b = (\alpha\mu S)^{1/2} \, m_o$ | $M_* = (\alpha\mu S) \, m_o$ | $M_U = (\alpha\mu S)^{3/2} m_o$ |
| VALUE | −4.662199 | 15.579278 | 35.820755 | 56.062232 |

While the star and universe values fit with other measurements and estimates, the baryon value derived from this formula is totally incorrect. The interpolative use of the $M_n = (\alpha\mu S)^n \, m_o$ formula, however, suggests the existence of a massive particle of minute size that could be a possible candidate for dark matter.

TABLE 4. Gives the masses of the four levels by extrapolating the correct ratio of the baryon mass to the Planck mass, $m_p/m_o = (\alpha\mu)^{1/2} \, S^{-1/2}$, explicitly, $M_n = (\alpha\mu)^n \, S^{-n} \, m_o$.

TABLE 4.

| OBJECT | PLANCK | BARYON | STAR | UNIVERSE |
|---|---|---|---|---|
| FORMULA | $m_o = (c\hbar/G)^{1/2}$ | $(\alpha\mu)^{1/2} \, S^{-1/2} \, m_o$ | $(\alpha\mu) \, S^{-1} \, m_o$ | $(\alpha\mu)^{3/2} \, S^{-3/2} \, m_o$ |
| VALUE | −4.662199 | −23.776602 | −42.891005 | −62.005328 |

Here while the baryon [proton] mass is correct, the values for star and universe are out of bounds but provide clues to additional frequencies. do $(\alpha\mu)^{-1} S$ $(\alpha\mu)^{-3/2} S^{3/2}$

4c

THE FREQUENCIES

There are six combinations of the fundamental constants that when combined with L and M have time dimensionality. These combinations were given in TABLE 1 along with their values at the Planck level. The values of these six time/frequencies for the baryon, star, and universe levels are given in Table 5. The values for L and M in Tables 5 and 6 are the observed values for the baryon level and the $(\alpha\mu S)^n$ values at the star and universe levels, [sizes from Table 2, masses from Table 3]

TABLE 5.

| Object | t | $\tau$ | T | Z | $\zeta$ | $\Phi$ |
|---|---|---|---|---|---|---|
| baryon | -23.026889 | -3.348949 | -62.382770 | -24.153964 | +15.201917 | -22.463352 |
| star | -2.785412 | -2.785412 | -2.785412 | -83.751321 | -83.751321 | 37.697542 |
| universe | 17.456067 | 17.456067 | 17.456067 | -103.992798 | -103.992798 | 78.180497 |

The values of these time/frequencies when expressed in terms of Planck units are given in Table 6:

TABLE 6.

| Object | t | $\tau$ | T | Z | $\zeta$ | $\Phi$ |
|---|---|---|---|---|---|---|
| baryon | $(\alpha\mu S)^{1/2}$ | $(\alpha\mu)^{1/2}S$ | $(\alpha\mu)^{1/2}S^{-1/2}$ | $(\alpha\mu)^{-1/2}S^{1/2}$ | $(\alpha\mu)^{-1/2}S^{3/2}$ | $\alpha\mu\ S^{1/2}$ |
| star | $\alpha\mu S$ | $\alpha\mu S$ | $\alpha\mu S$ | $(\alpha\mu S)^{-1}$ | $(\alpha\mu S)^{-1}$ | $(\alpha\mu S)^2$ |
| universe | $(\alpha\mu S)^{3/2}$ | $(\alpha\mu S)^{3/2}$ | $(\alpha\mu S)^{3/2}$ | $(\alpha\mu S)^{-3/2}$ | $(\alpha\mu S)^{-3/2}$ | $(\alpha\mu S)^3$ |

In Table 7 the values of size employed are those given by the $L_n = (\alpha\mu S)^n\, l_o$ formula, [Table 2], but the mass values are those given by the baryon mass formula, $M_n = (\alpha\mu)^n\, S^{-n}\, m_o$, [Table 4].

TABLE 7.

| Object | t | $\tau$ | T | Z | $\zeta$ | $\Phi$ |
|---|---|---|---|---|---|---|
| baryon | -23.026889 | -3.348949 | -62.382770 | -24.153964 | +15.201917 | -22.463352 |
| star | -2.785412 | 36.570468 | -81.497172 | -5.039561 | 73.672200 | -1.658338 |
| universe | 17.456067 | 76.489888 | -100.611575 | 14.074842 | 132.142484 | 19.146679 |

O

TABLE 8. Gives the values of the TABLE 7. time/frequencies when expressed in terms of Planck units

TABLE 8.

| OBJECT | t | $\tau$ | T | Z | $\zeta$ | $\Phi$ |
|---|---|---|---|---|---|---|
| baryon | $(\alpha\mu S)^{1/2}$ | $(\alpha\mu)^{1/2}S$ | $(\alpha\mu)^{1/2}S^{-1/2}$ | $(\alpha\mu)^{-1/2}S^{1/2}$ | $(\alpha\mu)^{-1/2}S^{3/2}$ | $\alpha\mu\ S^{1/2}$ |
| star | $\alpha\mu S$ | $\alpha\mu\ S^2$ | $\alpha\mu\ S^{-1}$ | $(\alpha\mu)^{-1}\ S$ | $(\alpha\mu)^{-1}\ S^3$ | $(\alpha\mu)^2\ S$ |
| universe | $(\alpha\mu S)^{3/2}$ | $(\alpha\mu)^{3/2}\ S^3$ | $(\alpha\mu)^{3/2}S^{-3/2}$ | $(\alpha\mu)^{-3/2}S^{3/2}$ | $(\alpha\mu)^{-3/2}S^{9/2}$ | $(\alpha\mu)^3\ S^{3/2}$ |

Some conclusions:

1) The t, $\tau$, and T time/frequency values for the universe in Table 5 (as well as the t and $\tau$ values in Table 7) are all equal to 17.456067 seconds, which is $(\alpha\mu S)^{3/2}$ = 60.724431 Planck time units. [One Planck time unit = $(\hbar G/c^5)^{1/2}$ = −43.268366 seconds]. The value of 10^17.456067 sec is equal to 9.056387 billion years or a Hubble time of 13.584581 billion years. This age reduces to a value of the Hubble parameter of $H_o$ = 71.977 km/sec/mpc. This is in excellent agreement with Freedman et al's 1999 value of 71 ± 7 km/sec/mpc determined from observations of 800 cepheids in 18 galaxies out to a distance of 25 megaparsecs. [Physics Today, Aug 1999, page 19]. If the final observed value of $H_o$ does converge to 71.977 km/sec/mpc, then the fact that this quantity is tied to the values of the fundamental constants, G, c, and $\hbar$, forces us to conclude that either the Hubble parameter is itself unvarying, in which case the expansion rate of the universe is constant, [cf the Steady State cosmological model], or that the fundamental "constants" vary with time.

2) Resonance and equilibrium of forces lead to the same results and are distinct ways of representing the same phenomenon. For resonance, we see that in Table 6. for the universe and star levels:

$$t = \tau = T = Z^{-1} = \zeta^{-1} = \Phi^{1/2}$$

The implication of t = T , for example, is

$$R/c = GM/c^3 \text{ or } GM = Rc^2 \text{ [the Schwartzschild bound]}$$

For balance of forces, on the other hand, we note that: Pressure is force per unit area or energy per unit volume. Taking $Mc^2/R^3$ as an "inertial" energy per unit volume that exerts an outward or expansive pressure, and $(GM^2/R)/R^3$ as a "gravitational" energy per unit volume that exerts an inward or contractive pressure, when these are placed in equilibrium we have:

$$Mc^2/R^3 = GM^2/R^4 \text{ or } GM = Rc^2 \text{ [again the Schwartzschild bound]}$$

STARFRM1.WPD APRIL 23, 2000

# STAR FRAMES PART I

THE SCHWARZSCHILD FRAME

The values in these tables are the positions allowed for neutron stars .

TABLE I [values are $\log_{10}$]

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\ m_o = 35.820755$ | $S\ m_o = 34.693681$ | $(S/\alpha\mu)\ m_o = 33.566607$ |
| RADIUS | $\alpha\mu S\ l_o = 7.691409$ | $S\ l_o = 6.564335$ | $(S/\alpha\mu)\ l_o = 5.437261$ |

$M^*$ = max mass, $M\sim$ = mean mass, $M_*$ = min mass

$R^*$ = max radius, $R\sim$ = mean radius, $R_*$ = min radius

$m_o/l_o = c^2/G = 28.129346$; $m_o l_o = \hbar/c = -37.453745$; $S^2\hbar/c = 41.258015$

TABLE II

| | |
|---|---|
| $M^*/R^* = m_o/l_o = c^2/G = 28.129346$ | $M^*R^* = (\alpha\mu)^2\ S^2\ \hbar/c = 2.254148\ S^2\ \hbar/c$ |
| on Schwarzschild bound | $= 80.965908\ \hbar/c = 43.512163$ |
| $M^*/R\sim = \alpha\mu\ m_o/l_o = 1.127074\ c^2/G$ | $M^*R\sim = \alpha\mu\ S^2\ \hbar/c = 1.127074\ S^2\ \hbar/c$ |
| in 2nd quadrant, $= 29.256420$ | $= 79.838835\ \hbar/c = 42.385090$ |
| $M^*/R_* = (\alpha\mu)^2\ m_o/l_o = 2.254148\ c^2/G$ | $M^*R_* = S^2\ \hbar/c = 1\ S^2\ \hbar/c$ |
| in 2nd quadrant, $= 30.383495$ | $= 78.711760\ \hbar/c = 41.258015$ |
| $M\sim/R^* = (\alpha\mu)^{-1}\ m_o/l_o = -\ 1.127074\ c^2/G$ | $M\sim R^* = \alpha\mu\ S^2\ \hbar/c = 1.127074\ S^2\ \hbar/c$ |
| in 1st quadrant, $= 27.002272$ | $= 79.838835\ \hbar/c = 42.385090$ |
| $M\sim/R\sim = m_o/l_o = c^2/G = 28.129346$ | $M\sim R\sim = S^2\ \hbar/c = 1\ S^2\ \hbar/c$ |
| on Schwarzschild bound | $= 78.711760\ \hbar/c = 41.258015$ |
| $M\sim/R_* = \alpha\mu\ m_o/l_o = 1.127074\ c^2/G$ | $M\sim R_* = (\alpha\mu)^{-1}\ S^2\ \hbar/c = -\ 1.127074\ S^2\ \hbar/c$ |
| in 2nd quadrant, $= 29.256420$ | $= 77.584687\ \hbar/c = 40.130942$ |
| $M_*/R^* = (\alpha\mu)^{-2}\ m_o/l_o = -\ 2.254148\ c^2/G$ | $M_*R^* = S^2\ \hbar/c = 1\ S^2\ \hbar/c$ |
| in 1st quadrant, $= 25.875198$ | $= 78.711760\ \hbar/c = 41.258015$ |
| $M_*/R\sim = (\alpha\mu)^{-1}\ m_o/l_o = -\ 1.127074\ c^2/G$ | $M_*R\sim = (\alpha\mu)^{-1}\ S^2\ \hbar/c = -\ 1.127074\ S^2\ \hbar/c$ |
| in 1st quadrant, $= 27.002272$ | $= 77.584687\ \hbar/c = 40.130942$ |
| $M_*/R_* = m_o/l_o = c^2/G = 28.129346$ | $M_*R_* = (\alpha\mu)^{-2}\ S^2\ \hbar/c = -\ 2.254148\ S^2\ \hbar/c$ |
| on Schwarzschild bound | $= 76.457612\ \hbar/c = 39.003867$ |

STARFRM2.WPD APRIL 23, 2000

# STAR FRAMES PART II

THE MAIN SEQUENCE FRAME

The values in these tables are the positions allowed for normal stars .

TABLE I [values are $\log_{10}$] [$\alpha^2 = -4.273670$]

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\ m_o = 35.820755$ | $S\ m_o = 34.693681$ | $(S/\alpha\mu)\ m_o = 33.566607$ |
| RADIUS | $(\alpha\mu S)\ l_o/\alpha^2 = 11.965079$ | $S\ l_o/\alpha^2 = 10.838005$ | $(S/\alpha\mu)\ l_o/\alpha^2 = 9.710331$ |

$M^*$ = max mass, $M\sim$ = mean mass, $M_*$ = min mass

$R^*$ = max radius, $R\sim$ = mean radius, $R_*$ = min radius

$\alpha^2\ m_o/l_o = \alpha^2\ c^2/G = 23.855676$; $m_o l_o/\alpha^2 = \hbar/c\alpha^2 = -33.180075$; $S^2\hbar/c\alpha^2 = 45.531685$

TABLE II

| | |
|---|---|
| $M^*/R^* = \alpha^2\ m_o/l_o = \alpha^2\ c^2/G = 23.855676$ | $M^*R^* = (\alpha\mu)^2\ S^2\ \hbar/c\alpha^2 = 2.254148\ S^2\ \hbar/c\alpha^2$ |
| on the $\alpha^2$ bound | $80.965909\ \hbar/c\alpha^2 = 47.785834$ |
| $M^*/R\sim = \alpha^2\ \alpha\mu\ m_o/l_o = 1.127074\ \alpha^2\ c^2/G$ | $M^*R\sim = \alpha\mu\ S^2\ \hbar/c\alpha^2 = 1.127074\ S^2\ \hbar/c\alpha^2$ |
| above $\alpha^2$ bound $= 24.982750$ | $= 79.838835\ \hbar/c\alpha^2 = 46.658759$ |
| $M^*/R_* = \alpha^2\ (\alpha\mu)^2\ m_o/l_o = 2.254148\ \alpha^2\ c^2/G$ | $M^*R_* = S^2\ \hbar/c\alpha^2 = 1\ S^2\ \hbar/c\alpha^2$ |
| above $\alpha^2$ bound $= 25.728602$ | $= 78.711760\ \hbar/c\alpha^2 = 45.531685$ |
| $M\sim/R^* = \alpha^2\ (\alpha\mu)^{-1}\ m_o/l_o = -1.127074\ \alpha^2\ c^2/G$ | $M\sim R^* = \alpha\mu\ S^2\ \hbar/c\alpha^2 = 1.127074\ S^2\ \hbar/c\alpha^2$ |
| below $\alpha^2$ bound $= 22.728602$ | $= 79.838835\ \hbar/c\alpha^2 = 46.658759$ |
| $M\sim/R\sim = \alpha^2\ m_o/l_o = \alpha^2\ c^2/G = 23.855676$ | $M\sim R\sim = S^2\ \hbar/c\alpha^2 = 1\ S^2\ \hbar/c\alpha^2$ |
| on the $\alpha^2$ bound | $= 78.711760\ \hbar/c\alpha^2 = 45.531685$ |
| $M\sim/R_* = \alpha^2\ \alpha\mu\ m_o/l_o = 1.127074\ \alpha^2\ c^2/G$ | $M\sim R_* = (\alpha\mu)^{-1}\ S^2\ \hbar/c\alpha^2 = -1.127074\ S^2\ \hbar/c\alpha^2$ |
| above $\alpha^2$ bound $= 24.982750$ | $= 77.584687\ \hbar/c\alpha^2 = 44.404611$ |
| $M_*/R^* = \alpha^2\ (\alpha\mu)^{-2}\ m_o/l_o = -2.254148\ \alpha^2\ c^2/G$ | $M_*R^* = S^2\ \hbar/c\alpha^2 = 1\ S^2\ \hbar/c\alpha^2$ |
| below $\alpha^2$ bound $= 21.601528$ | $= 78.711760\ \hbar/c\alpha^2 = 45.531685$ |
| $M_*/R\sim = \alpha^2\ (\alpha\mu)^{-1}\ m_o/l_o = -1.127074\ \alpha^2\ c^2/G$ | $M_*R\sim = (\alpha\mu)^{-1}\ S^2\ \hbar/c\alpha^2 = -1.127074\ S^2\ \hbar/c\alpha^2$ |
| below $\alpha^2$ bound $= 22.728602$ | $= 77.584687\ \hbar/c\alpha^2 = 44.404611$ |
| $M_*/R_* = \alpha^2\ m_o/l_o = \alpha^2\ c^2/G = 23.855676$ | $M_*R_* = (\alpha\mu)^{-2}\ S^2\ \hbar/c\alpha^2 = -2.254148\ S^2\ \hbar/c\alpha^2$ |
| on the $\alpha^2$ bound | $= 76.457612\ \hbar/c\alpha^2 = 43.277537$ |

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STARFRM3.WPD APRIL 23, 2000

# STAR FRAMES PART III

THE SUN

The values in these tables are the observed and frame positions for the sun.

TABLE I [values are $\log_{10}$]

| SOLAR | Observed | Frame | Frame Value |
|---|---|---|---|
| MASS 1 | 33.298657 g | $(S/\alpha\mu)\ m_o$ | 33.566607 g |
| MASS 2 | 33.298657 g | $(S/\alpha\mu)\ \alpha^{1/8}\ m_o$ | 33.299503 g |
| RADIUS 1 | 10.842302 cm | $(\alpha\mu S/\alpha^2)\ l_o$ | 11.965079 cm |
| RADIUS 2 | 10.842302 cm | $(S/\alpha^2)\ l_o$ | 10.838005 cm |

$\Delta$ Frame Mass 1 - Frame Mass 2 = 0.267104 = $\alpha^{1/8}$
$\Delta$ Frame Mass 1 - Observed Solar Mass = 0.267950
$\Delta$ Frame Mass 2 - Observed Solar Mass = 0.000846 ~ antilog 1.0018 or 2 parts per thousand

$\Delta$ Frame Radius 1 - Frame Radius 2 = 1.127074 = $\alpha\mu$
$\Delta$ Frame Radius 1 - Observed Solar Radius = 1.122777
$\Delta$ Frame Radius 2 - Observed Solar Radius = 0.004297 ~ antilog 1.009 or 9 parts per thousand

We conclude the Solar Mass = $(S/\alpha\mu)\ \alpha^{1/8}\ m_o$ and the Solar Radius = $(\alpha\mu)^{-1}/\alpha^2\ (\alpha\mu S)\ l_o$ conforming to $(S/\alpha\mu)^n\ m_o$ for mass and $(\alpha\mu S)^n\ l_o$ for size.

TABLE II

| Observed Solar | Frame Value (2) |
|---|---|
| M/R = 22.456355 | M/R = 22.461498 |
| MR = 44.140959 | MR = 44.137508 |

The $\alpha^2$ boundary = $\alpha^2\ m_o/l_o = \alpha^2\ c^2/G$=23.855676 ; $S^2\hbar/c\alpha^2$ = 45.531685

Observed differences:

$\Delta$ Solar M/R and $\alpha^2$ boundary = $\log_{10}(1.399321)$ or 25.079623
$\Delta$ Solar MR and $S^2\ \hbar/c\alpha^2$ = $\log_{10}(1.390726)$ or 24.588158

The mean density of the sun is: (M/V)

$\rho = \log_{10}(0.149662)\ g/cm^3$ or 1.411 $g/cm^3$

The mass of the sun is given <u>exactly</u> by:

$$M = 1 + (\alpha\mu)^{-17/8}\ S\ m_o = 1 + 32.298648 = 33.298648$$

probably a numerical coincidence.

STARFRM4.WPD APRIL 25, 2000

# STAR FRAMES PART IV
## FRAME DENSITIES

All values are $\log_{10}$ values. Densities are given as $M/R^3$;
To convert to Mass/spherical Volume, subtract 0.622089; [$M/R^3 - 0.622089 = M/V$]
Density of the Planck particle: $m_o/l_o^3 = c^5/\hbar G^2 = 93.712439$ g/cm$^3$
Density of a proton: $m_p/r_e^3 = 13.873602$ g/cm$^3$

| NEUTRON STARS | $M^*$ | $M\sim$ | $M_*$ |
|---|---|---|---|
| $R^*$ | 12.746528 SL | 11.619454 1Q | 10.492380 1Q |
| $R\sim$ | 16.127747 2Q | 15.000673 SL | 13.873599 1Q |
| $R_*$ | 19.508972 2Q | 18.381898 2Q | 17.254824 SL |

SL = on the Schwarzschild bound; 1Q = in first quadrant; 2Q = in second quadrant
Note: The $M_*/R\sim^3$ density is identical with that of the proton. This suggests that the proper equations for mass and radius of a neutron star are $(S/\alpha\mu)m_o$ and $S\,l_o$ respectively. [However, the proton uses $(\alpha\mu/S)^{1/2}\,m_o$ and $(\alpha\mu S)^{1/2}\,l_o$ respectively.]

| " $\alpha^2$ " STARS | $M^*$ | $M\sim$ | $M_*$ |
|---|---|---|---|
| $R^*$ | -0.074482 ON | -1.201556 B | -2.328630 B |
| $R\sim$ | 3.306740 A | 2.179666 ON | 1.052592 B |
| $R_*$ | 6.689762 A | 5.562688 A | 4.535077 ON |

ON = on the $\alpha^2$ bound; A = above the $\alpha^2$ bound; B = below the $\alpha^2$ bound
Note: For the sun $M/R^3 = 0.771751$, which differs from $M_*/R\sim^3$ by a factor of about 2.
The solar $M/V = 0.149662$ or antilog 1.411 g/cm$^3$

| UNIVERSE | $M^*$ | $M\sim$ | $M_*$ |
|---|---|---|---|
| $R^*$ | - 27.736426 | - 29.427037 X | - 31.117648 X |
| $R\sim$ | - 22.664593 C | - 24.355204 C | - 26.045815 C |
| $R_*$ | - 17.592760 C | - 19.283371 C | - 20.973982 C |

In an homogeneous isotropic model, the critical density is $\rho_c = 3H_o^2/8\pi G$. If the present density is $\rho_o$ and $\Omega_o = \rho_o/\rho_c$, then the universe will expand forever if $\Omega_o < 1$ or will collapse if $\Omega_o > 1$. Taking $H_o$ as 71.977 km/s/mpc, [$T_U = 17.456065$], $\rho_o = -27.736426$ g/cm$^3$ $\equiv \rho_c$ if the mass of the universe is given by $M^*$ and the radius by $R^*$. In the above table X means if this is $\rho_o$, the universe will expand forever, and C means with this value of $\rho_o$ the universe will collapse. If the present density = the critical density [$\Omega_o$=1], then the universe is stable.

COSMFRM1.WPD APRIL 28, 2000

# COSMIC FRAME PART I

THE HUBBLE UNIVERSE FRAME The values in these tables are the allowed positions.

TABLE I [values are $\log_{10}$] [$\alpha^2 = - 4.273670$]

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{3/2}\, m_o = 56.062232$ | $S^{3/2}\, m_o = 54.371621$ | $(S/\alpha\mu)^{3/2}\, m_o = 52.681010$ |
| RADIUS | $(\alpha\mu S)^{3/2}\, l_o = 27.932886$ | $S^{3/2}\, l_o = 26.242275$ | $(S/\alpha\mu)^{3/2}\, l_o = 24.551664$ |
| TIME | $(\alpha\mu S)^{3/2}\, t_o = 17.456065$ | $S^{3/2}\, t_o = 15.765454$ | $(S/\alpha\mu)^{3/2}\, t_o = 14.074843$ |

$M^*$ = max mass, $M\sim$ = mean mass, $M_*$ = min mass
$R^*$ = max radius, $R\sim$ = mean radius, $R_*$ = min radius

TABLE II [$S^3\, m_o l_o = 80.613896$ ]

| | |
|---|---|
| $M^*/R^* = m_o/l_o = c^2/G = 28.129346$ | $M^*R^* = (\alpha\mu)^3\, S^3\, m_o l_o = (\alpha\mu)^3\, S^3\, \hbar/c =$ |
| on the Schwarzschild bound | $= 83.995118$ |
| $M^*/R\sim = (\alpha\mu)^{3/2}\, m_o/l_o = 29.819957$ | $M^*R\sim = (\alpha\mu)^{3/2}\, S^3\, m_o l_o = 82.304507$ |
| in the second quadrant | |
| $M^*/R_* = (\alpha\mu)^3\, m_o/l_o = 31.510568$ | $M^*R_* = S^3\, m_o l_o = 80.613896$ |
| in the second quadrant | |
| $M\sim/R^* = (\alpha\mu)^{-3/2}\, m_o/l_o = 26.438735$ | $M\sim R^* = (\alpha\mu)^{3/2}\, S^3\, m_o l_o = 82.304507$ |
| in the first quadrant | |
| $M\sim/R\sim = m_o/l_o = c^2/G = 28.129346$ | $M\sim R\sim = S^3\, m_o l_o = 80.613896$ |
| on the Schwarzschild bound | |
| $M\sim/R_* = (\alpha\mu)^{3/2}\, m_o/l_o = 29.819957$ | $M\sim R_* = (\alpha\mu)^{-3/2}\, S^3\, m_o l_o = 78.923285$ |
| in the second quadrant | |
| $M_*/R^* = (\alpha\mu)^{-3}\, m_o/l_o = 24.748124$ | $M_*R^* = S^3\, m_o l_o = 80.613896$ |
| in the first quadrant | |
| $M_*/R\sim = (\alpha\mu)^{-3/2}\, m_o/l_o = 26.438735$ | $M_*R\sim = (\alpha\mu)^{-3/2}\, S^3\, m_o l_o = 78.923285$ |
| in the first quadrant | |
| $M_*/R_* = m_o/l_o = c^2/G = 28.129346$ | $M_*R_* = (\alpha\mu)^{-3}\, S^3\, m_o l_o = 77.232674$ |
| on the Schwarzschild bound | |

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MASSRADS.WPD MAY 8, 2000

# MASSES AND RADII

The values in this table are for baryons.

| | minimum mass | mean | maximum mass |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{-1/2}m_o$=-24.903676 | $S^{-1/2}\ m_o$ = -24.340139 | $(S/\alpha\mu)^{-1/2}\ m_o$=-23.776602 |
| RADIUS | $(S/\alpha\mu)^{1/2}\ l_o$= –13.677142 | $S^{1/2}\ l_o$ = -13.113605 | $(\alpha\mu S)^{1/2}l_o$= -12.550068 |

The values in this table are for quasi dark matter

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{1/2}m_o$= 15.579278 | $S^{1/2}\ m_o$ = 15.015741 | $(S/\alpha\mu)^{1/2}\ m_o$= 14.452204 |
| RADIUS | $(\alpha\mu S)^{1/2}l_o$=-12.550068 | $S^{1/2}\ l_o$ = -13.113605 | $(S/\alpha\mu)^{1/2}\ l_o$=-13.677142 |

The values in this table are for neutron stars .

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\ m_o$ = 35.820755 | $S\ m_o$ = 34.693681 | $(S/\alpha\mu)\ m_o$= 33.566607 |
| RADIUS | $\alpha\mu S\ l_o$ = 7.691409 | $S\ l_o$ = 6.564335 | $(S/\alpha\mu)\ l_o$ = 5.437261 |

$M^*$ = max mass, M~ = mean mass, $M_*$ = min mass
$R^*$ = max radius, R~ = mean radius, $R_*$ = min radius

The values in this table are for normal stars . [$\alpha^2$ = - 4.273670]

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $\alpha\mu S\ m_o$ = 35.820755 | $S\ m_o$ = 34.693681 | $(S/\alpha\mu)\ m_o$= 33.566607 |
| RADIUS | $(\alpha\mu S)\ l_o/\alpha^2$ = 11.965079 | $S\ l_o/\alpha^2$ = 10.838005 | $(S/\alpha\mu)\ l_o/\alpha^2$ = 9.710331 |

The values in this table are for the Hubble universe.

| | maximum | mean | minimum |
|---|---|---|---|
| MASS | $(\alpha\mu S)^{3/2}\ m_o$= 56.062232 | $S^{3/2}\ m_o$ = 54.371621 | $(S/\alpha\mu)^{3/2}\ m_o$= 52.681010 |
| RADIUS | $(\alpha\mu S)^{3/2}\ l_o$ = 27.932886 | $S^{3/2}\ l_o$ = 26.242275 | $(S/\alpha\mu)^{3/2}\ l_o$ = 24.551664 |
| TIME | $(\alpha\mu S)^{3/2}\ t_o$ = 17.456065 | $S^{3/2}\ t_o$ = 15.765454 | $(S/\alpha\mu)^{3/2}\ t_o$ = 14.074843 |

PBMUTUAL.WPD JANUARY 7, 2001

# PLANCK PARTICLE–BARYON MUTUALITIES PART I

It is the present hypothesis that existing entities come into being, not by uni-directional *causality*, but by some form of bi-directional *mutuality*. In the case of frequencies such mutualities are the well known phenomenon of resonance. But in other parameters some other form of ~~resolution~~ resonance may be operating. [all numbers are $\log_{10}$]

The Mass–Size Mutuality

| | P | | B | δ | |
|---|---|---|---|---|---|
| M | -4.662199 | \ | -23.776602 | -19.114403 | $= (\alpha\mu)^{½} S^{-1/2}$ |
| L | -32.791545 | / | -12.550068 | +20.241477 | $= (\alpha\mu)^{½} S^{1/2}$ |

This mutuality infers that in a one dimensional world $(\alpha\mu S)^{1/2}$ planck particles would space-wise fit into one baryon. In a two dimensional world $(\alpha\mu S)$ planck particles would fit into one baryon, and in a three dimensional world $(\alpha\mu S)^{3/2}$ planck particles would fit into one baryon. One approach to the resolution of this mutuality could be through some form of *completion*.

One-dimensional completion:
If we convert to planck units, taking the planck length as 1, the size of the baryon becomes the above, +20.241477. If this be taken as the diameter of a ring, R, the radius would be, +19.940447. The diameter of a planck particle located on a ring of radius R would subtend an angle of −19.940447 radians; $2\pi$ x this number = 20.738627, would be the number of planck particles that would complete the ring. The mass of this ring would be 16.076428 grams.

Two-dimensional completion:
A disk of radius R would have a planck area of $\pi R^2 = 40.378044$. The "cross section area" of a planck particle is $\pi/4 = -0.104910$, hence the number of planck particles in the disk would then be 40.482954 = $\alpha\mu S$. This disk would have a mass of 35.820755 grams.
Alternatively, a two-dimensional completion could be obtained in a spherical shell. The area of such a shell would be $4\pi R^2$, four times the area of the above disk. This would require four times the number of planck particles or 41.085014 particles. This shell would have a mass of 36.422815 grams.

Three-dimensional completion:
A sphere of radius R would have a planck volume of $4\pi R^3/3$; the "volume" of a planck particle would be = $\pi/6$; hence the number of planck particles to complete the sphere would be $8R^3$, which is = 60.724413 = $(\alpha\mu S)^{3/2}$. The mass of this sphere would be 56.062214 grams.

The mass of the sphere is of the order of the estimated mass of the universe. The mass of the disk is of the order of maximum stellar mass. ( inferring $10^{20}$ stars in the universe). The mass of $10^{16}$ grams may be a clue to hypothetical dark matter.

SPMAFREQ.WPD MARCH 9, 2001

# SPACE, MATTER, AND FREQUENCY

Space and matter breathe, they are vibratory. Both oscillate at many frequencies and interact by resonating, interfering, and modulating. Space oscillates between expansion and contraction [expansion and contraction may even include changes in the number of dimensions]. Matter oscillates between fragmenting and merging; and space and matter together oscillate between existence and non-existence. Minkowski joined space with time to create "space-time". Einstein then showed that the existence of space-time depended on the existence of matter. Space-time is an attribute of matter and matter is an attribute of space-time, they are mutually causal. And an empty space-time would not exist.

The relations between the Planck particle and the baryon give us an example of interactions between space-time and matter. We shall here assume that the Planck particle, whose mass, $m_o = -4.662199$ gm, and whose size. $l_o = -32.791545$ cm, fragments into a baryon and three other particles. We take the mass of the proton to be $m_b = -23.776602$ gm; and the Radius to be $r_e = -12.550068$ cm (All values are $\log_{10}$ values)

TABLE I

| Particle | mass gm | size cm | M x R cgs | M/R cgs |
|---|---|---|---|---|
| [1] baryon | –23.776602 | –12.550068 | –36.326670 | –11.226534 |
| [2] mini black hole ? | +15.579276 | –51.905964 | –36.326670 | +67.485240 |
| [3] | –23.776602 | –51.905964 | –75.682566 | +28.129362 |
| [4] | +15.579276 | –12.550068 | +3.029208 | +28.129344 |

TABLE II

| Particle | MxR Planck values | M/R Planck values | Quadrant |
|---|---|---|---|
| [1] baryon | $\alpha\mu\hbar/c$ | $S^{-1}\ c^2/G$ | 1° |
| [2] mini black hole ? | $\alpha\mu\hbar/c$ | $S\ c^2/G$ | 2° |
| [3] | $S^{-1}\ \alpha\mu\hbar/c$ | $c^2/G$ | On S.B. 3°–4° |
| [4] | $S\ \alpha\mu\hbar/c$ | $c^2/G$ | On S.B 1°–2°. |

Where, $\hbar$ is Planck's constant, = –26.976924 cgs units; $\alpha$ is the fine structure constant, = –2.136835; $\mu$ is the proton/electron mass ratio = 3.263909; and S is the coulomb/gravitational force ratio = +39.355878. $\alpha$, $\mu$, and S are dimensionless constants.
S.B. = the Schwarzschild Boundary, where $M/R = c^2/G = +28.129362$ cgs

## FOUR QUADRANTS

The cosmos may be divided into four quadrants according to the following rules:

| | S.B. | H.B. | |
|---|---|---|---|
| First quadrant: | $M/R < c^2/G$; | $MR > \hbar/c$ | (Normal matter, atoms, stars, etc) |
| Second quadrant: | $M/R > c^2/G$; | $MR > \hbar/c$ | (Black holes ) |
| Third quadrant: | $M/R > c^2/G$; | $MR < \hbar/c$ | ? |
| Fourth quadrant: | $M/R < c^2/G$; | $MR < \hbar/c$ | (photons, etc.) |

H.B. = the Heisenberg Boundary, where $\hbar/c = -37.453745$ cgs.

Baryons reside in the first quadrant, where those such as protons are relatively stable. Particle 2 resides in the second or black hole quadrant where it is relatively stable. However particle 3 and particle 4 lie <u>on</u> the Schwarzschild boundary, an unstable watershed, where a perturbation into the first quadrant would result in expansion or into the second quadrant ~~resulting in~~ with contraction.

## ENERGY

TABLE IIIa The $Mc^2$ or Mass Energy [1,0]

| Particle | $Mc^2$ cgs | $Mc^2$ Planck units | $Mc^2$ Planck values |
|---|---|---|---|
| [1] baryon | −2.822960 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [2] mini black hole | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| [3] | −2.822960 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | +67.419912 | + 2.254144 | $(\alpha\mu)^2$ |

$c^2 = 20.953642$ cgs units The brackets [p,q] refer to the exponents $M^p$ and $R^q$

TABLE IIIb The $\hbar c/R$ or Space Energy [0,−1]

| Particle | $\hbar c/R$ cgs | $\hbar c/R$ Planck units | $\hbar c/R$ Planck values |
|---|---|---|---|
| [1] baryon | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| [2] mini black hole | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [3] | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [4] | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911656 | −2.254144 | $(\alpha\mu)^{-2}$ |

$\hbar c = -16.500102$ cgs units

ENERGY (continued)

TABLE IIIc The $\hbar c^3/GM$ Energy [−1,0]

| Particle | $\hbar c^3/GM$ cgs | $\hbar c^3/GM$ Planck units | $\hbar c^3/GM$ Planckvalues |
|---|---|---|---|
| [1] baryon | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [2] mini black hole | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| [3] | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [4] | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911656 | −2.254144 | $(\alpha\mu)^{-2}$ |

$\hbar c^3/G$ = + 11.629246 cgs units

TABLE IIId The $c^4R/G$ Energy [0.1]

| Particle | $c^4R/G$ cgs | $c^4R/G$ Planck units | $c^4R/G$ Planckvalues |
|---|---|---|---|
| [1] baryon | 36.532921 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| [2] mini black hole | −2.822975 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [3] | −2.822975 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | 36.532921 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | 67.419892 | 2.254144 | $(\alpha\mu)^2$ |

$c^4/G$ = 49.082989 cgs units

From the above four tables, we have the first order energy sums for the four particles:
$Mc^2$ or [1,0] energy = $(\alpha\mu)^2$; $\hbar c/R$ or [0,−1] energy = $(\alpha\mu)^{-2}$;
$\hbar c^3/GM$ or [−1,0] energy = $(\alpha\mu)^{-2}$; $c^4R/G$ or [0,1] energy = $(\alpha\mu)^2$

The total of these four energies = 0; and since the total energies of the Planck particle are zero, we conclude that in the decay of the Planck particle into a baryon and particles [2], [3], and [4], energy has been conserved.

However, there are numerous 'higher order' energies, $\hbar\nu$, corresponding to all allowable frequencies, $\nu$, that involve additional integral and fractional exponents [p,q], $M^p$ and $R^q$. From symmetry considerations, all of these may be paired, [p,q] with [-p,-q], so that the energies sum to zero. Thus the decay of the Planck particle into the four above described particles obeys the first law of thermodynamics for all energies. An additional example showing paired energies is given in TABLE IIIe [2,-1], and in TABLE IIIf [-2,1].

Example of [p,q] energy symmetry:

TABLE IIIe The $GM^2/R$ or Gravitational Energy [2,–1]

| Particle | $GM^2/R$ cgs | $GM^2/R$ Planck units | $GM^2/R$ Planck values |
|---|---|---|---|
| [1] baryon | –42.178842 | –58.470284 | $(\alpha\mu S)^{-3/2}\,(\alpha\mu)^2$ |
| [2] mini black hole | +75.888810 | +59.597368 | $(\alpha\mu S)^{3/2}/(\alpha\mu)^{-1}$ |
| [3] | –2.822960 | –19.114402 | $(\alpha\mu/S)^{½}$ |
| [4] | +36.532916 | +20.241474 | $(\alpha\mu S)^{½}$ |
| sum of values | +67.419912 | + 2.254144 | $(\alpha\mu)^2$ |

G = –7.175706 cgs units

TABLE IIIf The $c^5\,\hbar R/G^2M^2$ Energy [–2.1]

| Particle | $c^5\hbar R/G^2M^2$ cgs | $c^5\hbar R/G^2M^2$ Planck | $c^5\hbar R/G^2M^2$ values |
|---|---|---|---|
| [1] baryon | +74.761729 | +58.470286 | $(\alpha\mu S)^{3/2}\,(\alpha\mu)^{-2}$ |
| [2] mini black hole | –43.305931 | –59.597375 | $(\alpha\mu S)^{-3/2}/(\alpha\mu)$ |
| [3] | +35.405833 | +19.114389 | $(\alpha\mu/S)^{-1/2}$ |
| [4] | –3.950035 | –20.241479 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911596 | –2.254144 | $(\alpha\mu)^{-2}$ |

$c^5\hbar/G^2$ = 39.758593 cgs units

$[2,-1] + [-2,1] = (\alpha\mu)^2 + (\alpha\mu)^{-2} = 0$

GEONRGY.WPD February 15, 1999

# GEOMETRY __ENERGY

The basic equation of the general theory of relativity,

$$R_{ij} = 8\pi G\left(T_{ij} - \frac{1}{2} g_{ij} T\right)$$

where $R_{ii}$ is the curvature tensor, $T_{ii}$ is the stress-energy tensor, and $g_{ii}$ is the metric tensor, states that the geometry (curvature and metric) and the dynamics (stress-energy) of a system determine one another. Or as J. A. Wheeler succinctly puts it:

> Curvature tells matter how to move;
> Matter tells space time how to curve.

This interaction between geometry and force-energy has been confirmed by many astronomical and physical observations. The equation has been applied mostly in attempts to describe the large scale structure and behavior of the universe, for which purpose it is assumed that the universe is both homogeneous and isotropic because of the great difficulty in solving the equations for more complex configurations. The implications of this equation have been revolutionary in both astronomy and physics, and currently generalizations are sought that will include all the known forces of physics. But in this essay a different kind of generalization is sought.

It is tautological to note that the dynamic capabilities of all systems, animate and inanimate, are both enabled and limited by their form or structure. Historically interactions between structure and behavior have long been recognized. Centuries ago Plato described a realm of archetypes or templates that manifest themselves as behavior or energy patterns in the material world. Einstein's equation marries the structure of space-time to the behavior of bodies in the material world. Plato's dichotomy is information (template or scenario) // form-behavior in the material world. Einstein's dichotomy is structure (information) of space-time // behavior of material objects. If the realm of archetypes is the equivalent of space-time then Plato and Einstein are conceptually in accord. However there may be an important difference. In the material world both energy and information (matter is energy plus information) are present. But what about space-time? Does it contain only information (geometry = pure information) or is space-time itself a species of energy? The equations put information into the curvature and metric tensors and energy into the stress tensor. Is this separation totally correct?

We note here that energy is proportional to frequency:

$$E = \hbar\nu$$

Hence we may consider space-time as space-~~t~~energy. That is energy is implicitly contained in space-time. So called "empty" space, since it contains "free" energy, will necessarily expand. No cosmological constant is required.

GEONRGY.WPD p.2

If not only information but also energy is present in space-time then both the material world of physical things and the world of archetypes contain both information and energy. An archetype is then more than a template or scenario, it is a species of energy.

Let us redo Plato. Instead of a realm of pure information, let us hypothesize a realm of non material energy forms. That is energy plus information need not necessarily result in matter.

SDAPHORS.WPD July 21, 2008

In his **Accent on Form** L.L.Whyte regards pattern as the dynamic idea of the science of the future, just as number, space, time, atom, energy, organism, mind ,unconscious mind, historical process and statistics have each in turn been the dynamic ideas of the past, serving as he says, "directly as instruments for understanding the universe, To understand anything, one must penetrate sufficiently deeply towards the ultimate pattern. Only a new scientific doctrine of structure and form, i.e. pattern, can suggest the crucial experiments which can lead to the solution of the master problems of matter, life and mind."

**A special feature of the development of physics in the nineteenth century has been the arising of general principles beside the special laws, such as the principles of conservation of mass and of energy, the principle of least action, and the like. These differ from the special laws, not only by being more general, but they aspire, so to say, to a higher status than the laws. Their claim is that they express fundamental facts of nature, general rules, to which all special laws have to conform. And they accordingly exclude a priori all attempts at "explanation" by hypotheses or mechanical models. It is characteristic of the theory of relativity that it enables us to include all these principles of conservation in one single equation. December 28,2007**

Willem DeSitter
**Kosmos, Harvard Univ. Press 1932**

Entitation is vastly more important than quantitation. Let us look at the universe in terms of some new kinds of entities, some new kinds of units; or, what really comes to the same thing, in some new way of combining units, because combining units gives a new unit at the superordinate level "

–Ralph Gerard November 1968

The world of symbols is but a faint echo of the world they claim to represent.
Yet
"SYMBOLS PARTICIPATE IN THE WORLD THEY REPRESENT"
—Paul Tillich

"The cosmic diagram suggests some form of resonance as the process of morphogenesis, as sand collects at the nodes on a vibrating drum head, matter concentrates at nodes corresponding to the set of frequencies $S^{3/2-\nu}f_o$. This raises many physical questions. Most importantly what is it that is pulsating or vibrating at these frequencies– some substratum, matter itself, or what? Analogies to familiar equations suggest that from the cosmic diagram, we have a set of eigen values representing mass levels, energy levels, or frequencies that are solutions to some 'cosmic wave equation'."

from Hierarchical Structures in the Cosmos, 1969
Hierarchical Structures, Whyte, Wilson and Wilson

Reality is a consensus derived from temporal and spatial continuity. But all continuity, both temporal and spatial is illusory. Hence, to think about the universe at all we must consider its *measure.* Where by measure is meant Lebesgue measure.

Both space and time are dyadic in nature. Space is divided into extension and separation, time is divided into duration and interval ("while and until"). If these dyads are viewed with higher resolving power, the concept of density is involved. In the case of physical space, matter density, $\rho$. When $\rho = 0$, there is pure separation, when $\rho > 0$, there is some sort of extension. Similarly with time. The Kepler-Newton law,

(1)
$$T=2\pi\frac{R^{3/2}}{\sqrt{GM}}$$

states that time $\propto \rho^{-1/2}$. Thus when $\rho = 0$, T is infinite. Spatial separation is associated with infinite time or eternity. But when $\rho > 0$, time is finite having duration and space possesses extension.

Aristotle based the idea of change on motion, in fact holding they were equivalent. (What about color change?) Assuming he is right, then all change is related to velocity, which is space/time.

(2)
$$\frac{SPACE}{TIME}=\frac{\rho}{\rho^{-1/2}}=\rho^{3/2}$$

But this quantity is assumed in relativity theory to be bounded. In particular linear velocities are bounded by c, the velocity of light. We conclude that $\rho^{3/2}$ is bounded by some appropriate power of the velocity of light.

Bring in Hausdorf dimension

$\leq$ 2 ; more than 2 spaces$^2$;
times$^2$;

FORMULAE.WPD JANUARY 9, 2001

# PHYSICS AND SOCIETY

It is amusing to note that certain formulae from physics, when generalized beyond their proper domain of proven applicability, still appear to apply. This is especially so when the physical meanings are replaced by somewhat parallel psychological meanings. Some examples:

The Heisenberg uncertainty principle tells us that,

$$E \times T \geq \hbar$$

This means that the product of energy, E and time, T must be greater than some constant. If T, for example is shortened then E must be increased in order to preserve the inequality. Or if E is reduced then T must be increased. Translating this into the vernacular, it says that if we want to be time efficient, do something in a shorter time, then it is going to take more energy. Of if we wish to consume less energy for a given task then it will take more time. In other words, the principle tells us that there is a trade off between time efficiency and energy efficiency. To go from St. Louis to Kansas City by covered wagon is going to require a lot less energy than to go by jet plane. But it sure will take longer. So if we need to save energy, slow down!

Another example comes from Bernoulli's formula, which says,

$$p + \rho v^2 = k$$

This equation tells us that the sum of the pressure, p, and the product of the density, $\rho$, times the velocity, v, squared is a constant. Assume there is what we might call a "threshold pressure" beyond which we flip and go into some form of rage. Then we might let

$$k - p$$

represent this pressure, which is a constant [but has different values for different people]. Now this rage pressure will be governed by the product of density and speed. Consider the case of freeway traffic. If we are driving along at a certain speed which we wish to maintain, and the density increases, we must either slow down or go into road rage [or both]. This equation tells us what we already know, that the greater the density the slower we have to go. But it also tells us that for every combination of density and speed there is a critical rage pressure which is proportional to $\rho v^2$ . The increase in road rage in recent years is the result of the density increase which forces us to go slower. I suppose we will just have to change our subjective value of $k - p$, because it appears that $\rho$ is going to continue to increase.

There is a third example that comes, not from physics, but from mathematics. This is Gödel's famous incompleteness theorem. This theorem in its pristine form says that a structure at least as complex as arithmetic is incapable of proving all theorems that may be valid within that structure. Another way this has been put is to say there is a trade off between completeness and consistency. Take the example of a filing system. If there is a well ordered file that allows ready retrieval, then the file will not be complete. If the file is complete, containing all your stuff, then it must have a miscellaneous category that does not lend itself to ready retrieval. Another rewording of the theorem, nothing (except possibly Pope Pius IX) can fully validate or explain itself.. However, philosophically, it says that there are limits to the logical and the rational. There is a reality that lies beyond access to our reason alone.

# THE UR VIBRATIONS

Some recent ideas in modern physics have pointed to the underlying structure of the physical world as being not matter but rhythm. Some physicists, such as J.A. Wheeler, even hold that the ultimate or ur reality is thought. Similar ideas have been around for a few decades:

> "The cosmic diagram suggests some form of resonance as the process of morphogenesis, as sand collects at the nodes on a vibrating drum head, matter concentrates at nodes corresponding to the set of frequencies $S^{3/2-v} f_o$. This raises many physical questions. Most importantly what is it that is pulsating or vibrating at these frequencies--some substratum, matter itself, or what? Analogies to familiar equations suggest that from the cosmic diagram, we have a set of eigen values representing mass levels, energy levels, or frequencies that are solutions to some 'cosmic wave equation'."
>
> from Hierarchical Structures in the Cosmos, 1969
> Hierarchical Structures, Whyte, Wilson and Wilson

[The following from notes Santa Fe, New Mexico, 95/07/13]

The ur vibrations in the world result in infinite bonding and dissolving combinations. This is the nature of Sunyata, the ur process manifesting as impermanence and sustaining change.

In the absence of iteration of this repetitive bonding-dissolving operation nothing permanent occurs. A 'Parmenidean" factor beyond the fundamental bonding-unbonding must be present. Some bonds must survive to serve as the elements of more complex bondings. We then ask, what processes can sustain a bonding? What is there that renders iteration possible?

One candidate is two level bonding. One level bonding is forever immediately dissolved. But two level bonding can be both sustainable and iteratable. The Tathagata Akshobya symbolizes the processes leading to sustainment and allowing iteration. We may think of the 'Akshobya operation' as self-reference, naming, sealing, mirroring (but not cloning).

Another process lies in the domain of the Tathagata Ratna Sambhava. This consists giving an address to a bonding, a reference to space and time, thus establishing two levels, address and content.

A triple bonding is also one capable of sustainment. While the probabilities of single encounters or two element bonding are high, the probability of three element bonding is remote.

Levels of bonding have different orders of lifetimes. This is apparent in the meso and macro worlds, the more massive structures having the longer lifetimes. It presumably is also true in the micro and micro-micro worlds. The elemental bonding to which we have been referring may have a lifetime of the order of a few planck units, i.e. the order of $10^{-42}$ seconds.

It also appears that at higher levels the bonded structures acquire a certain exclusiveness, that is respond only to certain eigen values. We see this in atomic and molecular spectra and in a different form, but conceptually the same, in the ability of diverse species to mate only with 'eigen-species'. This is a boundary condition for natural selection.

At a certain level of sophistication, the bonding structures acquire the ability to replicate and to beget. [Replication or cloning produces identical elements, while begetting is capable of creating variant elements that are also capable of replication and inter-bonding.]

Recapitulating:

Sustainment is effected by

1. Two or more levels or dimensions
2. Some form of self reference, such as mirroring
3. Simultaneous triple or higher encounter bonding
4. Additional sustainment is effected by linking to other bonded structures.

[1,2 and 3 are Vairacona-Akshobya, 4 is Ratna Sambhava]

Are bonds intersects or unions and what role does the degree of overlap play?

[Add material on standing waves]

# THE ENTIFICATION MANIFESTO

*"Entitation is vastly more important than quantitation. Let us look at the universe in terms of some new kinds of entities, some new kinds of units; or, what really comes to the same thing, in some new way of combining units, because combining units gives a new unit at the superordinate level "* –Ralph Gerard November 1968

Four Perspectives

Entity, the particle view
Resonance, the wave view
Pattern, the dimensional view
Fractal, the level view

Every entity has a presence and an absence, a manifest aspect and an unmanifest aspect.

Manifest: [sensory], material, nodes, Nuclei
P-SPACE, position in space and time
H-SPACE form, shape, scale
Unmanifest: [feeling] vibratory, links, Cells
B-SPACE bonds, forces, resonance

Four Species of Entities

Things: inanimate, rocks, artifacts
Aggregates of multiplicity: crystals, flocks, schools, sponges
Aggregates of diversity: ecologies, societies
Organisms: lives of their own, reproduce, mortality, subvert the 2nd Law

Multiplicities contend, diversities converge, i.e. Flocks fight, ecologies emerge
Each of the four species may be multi-level, i.e. a fractal
At what level does intention, will, purpose enter?
Which species may be "holographic"?
Function vs Pattern
Are wholes always loops?
Standardization vs Specialization
Are storms, fires, wars organisms?
{[cf. "The Empty Quadrant", Entity and Architecture ]}
Units
Planck system based on the fundamental constants: **c, G,** and $\hbar$
Physical Dimensions:

Length: extension and separation
Time: duration and interval
Mass: energy and information

# AN ENTIFICATION MANIFESTO

*"Entitation is vastly more important than quantitation. Let us look at the universe in terms of some new kinds of entities, some new kinds of units; or, what really comes to the same thing, in some new way of combining units, because combining units gives a new unit at the superordinate level "*

–Ralph Gerard November 1968

An ontology consists of a set of entities and their interrelations. What we **perceive** to be entities depends on our biology. What we **infer** to be entities depends on our epistemology. That is to say, the manifest portions of entities are the product of sensory experience, the unmanifest portions are the product of our way of thinking. Hence, a call to re-entify is a summons both to enhance and extend our perceptions and to modify and deepen our modes of reasoning. We select what we call reality by how we entify.

For centuries we have enhanced and extended the spectra of our perceptions with the development of optical devices such as microscopes and telescopes; auditory devices such as stethoscopes and amplifiers; and meta devices such as radar, sonar, infrared, Xray. etc. But throughout the same centuries little has been done to modify and deepen our modes of reasoning. While it is true that there have been large advances in the power of mathematics to explore the physical aspects of the unmanifest, our dyadic way of thinking has obstructed access to vast portions of reality. Hence, the Entification Manifesto in large part is a call for alternate ways of looking at the unmanifested links and relations between the manifested events and processes of sensory experience. In other words, it is also a call for a **Cognitive Manifesto.**

The century just past has injected many new concepts into our culture, concepts whose entification implications have largely been unexplored. Important among these concepts are:

| | |
|---|---|
| Holograms: | The whole contains each part, each part contains the whole |
| Fractals: | Similarity or isomorphy over different scales |
| Non locality: | Parts in instant communication at any degree of spatial separation |
| Force: | Re-defined as set of particles possessing momentum and direction |
| Oscillation: | Particles or links that oscillate between existence and non-existence |
| Units: | The extension of the Planck system based on **c**, **G**, and **ħ** |
| Life: | Generalization of "living system" to entities with life-like attributes |
| Cell: | The commonality of the cell \| nucleus pattern |
| Subjectivity: | Every fact has a subjective component, an observer orientation |
| Randomness: | Not new, but poorly understood |
| Ecology | |

Any re-entification of the world cannot ignore the possible roles of these items in its structure.

NEW G: -7.175600

Physics Today 2000 July p. 21

$c = 10.476820703$

PLNCK2BN1.WPD $\hbar = -26.976923920$ April 28, 1999

# PHYSICAL QUANTITIES

## $\log_{10}$ cgs units

$\frac{\hbar}{c} = -37.453745$

## Fundamental Constants:

$c = 10.476821$ [L/T]; $G = -7.1757056$ [$L^3/MT^2$]; $\hbar = -26{,}976924$ [$ML^2/T$]

$c^2 = 20.953642$ ; $c^3 = 31.430463$ ; $c^4 = 41.907284$ ; $c^5 = 52.384105$

$c^2/G = 28.129347$[M/L]; $c^3/G = 38.606168$ [M/T]; $c^4/G = 49.082989$ [$ML/T^2$] (Force);

$c^5/G = 59.559810$ [$ML^2/T^3$] (Power) ; $\hbar G/c^4 = -76.059913$ [LT];

$\hbar/c = -37.453745$ [ML]; $\hbar/\alpha^2 c = -33.180075$; $\hbar/c^2 = -47.930\cancel{386}$ 566 [MT]; $\hbar/\alpha^2 c^2 = -43.656\cancel{716}$ 896

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$\hbar c = -16.500102 = $ Planck charge $= \frac{m_o l_o^3}{t_o^2}$

## The Planck Particle

$Pe^2 \cdot \alpha = e^2$

$m_o = \sqrt{(\hbar c/G)} = -4.662199$ [M] $\quad l_o = \sqrt{(\hbar G/c^3)} = -32.791545$ [L]

$t_o = l_o/c = -43.268366 = \sqrt{(\hbar G/c^5)}$ [T] $= \tau_o = \sqrt{(l_o^3/Gm_o)} = -43.268366 = \sqrt{(\hbar G/c^5)}$ [T]

$E_o = m_o c^2 = 16.291442 = \sqrt{(\hbar c^5/G)}$ [$ML^2/T^2$] $= \epsilon_o = Gm_o^2/l_o = 16.291442 = \sqrt{(\hbar c^5/G)}$ [$ML^2/T^2$]

$\varrho_o = c^5/\hbar G^2 = 93.712439$ [$M/L^3$]; $G\varrho_o\tau_o^2 = 1$; $E_o t_o = \epsilon_o \tau_o = \hbar$; $\hbar\nu_o = 16.291442$ ; $\hbar = -26.976923$ $ML^2/T$

---

## The Baryon:

$m_p = \left(\frac{\alpha\mu}{S}\right)^{1/2} m_o$

TORQUE = F × L = [E]

$m_p = -23.776602$ [M] $\quad m_n = -23.776004$ [M]

$r_e = -12.550068$ [L]

$t_b = -23.026889 = r_e/c \quad \tau_b = -3.348949 = \sqrt{(r_e^3/Gm_p)} \sim [= 4.48 \times 10^{-4}$ sec] [T]

$\varrho_b = 13.873602 = m_p/r_e^3$ [$M/L^3$];

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## The Electron:

$m_e = -27.040511$ [M] $\quad m_e = \left(\frac{\alpha}{\mu S}\right)^{1/2} m_o$

$t_e = -23.026889 = r_e/c \quad \tau_e = -1.716994 = (G\varrho_e)^{-1/2} \sim [= 1.9187 \times 10^{-2}$ sec] [T]

$e = -9.318469 \quad e^2 = -18.636938 = \hbar\alpha c$ [$ML^3/T^2$] $\quad e/\sqrt{G} = -5.730617$ [M]

$\varrho_e = 10.609693$ [$M/L^3$] $\quad e^2/\alpha = -16.500103 = q_o^2$

---

$\alpha c = 8.339986$

## Dimensionless Constants:

$\alpha^{1/2} = -1.068418$; $\alpha = -2.136835$; $\alpha^{3/2} = -3.205253$; $\alpha^2 = -4.273670$ $\quad \alpha = -2.136834638$

$\alpha^{1/8} = -0.267104$; $\alpha^{2/3} = -1.424556$

$\mu^{1/2} = 1.631955$; $\mu \doteq 3.263909$; $\mu^{3/2} = 4.895864$; $\mu^2 = 6.527818$

$(\alpha\mu)^{1/2} = 0.563537 = n$; $\alpha\mu = 1.127074$; $(\alpha\mu)^{3/2} = 1.690611$; $(\alpha\mu)^2 = 2.254148$ ; $(\alpha\mu)^3 = 3.381222$

$(\alpha\mu)^{2/3} = 0.751383$; $(\alpha\mu)^{3/4} = 0.845306$; [$\log_{10} 7 = 0.845098$] $\quad (\alpha\mu)^{1/4} = 0.281768$

$S^{1/2} = 19.677940 = N$; $S = 39.355880$; $S^{3/2} = 59.033820$; $S^2 = 78.711760$

---

## Mathematical Quantities:

$\pi = 0.497150$; $2\pi = 0.798180$; $4\pi^2 = 1.596360$; $4\pi/3 = 0.622089$; $8\pi/3 = 0.923119$

$e = 0.434294$; $\Phi = 0.208988$;

---

$a_o$; the Bohr Radius $= -8.276344$

## Miscellaneous Quantities:

No. sec in year: = 7.499112; $T_U = 17.456065$ seconds; $\quad R_{\infty}c = 15.517175$ hertz

$\hbar/[(\alpha c)^2 t_o] = -\cancel{0.365274}$ [M] $\sim 0.\cancel{431247}$ g $= \frac{m_o}{\alpha^2}$

$-0.388530 \quad 0.408762$ g

Lifetime of neutron = 887 sec. $= {}_{10}2.947924 = m$

$D = +15.579275$

Note: $n^2 - 1 = \mu^{3/2}$

$H_o = \frac{978}{H.T.}$ , $H.T. = \frac{3}{2} T_U$

$g_{\oplus} = 2.991521$ cm/sec²

# A GENERALIZATION OF AVAGADRO'S NUMBER

The gram molecular weight of a substance is defined as the amount of a substance whose weight is equal to the molecular weight of the substance measured in grams. Avagadro's number, $N_A$, is the number of particles in a gram molecular weight. Chemists basing their definition on the assumption that $^{12}C=12$, obtained the value $N_A = 6.022\ 136\ 7 \times 10^{23}$, or $\log_{10} N_A = 23.779751$. Physicists using the value of $\log_{10}(m_p) = -23.776602$, for the mass of the proton obtained the value $N_P = 5.978\ 629 \times 10^{23}$ (whose log value is 23.776602). When converted to Planck units these log values become,

Chemists: $N_A = 19.117552$  Physicists: $N_p = 19.114403$

The physicists' value, $N_p$, is precisely equal to the ratio of the Planck mass to the proton mass, [Which is also equal to $[S/\alpha\mu]^{1/2}$, where S is the ratio of the coulomb force to gravitational force, $\alpha$ is the fine structure constant, and $\mu$ is the ratio of the proton mass to the electron mass.]

The equality of the Avagadro number $N_p$ to the ratio of the Planck mass to the proton mass suggests a generalization of Avagadro's number, namely, that $N_p$ represents the number of "particles" of level n that will be found in an aggregate of level n+1. Thus, mass wise,

The number of protons contained in a Planck particle = $N_p$
The number of Planck particles contained in a third level particle $P_3 = N_p$ [1]
The number of $P_3$ particles contained in a star = $N_p$
The number of stars contained in the universe = $N_p$

where $N_p = 1.301377 \times 10^{19}$ and $\log_{10} N_p = 19.114403$.

Using log values,

The baryon mass of -23.776602 g x $N_p$ gives the Planck mass of -4.662199 g
The Planck mass x $N_p$ gives the $P_3$ mass of 14,452204 g
The $P_3$ mass x $N_p$ gives a stellar like mass of 33.566607 g [ = about 2 solar masses]
The stellar mass x $N_p$ gives for the universe aggregate a mass of 52.681010 g

[These values approximate the mass values at each level, except for the proton/Planck ratio which is exact.]

Besides the mass ratio, a second Avagadro type number exists for size. This number is the ratio of the electron radius, $r_e = -12.550068$ cm to the Planck radius, $l_o = -32.791545$ cm [$\log_{10}$ values] and is $L_p = 20.241477$

The Planck size of –32.791545 cm x $L_p$ gives the baryon size of –12.550068 cm
The baryon size of -12.550068 cm x $L_p$ gives a stellar size of 7.691409 cm [2]
The stellar size of 7.691409 cm x $L_p$ gives for the size of the universe 27,932886 cm

[$P_3$ turns out to have the same size as a baryon and may be substituted for it in this series.]

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[1] $P_3$ represents a hypothetical aggregate that may be a candidate for dark matter.

[2] This size is typical of a neutron star.

# THE SPECIES OF SPACE

- METRIC SPACES
  - CURVATURE PARAMETER
    - $K = 0$ EUCLIDIAN OR FLAT SPACE
      - An "interface" space *
      - Has the property that form and scale are independen t †
    - $K \neq 0$ NON-EUCLIDIAN SPACES
      - Positive curvature: Closed spaces
      - Negative curvature: Open spaces
  - DISTANCE ~~w~~ SEPARATION
  - SCALE ~~w~~ FORM
  - DIMENSION PARAMETER
- PROJECTIVE SPACES
- TOPOLOGICAL SPACES
- HAMMING SPACES
  - SIMILARITY SPACES
    - SEPARATION $\propto$ FORM DIFFERENCE
    - Form-metric dependence (not same as form-scale dependence)
- COGNITION SPACES
  - INFORMATION SPACES
  - ENTITY ~~w~~ RELATION NODE - LINK
- INTEGRITY SPACES
  - TOTAL RELATIONAL MODULES [NODES]
    - No internally severed relations
      - GLOBAL
      - LOCAL
- PARTIAL RELATIONAL MODULES
    - ORGANISMS
- SOLIPSISTIC MODULES
  - No contexts

* Flat euclidian space, the space in which we physically exist, is an interface space between open and closed spaces. Being an interface it is not surprising that it is a breeding region for complex systems.

† In non-flat metric spaces form and size are not independent. There are no such things as similar triangles, for example, i.e. same shape but different size. On a sphere of fixed radius the angles of an equilateral triangle depend on the size of the triangle.

BODESLAW.WPD May 28, 2006

# THE TITIUS-BODE LAW

This relationship approximating the distances of the planets from the sun was first noticed by Titius of Wittenberg in 1766, then independently by Bode in 1772. It may be developed as follows:

1) Form the sequence: 0 3 6 12 24 48 96 192 384 768
each number after 3 being doubled
2) Add 4 to each number: 4 7 10 16 28 52 100 196 388 772
3) Divide by 10 0 .4 0.7 1.0 1.6 2.8 5.2 10 19.6 38.8 77.2

The sequence in 3) closely approximates the distances of the successive planets from the sun as measured in astronomical units (earth = 1)

| PLANET | DISTANCE IN A.U. | BODE VALUE |
|---|---|---|
| MERCURY | 0.3871 | 0.4 |
| VENUS | 0.7233 | 0.7 |
| EARTH | 1.0000 | 1,0 |
| MARS | 1.5237 | 1.6 |
| CERES (ASTEROIDS) | 2.767 | 2.8 |
| JUPITER | 5.2028 | 5.2 |
| SATURN | 9.540 | 10 |
| URANUS | 19.18 | 19.6 |
| NEPTUNE | 30.07 | 38.8 |

This relation made important contributions to the history of astronomy, leading to the search for Uranus and the discovery of the asteroids. Uranus was discovered in 1781 having a distance in good agreement with the Bode sequence. But there still was a gap. No planet in the 2.8 position. This lead to a search that discovered the first asteroid, Ceres, on Jan 1 1801, followed by the discovery of hundreds of others that filled in the gap. A planet that fragmented? Or never coalesced?

Since Neptune and Pluto and all beyond disregard the sequence, and having no physical basis, Bode's Law lost its status of being a law and became sort of a curiosity. None the less, its numerical regularity with approximate fits to each of the eight existing planetary objects nearest the sun requires that its be kept on the table of discourse. When data from other planetary systems is available, there might turn out to be a "Bode Zone" in which planetary distances from their principal star, follow a similar sequence.

According to our way of describing the world, a "law" requires that a relationship be valid for all phenomena of the same type. The idea that there might be different laws for different places and times is contrary to our monolatry tradition.

# COSMOLOGY IN THE TRADITION OF PYTHAGORAS

underlying

According to Pythagoras, behind astronomy, behind physics, even behind mathematics, lies number. The structures and processes of nature take their forms, directions and values ultimately from the properties of numbers. If this be so, then the properties of numbers create a *template* that both enables and delimits what exists and what happens. Such a template would govern both what *may* occur and what *must* occur: the domains of choice and necessity. Further, such a template would explain our questions regarding why mathematics allows us so well to describe the physical world, ~~and permits that we both discover and invent mathematics~~.

Legend tells us that the Pythagoreans were dismayed at the discovery of $\sqrt{2}$. Such a number violated their belief in the absolute sovereignty of the natural numbers, ~~that is of~~ 1,2,3,... But since negative, rational, irrational, complex and other numbers all trace their ancestry to the natural numbers, the Pythagoreans should not have despaired. While the positive integers may not be the sovereigns, they are the undisputed ancestors of all other numbers. We may accordingly assert, without tracing all the mathematical genealogy of the intervening centuries, that Pythagoras is the legitimate ancestor of an approach to cosmology that is based on numbers and their properties. However, today we begin, not with 1,2,3... but with the fundamental constants of physics. These are indeed numbers and for the present purpose will also be assumed to be constants.

Seven of the fundamental physical constants turn out to play a significant role in the cosmic template. These are: **c**, the velocity of light; **G**, the gravitational constant; $\hbar$, Planck's constant; $\alpha$, the fine structure constant; $\mu$, the proton/electron mass ratio; $\mathbf{m_b}$, the proton mass; → use $m_e$ and $\mathbf{r_e}$, the electron radius. These constants provide a system of units, the Planck system, that unlike the SI, cgs, or English systems, is not an arbitrary fabrication, but takes its values directly from the natural order. The three constants **c, G,** and $\hbar$, can be put together to make units of mass, length, and frequency as follows:[1]

$$\sqrt{\frac{\mathbf{c}\hbar}{\mathbf{G}}} = \mathbf{m_o} \qquad \sqrt{\frac{\mathbf{G}\hbar}{\mathbf{c}^3}} = \mathbf{l_o} \qquad \sqrt{\frac{\mathbf{c}^5}{\mathbf{G}\hbar}} = \nu_o$$

These values may be considered to be the mass, size, and frequency of a virtual particle, called the Planck particle. This "particle" might be said to have the same relation to the cosmos that a stem cell has to a living organism. The Planck particle is a "cell" from which the cosmos and its sub–structures can be derived. It is also usefully taken as the origin in all of the coordinate systems that constitute the cosmic template.

[1]The $\log_{10}$ cgs values are: $\mathbf{m_o}$ = –4.662199 grams; $\mathbf{l_o}$ = –32.791545 centimeters; $\nu_o$ = +43.268366 hertz

PYTHCOSM.WPD DECEMBER 22, 2000

# PYTHAGOREAN COSMOLOGY

*Ultimate reality is number –Pythagoras*

The "*Pythagorean*" approach to cosmology is predicated on the existence of a template that prescribes and proscribes what can and cannot physically exist. While the template tells what can and cannot be, it does not specify what actually is or will be. What is actualized, [reality], is but a sub-set of the set of what is possible. In this sense, the template bears the same relation to the actual cosmos that mathematics does to physics or in a general sense that software does to hardware. Moreover, this template not only describes the bounds or eigen-values of existence, but what processes and forces can or cannot exist. That is, it speaks both to **being** and to **becoming**.

> What is the Pythagorean power with which number holds sway above the flux?
> —Bertrand Russell

In the Pythagorean approach the values of fundamental constants, such as G, c, and h, are assumed to be constants and are taken as a basic part of the template, number itself being the ur-basis of the template. [Hence, the label, *Pythagorean*.] However, there are several non-numerical supplementary assumptions regarding the structure of the template. These include certain symmetries between the "inside" and "outside" of every entity, especially the symmetry of mutual containment. In the outer order the whole [universe] contains all of the parts, while the inner of each part contains the entire outer order. [Similar to the phenotype containing all constituent cells and each cell containing the genotype of the phenotype.] [1] In addition it is assumed that the universal inner order contains a clock or zeitgeber that provides coherence among all entities. The inner order also contains a set of injunctions or a program that governs the changes taking place in and by each part.

One feature of the template approach is that it avoids the "horizon problem", how there can be coherence and uniformity without duplex communication. In all changes, entities follow built in injunctions rather than requiring exchanges such as the interaction of forces. Action at a distance is due to the each entity following its internal program. And this program is common to all entities, being updated through access to the shared or common internal template. The changes in the cosmos are thus like the coordinated movements of flocks of birds or schools of fish which depend on the internal programming of each entity rather than on explicit communication between them.

The fallacy in the Pythagorean approach is that our physical and mental processes, being conditioned by a particular limited set of experiences, are incapable of ~~modeling~~ accepting such a template.

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[1] The universe and all its parts is similar to what Bohm called the 'explicate order', and the common inner, the template, is like his 'implicate order'.

PSEPON.WPD APRIL 21, 2000

# COGNITION AND REALITY

| LEVEL | | | |
|---|---|---|---|
| IMAGINATIVE | CONCEIVED | NOT CONCEIVED | UNCONCEIVABLE |
| SENSORY | PERCEIVED | NOT PERCEIVED | UNPERCEIVABLE |
| EPISTEMOLOGICAL | KNOWN | NOT KNOWN | UNKNOWABLE |
| ONTOLOGICAL | EXISTING | NOT EXISTING | UNEXISTABLE |

<u>PROPOSITIONS and QUESTIONS</u>

1] The PERCEIVED is a subset of the KNOWN
because there are alternative modes of knowing beside perception, eg intuition, logic, etc
2] The KNOWN is a subset of the EXISTING
3] We habitually but erroneously assert that existence is tied to perception or
What is not perceived does not exist
4] Three reasons for non-perception:
1) Not experienced, i.e. exists but has not been encountered
2) Beyond the limitations of perception (UNPERCEIVABLE)
Some limits: Eddington limit, 1/f noise, Weber-Fechner limit,
Whitehead limit, Pythagoras' limit (some are intrinsic, some escapable)
3) NON EXISTING
5] Besides the limitations of perception, there are limitations of knowing
These have to do with the limitations of reason and logic (Gődel),
of computability (Turing), and the nature of the random (Chaitin)
6] Is Gődel's incompleteness theorem (cannot be both consistent and complete)
an ontological theorem [cf Ratna Sambhava] as well as an epistemological theorem?
[Note: This theorem puts traditional theistic and monistic notions in question.]
7] Is consistency/inconsistency the ontological boundary between existability and non-existability? [again Ratna Sambhava]
8] There must be a sufficient body of consistent {equations-propositions-phenomena} to qualify as {theory-model-reality} ~~ Einstein
9] Kant's *phenomena* belong to the set of KNOWN + EXISTING
10] Kant's *noumena* belong to the set of EXISTING but NOT KNOWN

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PYPLAPAN.WP6 APRIL 19, 1998

1998 #14
1998 #27

# AN ALTERNATE ONTOLOGICAL VIEW
# THE PYTHAGORAS-PLATO-PAULI MODEL

1) Along with Pythagoras, we postulate that there must be at least two of anything in order for that thing to exist.

2) Along with Plato, since by 1) there must be at least two spaces, we postulate that in addition to the every day physical and position space, P-SPACE, in which our senses are imbedded, there is a second space whose dimensions and coordinates determine the form and pattern of things. This second space we shall call H-SPACE.

3) Along with Pauli, we postulate a General Exclusion Principle that maintains no two entities in the universe can have the same coordinates in all spaces. This means that there must be at least one space in which any two entities must have different coordinates. The inference of this principle is that every entity in the universe is unique.

There is a basic contradiction between Pythagoras' 'more than one to exist' and Pauli's general exclusion principle which says every thing in the universe is unique. This can only be resolved if we assume that Pythagoras requires a like pair in every SPACE. Pythagorean non-existence would state that unless there are two or more identical entities, E(1), in a SPACE S, E(1) does not exist in SPACE S. Pauli requires that if there are two or more identical entities in space S, then these entities must differ in some other space.

4) Along with Noether, we postulate a General Conservation Principle that preserves basic symmetries and equilibra within and between all SPACES.

The operation of the General Exclusion Principle is ubiquitously displayed in P-SPACE by the fact that two objects cannot occupy the same place at the same time, that is, cannot have the same space-time coordinates. This fact allows more than one entity to have the same coordinates in H-SPACE. Were it not for this, there could not be a multiplicity of entities with the same form.[1]

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[1]If the converse were true, P-SPACE and H-SPACE properties being interchanged, then no two objects could have the same form at the same time, but many objects of different form could simultaneously occupy the same place in P-SPACE.

# TIME ARRAY: T=T( M,L,G,ħ,c)

[T] = 1

| M\L | −1 | −0.5 | 0 | +0.5 | +1 | +1.5 | +2 |
|---|---|---|---|---|---|---|---|
| +3 | $\sqrt{G^5M^6/L^2hc^{11}}$ | | $G^2M^3/hc^4$ | | $\sqrt{G^3M^6L^2/h^3c^5}$ | | $GM^3L^2/h^2c$ |
| +2.5 | | $\sqrt{G^4M^5/Lhc^9}$ | | $\sqrt{G^3M^5L/h^2c^6}$ | | $\sqrt{G^2M^5L^3/h^3c^3}$ | |
| +2 | $G^2M^2/Lc^5$ | | $\sqrt{G^3M^4/hc^7}$ | | $GM^2L/hc^2$ | | $\sqrt{GM^4L^4/h^3c}$ |
| +1.5 | | $\sqrt{G^3M^3/Lc^8}$ | | $\sqrt{G^2M^3L/hc^5}$ | | $\sqrt{GM^3L^3/h^2c^2}$ | |
| +1 | $\sqrt{G^3M^2h/L^2c^9}$ | | $GM/c^3$ | | $\sqrt{GM^2L^2/hc^3}$ | | $ML^2/h$ |
| +0.5 | | $\sqrt{G^2Mh/Lc^7}$ | | $\sqrt{GML/c^4}$ | | $\sqrt{ML^3/hc}$ | |
| 0 | $Gh/Lc^4$ | | $\sqrt{Gh/c^5}$ | | $L/c$ | | $\sqrt{L^4c/Gh}$ |
| -0.5 | | $\sqrt{Gh^2/MLc^6}$ | | $\sqrt{Lh/Mc^3}$ | | $\sqrt{L^3/GM}$ | |
| -1 | $\sqrt{Gh^3/M^2L^2c^7}$ | | $h/Mc^2$ | | $\sqrt{L^2h/GM^2c}$ | | $L^2c/GM$ |
| -1.5 | | $\sqrt{h^3/M^3Lc^5}$ | | $\sqrt{Lh^2/GM^3c^2}$ | | $\sqrt{L^3hc/G^2M^3}$ | |
| -2 | $h^2/M^2Lc^3$ | | $\sqrt{h^3/GM^4c^3}$ | | $Lh/GM^2$ | | $\sqrt{L^4hc^3/G^3M^4}$ |
| -2.5 | | $\sqrt{h^4/GM^5Lc^4}$ | | $\sqrt{Lh^3/G^2M^5c}$ | | $\sqrt{L^3h^2c^2/G^3M^5}$ | |
| -3 | $\sqrt{h^5/GM^6L^2c^5}$ | | $h^2/GM^3c$ | | $\sqrt{L^2h^3c/G^3M^6}$ | | $L^2hc^2/G^2M^3$ |

no c

no G

no M

no ħ

no L

# FORCE ARRAY: $F=F(M,L,G,\hbar,c)$

$\hbar$

No L

| M\L | 3 | 2 | 1 | 0 | -1 | -2 | -3 |
|---|---|---|---|---|---|---|---|
| -5 | | | | | | | |
| -4 | | | | | | | |
| -3 | $L^3c^{10}/G^4M^3$ | | $Lc^7\hbar/G^3M^3$ | | $c^4\hbar^2/G^2M^3L$ | | $c\hbar^3/GM^3L^3$ |
| -2 | | $L^2c^8/G^3M^2$ | | $c^5\hbar/G^2M^2$ | | $c^2\hbar^2/GM^2L^2$ | |
| -1 | $L^3c^9/G^3M\hbar$ | | $Lc^6/G^2M$ | | $c^3\hbar/GML$ | | $\hbar^2/ML^3$ |
| 0 | | $L^2c^7/G^2\hbar$ | | $c^4/G$ | | $c\hbar/L^2$ | |
| 1 | $ML^3c^8/G^2\hbar^2$ | | $MLc^5/G\hbar$ | | $Mc^2/L$ | | $GM\hbar/L^3c$ |
| 2 | | $M^2L^2c^6/G\hbar^2$ | | $M^2c^3/\hbar$ | | $GM^2/L^2$ | |
| 3 | $M^3L^3c^7/G\hbar^3$ | | $M^3Lc^4/\hbar^2$ | | $GM^3c/L\hbar$ | | $G^2M^3/L^3c^2$ |
| 4 | | $M^4L^2c^5/\hbar^3$ | | $GM^4c^2/\hbar^2$ | | $G^2M^4/L^2c\hbar$ | |
| 5 | $M^5L^3c^6/\hbar^4$ | | $GM^5Lc^3/\hbar^3$ | | $G^2M^5/L\hbar^2$ | | $G^3M^5/L^3c^3\hbar$ |
| 6 | | | | $G^2cM^6/\hbar^3$ | | $G^3M^6/L^2\hbar^2c^2$ | |
| 7 | | | $G^2M^7Lc^2/\hbar^4$ | | $G^3M^7/\hbar^3Lc$ | | |

$G^3M^8/\hbar^4$

No c

No G

No M

No $\hbar$

$G=0$ $\qquad$ $\hbar = 0$

$\frac{Mc^2}{L}\left(\frac{\hbar}{McL}\right)^{n-2}$ $\qquad$ $\frac{c^4}{G}\left[\frac{GM}{c^2L}\right]^{n-2}$



## FORCE TABLE: T=T( G,M,L,ħ,c) $\hbar^2/ML^3$

[T] = 1

| M\L | −1 | −0.5 | 0 | +0.5 | +1 | +1.5 | +2 |
|---|---|---|---|---|---|---|---|
| +3 | | | | | | | |
| +2.5 | | | | | | | |
| +2 | | | | | | | |
| +1.5 | | | | | | | |
| +1 | | | 1 $Lc^6/MG^2$ | | | | $\hbar^2/ML^3$ 4 |
| +0.5 | | | | 2 $c^4/G$ | | $\hbar c/L^2$ 3 | |
| 0 | | | $C^4/G$ | | 3 $Mc^2/L$ -2 | $\frac{M}{L^2}\sqrt{G\hbar c}$ | |
| -0.5 | | | | | | 4 $GM^2/L^2$ | |
| -1 | | | | | | | |
| -1.5 | | | | | | | |
| -2 | | | | | | | |
| -2.5 | | | | | | | |
| -3 | | | | | | | |

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PYTHUNIV.WP6 October 8, 1995

# A PYTHOGOREAN UNIVERSE

I am a Pythagorean. I believe that ultimate reality is not matter, not vibrating waves, not thought, not spirit. The UR essence of the universe is number! Sir James Jeans once said that God is a mathematician. I would say that the Creator is mathematics itself. Underlying all the structure in the world are the attributes of number. The laws of physics, the values of fundamental constants, the multitude of archetypes governing all processes, are what they are because of the properties of number. While in his day Pythagoras restricted cosmography to the natural integers and was devastated by the intrusion of $\sqrt{2}$, today every disciple of Pythagoras is free to adopt with impunity what was once a heresy by including all numbers.

The occurrence of Pythagoreans in history is like the integers, discrete not continuous. There are sometimes gaps of centuries between their appearance: Pythagoras and his school in the sixth century B.C.E., followed by the apostles, Diaphantus, Kepler, Mendeliev, Eddington, Dirac, J.G.Bennett, and many lesser saints, all of whom contributed to Pythagorean Holy Writ by building structures directly on number. But there have also been false prophets who preach various numerologies. As in every discipline there must be criteria for discriminating the valid from the deceptive. The primary test is that more must come out than is put in.

The concern of the present paper is the number basis underlying the structure of the observed astronomical universe. We shall employ a structuralist approach in that we shall look at the relations between entities rather than focusing on what takes place within the entities themselves. Further, we shall consider the synchronic rather than the diachronic aspects of the structure, although in cosmology the synchronic must be inferred from the diachronic.

The structure will be built on the three dimensionless quantities $\alpha$, $\mu$, and S, being respectively the fine structure constant, the ratio of baryon to lepton mass, and the ratio of coulomb to gravitational force. The fundamental dimensioned constants, c,(velocity of light), G, (Newton's gravitational constant) and h, (Planck's constant) are used as a bridge to the usual observables L,(size), M,(mass), and T (time).

Throughout we shall use more significant figures than may be meaningful in a scientific sense. But in order to test whether results derived from different sources are the same, as much accuracy as is available must be employed. In the case of the fundamental constants, except for the value of G, six or more significant figures may be safely assumed.

In the beginning was the Planck Particle whose extension, mass and time are given by

$$R_P=\sqrt{\frac{Gh}{c^3}},\quad M_P=\sqrt{\frac{hc}{G}},\quad T_P=\sqrt{\frac{hc}{c^5}}$$

whose values are: $4.050837\times10^{-33}$cm, $5.456203\times10^{-5}$g, and $1.351287\times10^{-43}$sec. The density of the Planck Particle, $\rho_P=c^5/hG^2$, is equal to $5.157\times10^{93}$g/cm$^3$.
To display the relational structure of the objects in the universe, we shall need the extension, mass, and density times of various fundamental particles. The values and $\log_{10}$ values for the electron, proton, and hydrogen atom as well as for the Planck particle are given in Table I and Table II.

TABLE I cgs Values

| PARTICLE | RADIUS cm | MASS g | ρ-TIME sec |
|---|---|---|---|
| PLANCK ($\hbar$) | $1.616050\times10^{-33}$ | $2.176710\times10^{-5}$ | $3.386989\times10^{-43}$ ? not $T_p$ above |
| PLANCK ($h$) | $4.050837\times10^{-33}$ | $5.456203\times10^{-5}$ | $8.489922\times10^{-43}$ ? |
| ELECTRON | $2.817941\times10^{-13}$ | $9.109390\times10^{-28}$ | 0.120555 |
| PROTON | $2.817941\times10^{-13}$ | $1.672623\times10^{-24}$ | 0.002813 |
| HYDROGEN ATOM | $5.291772\times10^{-9}$ | $1.673534\times10^{-24}$ | 7237.97 |

TABLE II $\log_{10}$(cgs Values)

| PARTICLE | RADIUS cm | MASS g | ρ-TIME sec |
|---|---|---|---|
| PLANCK ($\hbar$) | -32.791545 | -4.662199 | -42.470186 ? not $T_p$ above |
| PLANCK ($h$) | -32.392455 | -4.263110 | -42.071096 ? |
| ELECTRON | -12.550068 | -27.040511 | -0.918814 |
| PROTON | -12.550068 | -23.776602 | -2.550769 |
| HYDROGEN ATOM | -8.276399 | -23.776366 | 3.859617 |

The ρ-Time, τ, is calculated from the equation,

$$\tau = 2\pi\sqrt{\frac{R^3}{GM}}, \qquad T_P = \frac{\tau}{2\pi}$$

The log values of the ratio of the Planck Particle(based on h) to the proton are:

| RADIUS | MASS | TIME |
|---|---|---|
| $19.842387 = k^{-1}S^{1/2}$ | $19.513492 = kS^{1/2}$ | $39.520327 = k^{-1}S$ |

S, the ratio of coulomb to gravitational force has the value
$\log_{10}S = 39.355880$
$k = \sqrt{(2\pi/\alpha\mu)}$, where $\alpha$ is the fine structure constant and
$\mu$ is the proton to electron mass ratio, has the value,
$\log_{10}k = -0.164447$

The following table of $\log_{10}$ S and k values is useful for identifying relationships.

| | x 1 | x k | x $k^{-1}$ |
|---|---|---|---|
| $S^{1/2}$ | 19.677940 | 19.513493 | 19.842387 |
| S | 39.355880 | 39.191433 | 39.520327 |
| $S^{3/2}$ | 59.033820 | 58.869373 | 59.198267 |
| $S^2$ | 78.711760 | 78.547313 | 78.876207 |

For negative values, change the signs of the exponents of both k and S.

Some other frequently used $\log_{10}$ values:
Planck M(h) -4.263110
Planck R(h) -32.392455
Planck T(h) -42.869276

| | | | |
|---|---|---|---|
| c | 10.476821 | $2\pi$ | 0.798180 |
| G | -7.175705 | | |
| h | -26.178744 | | |
| h | -26.976924 | | |
| $\alpha$ | -2.136835 | | |
| $a_o$ | -8.276399 | | |
| $m_p$ | -23.776602 | | |
| $r_e$ | -12.550068 | | |
| $m_e$ | -27.040511 | | |
| e | -9.318469 | | |
| S | 39.355880 | | |
| $\mu$ | 3.263909 | | |
| k | $-0.164447 = \sqrt{(2\pi/\alpha\mu)}$ | | |

# COSMOS–BY THE NUMBERS INTRODUCTION

Recent observations of Cepheid variables in distant galaxies[1] and measurements of distant type II supernova[2] converge on a value close to 72 km/sec/mpc. If further observations confirm this value, then there is a strong possibility that the Hubble parameter, $H_o$, is related to the fundamental constants of physics by the relation,

$$H_o^{-1} = (\alpha\mu S)^{3/2}\sqrt{\frac{G\hbar}{c^5}}$$

where $\alpha$ is the fine structure constant, $\mu$ the proton to electron mass ratio, S the coulomb-gravity force ratio, G Newton's constant, $\hbar$ Planck's constant, and c the velocity of light. The value of $H_o^{-1}$ given by this equation is 71.977 km/sec/mpc or 10 ^ 17.456067 seconds. This corresponds to an age of 9.056 billion years or a Hubble time of 13.584 billion years.

While it is not surprising that the value of the Hubble parameter should depend on the values of the fundamental physical constants, it is disturbing, since it is believed the constants involved do not vary with time, that the equation implies a constant Hubble time and hence an unaging universe. We conclude either

1) The original assumption of the correctness of the equation is wrong
2) One or more of the fundamental may constants vary
3) The models relating Hubble time to the age of the universe are wrong
4) The interpretation of redshifts as purely velocity shifts is wrong.

The validity of a model depends on the number of observations explained and on there being a consistent relation or pattern between all the observational check points. The above equation is consistent with all the observations involved, but is not consistent with present interpretations of those observations, particularly those relating Hubble time to an age and possibly the doppler interpretation of redshifts. The following tables show the many ways in which the particular value $\log_{10}(H_o^{-1})$ = 17.456067 sec links other objects, including the Planck particle, baryons, stars, and the universe itself. But every good model should also make predictions by which it can be further tested. This equation and others related to it predict the existence of certain astronomical objects whose existence, if confirmed, would contribute to the solution of other problems. These predictions plus the extent and accuracies of the overall pattern involving this value of $H_o^{-1}$ suggest the above equation and its implications be investigated further.

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[1]Wendy Freedman et al. Physics Today August 1999, p19ff 71±7 km/sec/mpc

[2]R. Kirshner ApJ 438 L17 1995 73±7 km/sec/mpc

NOVCOS02.WPW    DISK:WORKDISK02    May 11, 1993

# NOVUM COSMOLOGIUM

We experience the world as a flat euclidian space. We find that objects of any given form may exist in different sizes. However, this property of form and size independence is peculiar to flat spaces, those with curvature $\kappa = 0$. In non-flat spaces, those in which the curvature $\kappa \neq 0$, a change in size of the object effects a change in form. For example, in such spaces there could be no such thing as similar triangles, the angles of an equilateral triangle would depend on the size of the triangle.

there is another relation between information and energy

In non-flat spaces if one wished to have an object of different size with the same form as a specified object, the **scale** of the space would have to be changed, which is to say the curvature or its reciprocal, the radius of curvature would have to be changed. For example, if we wanted an equilateral spherical triangle of twice the size but having the same angles, the radius of the sphere would have to be doubled. On an expanding sphere, if objects were to remain the same size their forms would have to change or if they were to preserve the same form their size would have to change. For spaces with $\kappa \neq 0$ form, size, and scale are interdependent.

⇒ form has to do with information content

⇒ same info

⇒ ∴ size increase

- Energy of Expansion
- Negentropy Form

In an expanding non-flat universe the shapes of galaxies would have to change if their size did not remain proportional to the universe' radius of curvature. Co-moving coordinates are used in describing expanding models. In these models, form is preserved because everything is assumed to "co-move", i.e. to expand. But if this assumption is wrong, morphology would depend on the scale of the universe. We traditionally interpret a change of form as being caused by the action of forces. Thus scale change may be what underlies force. [All of this is sort of like coming to the general theory of relativity through the back door. The dynamics of the universe are manifestations of its geometry, with the force involved being gravity.]

Another example of a form that changes with scale in an expanding non-flat universe, is a sine wave or some other cyclical form. The wave-length, like the sides of a triangle, would change with scale. How ~~does~~ is this ~~explain~~ related to the red-shift?

Does the universe expand simply because $\kappa > 0$ ? Is there some imperative to preserve form?

An imperative to preserve form could cause a $K \neq 0$ universe to be unstable.
e.g. information seeking to preserve itself.

see also COSMODEL.P51
DISK COSNUMBERS
05/04/91
#69

Can we decide $K > 0$, or $K < 0$ on the basis of how form changes as size increases?
In a closed space (e.g. on a sphere) as $R\uparrow$,

Is the octant triangle an exception?
A property of orthogonality

COSMPYTH.WPD                    January 16, 2000, revised January 31, 2000

# A PYTHAGOREAN COSMOLOGICAL MODEL

The Pythagorean approach is an attempt to construct a template which fits the observed universe rather than to describe the detailed physical steps by which the universe evolved. Its goal is to build a consistent net of nodes and links demonstrating how the various parts fit together. Recognition of the basic role that particle physics played in cosmology brought with it inferences of symmetries between the large and small, symmetries involving baryons and stars, the Hubble universe and the Planck particle. Hence it appears useful to explore the several symmetries and their implications by placing in juxtaposition the dimensions and magnitudes of the particles and constants of physics with those of various astronomical aggregates.

At the outset there is the difficulty of a basic asymmetry between the preciseness of the measurements in particle physics and of those in astrophysics. Whereas the former may in many cases reach accuracies exceeding eight significant figures, at present the latter usually have only order of magnitude accuracy. An exception to this is the recent improvement in the observed value of the Hubble parameter, which measures the rate of expansion of the universe, and can be used in conjunction with various cosmological models to give an age to the universe. The present Pythagorean model is based on this new value and on the best present values for fundamental constants and baryons. We thus have empirical data for the Planck level, the baryon level and the universe or "Hubble" level. There also exist a plethora of less precise measurements of masses and sizes of stars, but of sufficient accuracy to test the model at the stellar level, allowing us a basic four level model. Other aggregate levels exist and can possibly be explored using the best astronomical observations together with interpolations and extrapolations on the basic four level model.

Because of an inverted relation between the Planck particle and baryons, (Planck mass > baryon mass and Planck size < baryon size) we are led to a model consisting of two parts. The first part is constructed on size relations, the second on mass relations. Both parts are used to establish the basic frequencies that provide the resonances from which it is assumed all material bodies emerge. [It will be shown that resonances are alternatives to equilibria of forces.]

Before constructing any model it is important to note some properties of the Planck particle: The following six times (or alternately, frequencies) are all equal at the Planck level but diverge at other levels of size and mass. [All values are cgs given in $\log_{10}$ format]

TABLE 1

| $t$ | $\tau$ | $T$ | $Z$ | $\zeta$ | $\Phi$ |
|---|---|---|---|---|---|
| $L/c$ | $(L^3/GM)^{1/2}$ | $GM/c^3$ | $\hbar/Mc^2$ | $\hbar L/GM^2$ | $(ML^3\alpha/e^2)^{1/2}$ |
| −43.268366 | −43.268366 | −43.268366 | −43.268366 | −43.268366 | −43.268366 |

# THE KOSMOS ACCORDING TO PYTHAGORAS

## I Pythagoras and Planck

Somewhere around 600 B.C.E., at the beginning of the present age, Pythagoras held that the natural integers themselves sufficed as building blocks for constructing the universe. He was set back and dismayed when real numbers like $\sqrt{2}$ intervened. Even before his death the continuum of real numbers began to philosophically intrude and came to dominate physical thought until the beginning of the 20th century. Then at the beginning of the present age, Max Planck found that discreteness must be re-introduced. The continuum, as well as the integers, was found wanting. Pythagoras was somewhat justified when Planck showed that basic physical realtionships were governed by discrete rather than contiuous, quantities. Of course, Pythagoras' misinterpretation was that it was the integers themselves that sufficed, when it was discreteness, one of the properties of the integers that was the essence. Today as digital replaces analog, Pythagoras is firmly back in business.

Sometimes many centuries intervene between the writing of the first sentence of a worldview and the writing of the second, with many by-paths being explored in the while. Today it seems possible to add to what Pythagoras began since there have been several contributions to his approach in recent years. It is quite appropriate to call such modern natural philosophers as Planck, Eddington and Dirac followers of Pythagoras, since parts of their work are clearly "Pythagorean". They have taken number to be the ultimate basis of reality.

## II The Planck Particle

Today Pythagoreanism begins with the so-called fundamental constants of physics. It might be said that: In the beginning God created the numbers $\hbar$ ,G, and c, and from these all else followed. If these constants had had different values, even slightly different values, then the universe would have been quite different. In fact we might not even be here to contribute the feedback consciousness that references the universe. Planck, in addition to re-introducing the discrete, took the fundamental constants, h, G, and c and dimensionaly derived a system of "natural units" with which to describe the universe. When translated into these Planckian units relations between the masses, sizes, and life times of physical entities were seen to reveal symmetries and patterns that bring to mind Pythagoras' earlier patterns of tones and their harmonics.

Physicists have come to feel that the dimensionalities of mass (M), length (L), and time (T) are the basic descriptors of most observed physical phenomena. In terms of M, L, and T, the dimensionalities of the fundamental constants sre,

$$[\hbar] = [ML^2/T], \quad [G] = [L^3/MT^2], \quad [c] = [L/T]$$

When mass, length, and time are expressed explicitly in terms of ħ, G, and c, we find,

$$m_o = \sqrt{\frac{\hbar c}{G}} \quad l_o = \sqrt{\frac{\hbar G}{c^3}} \quad t_o = \sqrt{\frac{\hbar G}{c^5}} \tag{1}$$

This set of values is taken as the definition of a virtual particle, having the mass $m_o$, the radius $l_o$, and the characteristic time $t_o$, called the "Planck Particle". The $\log_{10}$ cgs values of the fundamental constants and the Planck Particle parameters are given in Table I,

all value ħ

Table I Fundamental Values (cgs)

| CONSTANT | symbol | dimensionality | $LOG_{10}$(VALUE) |
|---|---|---|---|
| Planck's constant | $\hbar$ | $ML^2/T$ | -26.9769235 |
| gravitational constant | $G$ | $L^3/MT^2$ | -7.1757050 |
| velocity of light | $c$ | $L/T$ | 10.4768207 |
| Planck mass | $m_o$ | M | -4.6621994 |
| Planck length | $l_o$ | L | -32.7915452 |
| Planck time | $t_o$ | T | -43.2683661 |
| fine structure constant | $\alpha$ | 1 | -2.1368346 |
| proton/electron mass ratio | $\mu$ | 1 | 3.2639088 |
| coulomb/gravity force ratio | $S$ | 1 | 39.3558802 |
| proton mass | $m_p$ | M | -23.7766019 |
| electron mass | $m_e$ | M | -27.0405107 |
| electron charge | $e$ | $\sqrt{(ML^3/T^2)}$ | -9.3184687 |
| electron radius | $r_e$ | L | -12.5500681 |
| Bohr radius | $a_o$ | L | -8.2763988 |

$\sqrt{S} = 19.677940$

$\alpha\mu = 1.127074$

$\sqrt{\alpha\mu} = 0.563537$

$\frac{\alpha}{\mu} = -5.400744$

$\sqrt{\frac{\alpha}{\mu}} = -2.700372$

## THE PLANCK PARTICLE LEVEL

In TABLE 2 the subscript "o" is used when refering to an attribute of the Planck Particle. The values in the table are taken from TABLE 1 or are derived using the equations given below. The tabular entries in the columns marked $\hbar$ G c $\alpha$ $\mu$ S are the powers to which these values are raised.

TABLE 2

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(cgs value) | $\log_{10}$(cgs value)/2 |
|---|---|---|---|---|---|---|---|---|
| $m_o^2$ | 1 | -1 | 1 | 0 | 0 | 0 | -9.324399 | -4.662199 |
| $l_o^2$ | 1 | 1 | -3 | 0 | 0 | 0 | -65.583090 | -32.791545 |
| $t_o^2$ | 1 | 1 | -5 | 0 | 0 | 0 | -86.536732 | -43.286366 |
| $[Gm_o/c^2]^2$ | 1 | 1 | -3 | 0 | 0 | 0 | -65.583090 | -32.791545 |
| $T_o^2$ | 1 | 1 | -5 | 0 | 0 | 0 | -86.536732 | -43.268366 |
| $E_T^2$ | 1 | -1 | 5 | 0 | 0 | 0 | 32.582886 | 16.291443 |
| $E_G^2$ | 1 | -1 | 5 | 0 | 0 | 0 | 32.582886 | 16.291443 |
| $\rho_o$ | -1 | -2 | 5 | 0 | 0 | 0 | 93.712439 | |
| $E_T t_o$ | 1 | 0 | 0 | 0 | 0 | 0 | -26.976924 | |
| $m_o l_o$ | 1 | 0 | -1 | 0 | 0 | 0 | -37.453744 | |
| $m_o/l_o$ | 0 | -1 | 2 | 0 | 0 | 0 | 28.129326 | |

$Gm_o/c^2$ is the gravitational radius which is equal to $l_o$ for the Planck Particle.
$T_o$ is the density time given by $\sqrt{(l_o^3/Gm_o)}$, equal to $t_o$ for the Planck Particle.
$E_T$ is the total energy = $m_o c^2$.
$E_G$ is the gravitational energy = $Gm_o^2/l_o$, equal to $E_T$ for the Planck Particle.
$\rho_o$ is the density = $m_o/l_o^3$
From the above values, the following relations may be seen to hold.

$$\rho_o = c^5/\hbar G^2, \qquad E_T = \hbar\sqrt{(G\rho)}, \qquad t_o = 1/\sqrt{(G\rho)}, \qquad E_T\, t_o = \hbar$$

$$m_o l_o = \hbar/c \qquad m_o/l_o = c^2/G \qquad Gm_o/l_o c^2 = 1$$

$$e^2 = \hbar\alpha c = \alpha c^2 m_o l_o = \alpha G m_o^2 \qquad T_e = \hbar^3/m_e e^4$$

## THE BARYON -- LEPTON LEVEL

### TABLE 3A THE ELECTRON

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(cgs value) | $\log_{10}$(cgs value)/2 |
|---|---|---|---|---|---|---|---|---|
| $m_e^2$ | 1 | -1 | 1 | 1 | -1 | -1 | -54.081022 | -27.040511 |
| $r_e^2$ | 1 | 1 | -3 | 1 | 1 | 1 | -25.100136 | -12.550068 |
| $t_e^2$ | 1 | 1 | -5 | 1 | 1 | 1 | -46.053778 | -23.026889 |
| $[Gm_e/c^2]^2$ | 1 | 1 | -3 | 1 | -1 | -1 | -112.339714 | -56.169857 |
| $T_e^2$ | 1 | 1 | -5 | 1 | 2 | 2 | -3.433989 | -1.716995 |
| $E_{Te}^2$ | 1 | -1 | 5 | 1 | -1 | -1 | -12.173938 | -6.086969 |
| $E_{Ge}^2$ | 1 | -1 | 5 | 1 | -3 | -3 | -97.413518 | -48.706659 |
| $\rho_e$ | -1 | -2 | 5 | -1 | -2 | -2 | 10.549693 | |
| $E_{Te}t_e$ | 1 | 0 | 0 | 1 | 0 | 0 | -29.113858 | |
| $E_{Te}T_e$ | 1 | 0 | 0 | 1 | 1/2 | 1/2 | -7.803964 | |
| $E_{Ge}t_e$ | 1 | 0 | 0 | 1 | -1 | -1 | -71.733648 | |
| $E_{ge}T_e$ | 1 | 0 | 0 | 1 | -1/2 | -1/2 | -50.423754 | |
| $m_e r_e$ | 1 | 0 | -1 | 1 | 0 | 0 | -39.590579 | |
| $m_e/r_e$ | 0 | -1 | 2 | 0 | -1 | -1 | -14.490443 | |

The dimensionless parameters $\alpha$ and $(\mu S)$ are introduced here through the equations: $m_e r_e c/\hbar = \alpha$ and $Gm_e/r_e c^2 = 1/(\mu S)$

$T_e = \sqrt{(\mu S)}\, t_e$, $E_{Te} = \mu S E_{Ge}$, $E_{Te}T_e = \sqrt{(\mu S)}\, E_{Te}t_e$, $E_{Ge}T_e = \sqrt{(\mu S)}\, E_{Ge}t_e$

$E_{Te}t_e = \alpha\hbar$, $E_{Te}T_e = \sqrt{(\mu S)}\alpha\hbar$, $E_{Ge}t_e = \alpha\hbar/\mu S$, $E_{Ge}T_e = \alpha\hbar/\sqrt{(\mu S)}$

$m_e r_e = \alpha\, m_0\, \ell_0$

THE BARYON -- LEPTON LEVEL

TABLE 3B THE PROTON

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(cgs value) | $\log_{10}$(cgs value)/2 |
|---|---|---|---|---|---|---|---|---|
| $m_p^2$ | 1 | -1 | 1 | 1 | 1 | -1 | -47.553204 | -23.776602 |
| $r_e^2$ | 1 | 1 | -3 | 1 | 1 | 1 | -25.100136 | -12.550068 |
| $t_p^2$ | 1 | 1 | -5 | 1 | 1 | 1 | -46.053778 | -23.026889 |
| $[Gm_p/c^2]^2$ | 1 | 1 | -3 | 1 | 1 | -1 | -105.811896 | -52.905948 |
| $T_p^2$ | 1 | 1 | -5 | 1 | 1 | 2 | -6.697898 | -3.348949 |
| $E_{Tp}^2$ | 1 | -1 | 5 | 1 | 1 | -1 | -5.646120 | -2.822960 |
| $E_{Gp}^2$ | 1 | -1 | 5 | 1 | 1 | -3 | -84.357682 | -42.178841 |
| $\rho_p$ | -1 | -2 | 5 | -1 | -1 | -2 | 13.873605 | |
| $E_{Tp}t_p$ | 1 | 0 | 0 | 1 | 1 | 0 | -25.849949 | |
| $E_{Tp}T_p$ | 1 | 0 | 0 | 1 | 1 | 1/2 | -6.172009 | |
| $E_{Gp}t_p$ | 1 | 0 | 0 | 1 | 1 | -1 | -65.205829 | |
| $E_{Gp}T_p$ | 1 | 0 | 0 | 1 | 1 | -1/2 | -45.527889 | |
| $m_pr_e$ | 1 | 0 | -1 | 1 | 1 | 0 | -36.326670 | |
| $m_p/r_e$ | 0 | -1 | 2 | 0 | 0 | -1 | -11.226534 | |

discriminated or separated

The dimensionless parameters $\mu$ and S are ~~differentiated~~ here through the equations: $m_pr_ec/\hbar\alpha = \mu$ and $Gm_p/r_ec^2 = 1/S$.

$T_p = \sqrt{(S)}\, t_p$, $E_{Tp} = SE_{Gp}$, $E_{Tp}T_p = \sqrt{(S)}\, E_{Tp}t_p$, $E_{Gp}T_p = \sqrt{(S)}\, E_{Gp}t_p$

$E_{Tp}t_p = \alpha\mu\hbar$, $E_{Tp}T_p = \alpha\mu\hbar\sqrt{(S)}$, $E_{Gp}t_p = \alpha\mu\hbar/S$, $E_{Gp}T_p = \alpha\mu\hbar/\sqrt{(S)}$

$m_pr_e = \alpha\mu\, m_o l_o$

## THE BARYON -- LEPTON LEVEL

### TABLE 4A ELECTRON VALUES IN PLANCK UNITS

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(PL value) | $\log_{10}$(PL value)/2 |
|---|---|---|---|---|---|---|---|---|
| $m_e^2$ | 0 | 0 | 0 | 1 | -1 | -1 | -44.756624 | -22.378312 |
| $r_e^2$ | 0 | 0 | 0 | 1 | 1 | 1 | 40.482954 | 20.241477 |
| $t_e^2$ | 0 | 0 | 0 | 1 | 1 | 1 | 40.482954 | 20.241477 |
| $[Gm_e/c^2]^2$ | 0 | 0 | 0 | 1 | -1 | -1 | -44.756624 | -22.378312 |
| $T_e^2$ | 0 | 0 | 0 | 1 | 2 | 2 | 83.102742 | 41..551371 |
| $E_{Te}^2$ | 0 | 0 | 0 | 1 | -1 | -1 | -44.756624 | -22.378312 |
| $E_{Ge}^2$ | 0 | 0 | 0 | 1 | -3 | -3 | -129.996202 | -64.998101 |
| $\rho_e$ | 0 | 0 | 0 | -1 | -2 | -2 | -83.102743 | |
| $m_e r_e$ | 0 | 0 | 0 | 1 | 0 | 0 | -2.136835 | |
| $m_e/r_e$ | 0 | 0 | 0 | 0 | -1 | -1 | -42.619789 | |

$E_{Ge} = m_e^2/r_e = \sqrt{(\alpha/\mu^3 S^3)} = E_{Te}/\mu S$, $\quad t_e = r_e = T_e/\sqrt{S}$, $\quad T_e^2\,\rho_e = 1$

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(PL value) | $\log_{10}$(PL value)/2 |
|---|---|---|---|---|---|---|---|---|
| $e^2$ | 0 | 0 | 0 | 1 | 0 | 0 | -2.136835 | -1.068418 |
| | | | | | | | $\log_{10}$(cgs value) | $\log_{10}$(cgs value)/2 |
| $e^2$ | 1 | 0 | 1 | 1 | 0 | 0 | -18.636938 | -9.318469 |

## THE BARYON--LEPTON LEVEL

### TABLE 4B PROTON VALUES IN PLANCK UNITS

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(PL value) | $\log_{10}$(PL value)/2 |
|---|---|---|---|---|---|---|---|---|
| $m_p^2$ | 0 | 0 | 0 | 1 | 1 | -1 | -38.228806 | -19.114403 |
| $r_e^2$ | 0 | 0 | 0 | 1 | 1 | 1 | 40.482954 | 20.241477 |
| $t_p^2$ | 0 | 0 | 0 | 1 | 1 | 1 | 40.482954 | 20.241477 |
| $[Gm_p/c^2]^2$ | 0 | 0 | 0 | 1 | 1 | -1 | -38.228806 | -19.114403 |
| $T_p^2$ | 0 | 0 | 0 | 1 | 1 | 2 | 79.838434 | 39.919417 |
| $E_{Tp}^2$ | 0 | 0 | 0 | 1 | 1 | -1 | -38.228806 | -19.114403 |
| $E_{Gp}^2$ | 0 | 0 | 0 | 1 | 1 | -3 | -116.940568 | -58.470284 |
| $\rho_p$ | 0 | 0 | 0 | -1 | -1 | -2 | -79.838834 | |
| $m_p r_e$ | 0 | 0 | 0 | 1 | 1 | 0 | 1.127074 | |
| $m_p/r_e$ | 0 | 0 | 0 | 0 | 0 | -1 | -.39.355880 | |

$E_{Gp} = m_p^2/r_e = \sqrt{(\alpha\mu/S^3)} = Etp/S$, $\quad t_p = r_e = T_p/\sqrt{S}$, $\quad T_p^2\,\rho_p = 1$

$t_p = t_e$, $\quad T_p = \sqrt{(\mu)}\,T_e$

| QUANTITY | $\hbar$ | G | c | $\alpha$ | $\mu$ | S | $\log_{10}$(PL value) | $\log_{10}$(PL value)/2 |
|---|---|---|---|---|---|---|---|---|
| $a_o^2$ | 0 | 0 | 0 | -3 | 1 | 1 | 49.030294 | 24.515147 |
| | | | | | | | $\log_{10}$(cgs value) | $\log_{10}$(cgs value)/2 |
| $a_o^2$ | 1 | 1 | -3 | -3 | 1 | 1 | -16.552798 | -8.276399 |

FREQ2 OBJECT log(cgs) FREQUENCIES

$G := -7.175296$ $c := 10.476821$ $h := -26.976924$

$S := 39.355471$ $\alpha := -2.136835$ $\mu := 3.263909$

$M := 27.776243$ $L := 8.804268$ EARTH

$\times 2\pi$ log $2\pi$ 0.798180

$T_1 := 0.5\cdot(3\cdot G + 2\cdot M + h - 2\cdot L - 9\cdot c)$ $T_1 = -52.4251255$

$T_2 := G + M - 3\cdot c$ $T_2 = -10.829516$ = Schwartzschild

$T_3 := 0.5\cdot(G + 2\cdot M + 2\cdot L - h - 3\cdot c)$ $T_3 = 30.7660935$

$T_4 := G + h - L - 4\cdot c$ $T_4 = -84.863772$

$T_5 := 0.5\cdot(G + h - 5\cdot c)$ $T_5 = -43.2681625$

$T_6 := L - c$ $T_6 = -1.672553$ −0.874373 Schumann

$T_7 := 0.5\cdot(G + 3\cdot h - 2\cdot M - 2\cdot L - 7\cdot c)$ $T_7 = -117.3024185$

$T_8 := h - M - 2\cdot c$ $T_8 = -75.706809$

$T_9 := 0.5\cdot(2\cdot L + h - G - 2\cdot M - c)$ $T_9 = -34.1111995$

$T_{10} := 0.5\cdot(G + M + L - 4\cdot c)$ $T_{10} = -6.2510345$ −5.452855

$T_{11} := 0.5\cdot(3\cdot L - G - M)$ $T_{11} = 2.9059285$ 3.704427 Schuster
84.387 min

# SPACE, MATTER, AND FREQUENCY

Space and matter breathe, they are vibratory. Both oscillate at many frequencies and interact by resonating, interfering, and modulating. Space oscillates between expansion and contraction [expansion and contraction may even include changes in the number of dimensions]. Matter oscillates between fragmenting and merging; and space and matter together oscillate between existence and non-existence. Minkowski joined space with time to create "space-time". Einstein then showed that the existence of space-time depended on the existence of matter. Space-time is an attribute of matter and matter is an attribute of space-time, they are mutually causal. And an empty space-time would not exist.

The relations between the Planck particle and the baryon give us an example of interactions between space-time and matter. We shall here assume that the Planck particle, whose mass, $m_o$ = –4.662199 gm, and whose size. $l_o$ = –32.791545 cm , fragments into a baryon and three other particles. We take the mass of the proton to be $m_b$ = –23.776602 gm; and the Radius to be $r_e$ = –12.550068 cm (All values are $\log_{10}$ values)

TABLE I

| Particle | mass gm | size cm | M x R cgs | M/R cgs |
|---|---|---|---|---|
| [1] baryon | –23.776602 | –12.550068 | –36.326670 | –11.226534 |
| [2] mini black hole ? | +15.579276 | –51.905964 | –36.326670 | +67.485240 |
| [3] | –23.776602 | –51.905964 | –75.682566 | +28.129362 |
| [4] | +15.579276 | –12.550068 | +3.029208 | +28.129344 |

TABLE II

| Particle | MxR Planck values | M/R Planck values | Quadrant |
|---|---|---|---|
| [1] baryon | $\alpha\mu\hbar/c$ | $S^{-1}\ c^2/G$ | 1° |
| [2] mini black hole ? | $\alpha\mu\hbar/c$ | $S\ c^2/G$ | 2° |
| [3] | $S^{-1}\ \alpha\mu\hbar/c$ | $c^2/G$ | On S.B. 3°–4° |
| [4] | $S\ \alpha\mu\hbar/c$ | $c^2/G$ | On S.B 1°–2°. |

Where, $\hbar$ is Planck's constant, = –26.976924 cgs units; $\alpha$ is the fine structure constant, = –2.136835; $\mu$ is the proton/electron mass ratio = 3.263909; and S is the coulomb/gravitational force ratio = +39.355878. $\alpha$, $\mu$, and S are dimensionless constants.
S.B. = the Schwarzschild Boundary, where M/R = $c^2/G$ = +28.129362 cgs

O

## FOUR QUADRANTS

The cosmos may be divided into four quadrants according to the following rules:

| | S.B. | H.B. | |
|---|---|---|---|
| First quadrant: | $M/R < c^2/G$; | $MR > \hbar/c$ | (Normal matter, atoms, stars, etc) |
| Second quadrant: | $M/R > c^2/G$; | $MR > \hbar/c$ | (Black holes ) |
| Third quadrant: | $M/R > c^2/G$; | $MR < \hbar/c$ | ? |
| Fourth quadrant: | $M/R < c^2/G$; | $MR < \hbar/c$ | (photons, etc.) |

H.B. = the Heisenberg Boundary, where $\hbar/c = -37.453745$ cgs.

Baryons reside in the first quadrant, where those such as protons are relatively stable. Particle 2 resides in the second or black hole quadrant where it is relatively stable. However particle 3 and particle 4 lie <u>on</u> the Schwarzschild boundary, an unstable watershed, where a perturbation into the first quadrant would result in expansion or into the second quadrant ~~resulting in~~ with contraction.

## ENERGY

TABLE IIIa The $Mc^2$ or Mass Energy [1,0]

| Particle | $Mc^2$ cgs | $Mc^2$ Planck units | $Mc^2$ Planck values |
|---|---|---|---|
| [1] baryon | −2.822960 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [2] mini black hole | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| [3] | −2.822960 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | +36.532916 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | +67.419912 | + 2.254144 | $(\alpha\mu)^2$ |

$c^2 = 20.953642$ cgs units The brackets [p,q] refer to the exponents $M^p$ and $R^q$

TABLE IIIb The $\hbar c/R$ or Space Energy [0,−1]

| Particle | $\hbar c/R$ cgs | $\hbar c/R$ Planck units | $\hbar c/R$ Planck values |
|---|---|---|---|
| [1] baryon | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| [2] mini black hole | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [3] | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [4] | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911656 | −2.254144 | $(\alpha\mu)^{-2}$ |

$\hbar c = -16.500102$ cgs units

ENERGY (continued)

TABLE IIIc The $\hbar c^3/GM$ Energy [−1,0]

| Particle | $\hbar c^3/GM$ cgs | $\hbar c^3/GM$ Planck units | $\hbar c^3/GM$ Planckvalues |
|---|---|---|---|
| [1] baryon | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [2] mini black hole | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| [3] | +35.405862 | +19.114402 | $(S/\alpha\mu)^{1/2}$ |
| [4] | −3.950034 | −20.241474 | $(\alpha\mu S)^{-1/2}$ |
| sum of values | +62.911656 | −2.254144 | $(\alpha\mu)^{-2}$ |

$\hbar c^3/G$ = + 11.629246 cgs units

TABLE IIId The $c^4R/G$ Energy [0.1]

| Particle | $c^4R/G$ cgs | $c^4R/G$ Planck units | $c^4R/G$ Planckvalues |
|---|---|---|---|
| [1] baryon | 36.532921 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| [2] mini black hole | −2.822975 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [3] | −2.822975 | −19.114402 | $(\alpha\mu/S)^{1/2}$ |
| [4] | 36.532921 | +20.241474 | $(\alpha\mu S)^{1/2}$ |
| sum of values | 67.419892 | 2.254144 | $(\alpha\mu)^2$ |

$c^4/G$ = 49.082989 cgs units

From the above four tables, we have the first order energy sums for the four particles:
$Mc^2$ or [1,0] energy = $(\alpha\mu)^2$; $\hbar c/R$ or [0,−1] energy = $(\alpha\mu)^{-2}$;
$\hbar c^3/GM$ or [−1,0] energy = $(\alpha\mu)^{-2}$; $c^4R/G$ or [0,1] energy = $(\alpha\mu)^2$

The total of these four energies = 0; and since the total energies of the Planck particle are zero, we conclude that in the decay of the Planck particle into a baryon and particles [2], [3], and [4], energy has been conserved.

However, there are numerous 'higher order' energies, $\hbar\nu$, corresponding to all allowable frequencies, $\nu$, that involve additional integral and fractional exponents [p,q], $M^p$ and $R^q$. From symmetry considerations, all of these may be paired, [p,q] with [-p,-q], so that the energies sum to zero. Thus the decay of the Planck particle into the four above described particles obeys the first law of thermodynamics for all energies. An additional example showing paired energies is given in TABLE IIIe [2,-1], and in TABLE IIIf [-2,1].

0

THE SUN:

Measured values: $M_\odot$ = 33.298685  $R_\odot$ = 10.842303

$M_\odot/R_\odot = 22.456832$ approximately $\cong \alpha^{-5}\,\mu^{-5}\,c^2/G = 22.493575$  $\delta = 0.036743$

$M_\odot\, R_\odot = 44.169181 =$ exactly $= S^2\,\alpha^{-9}\,\mu^{-5}\,\hbar/c = 44.169181$  $\delta = 0.000000$

Values computed from the preceding fundamental constant approximations:

Sun in reference to Planck particle:

$M_\odot = m_o\, S\, \alpha^{-7}\,\mu^{-5} = 33.331378$  $\delta(\text{comp - meas}) = 0.032693$

$R_\odot = l_o\, S\, \alpha^{-2} = 10.837803$  $\delta(\text{meas - comp}) = 0.004500$

$(M_\odot/R_\odot)/(m_o/l_o) = \alpha^{-5}\,\mu^{-5}$  $M_\odot\, R_\odot\,/m_o\, l_o = S^2\,\alpha^{-9}\,\mu^{-5}$

Sun in reference to standard star:

$M_\odot/M_\star = \alpha^{-6}\mu^{-4}$ ;  $R_\odot/R_\star = \alpha^{-3}\mu^{-1}$ ;

$(M_\odot/R_\odot)/(M_\star/R_\star) = \alpha^{-3}\mu^{-3}$ ;  $M_\odot R_\odot/M_\star/R_\star = \alpha^{-9}\mu^{-5}$

Sun in reference to baryon:

$M_\odot = m_p\, S^{3/2}\,\alpha^{-15/2}\,\mu^{-11/2}$ ;  $R_\odot = r_e\, S^{1/2}\,\alpha^{-5/2}\,\mu^{-1/2}$

$(M_\odot/R_\odot)/(m_p/r_e) = S\,\alpha^{-5}\,\mu^{-5}$ ;  $M_\odot\, R_\odot/m_p\, r_e = S^2\,\alpha^{-10}\,\mu^{-6}$

FORCE RATIOS:

The planck force $= X = c^4/G = 49.082587$

The coulomb force $= Q = \hbar c/r_e^2 = 8.600033$

Gravitation force $= N = G\, m_p^2\,/r_e^2 = -29.628371$

$Q/N = S/\alpha\mu = 38.228404$

$X/Q = \alpha\mu S = 40.482554$

$X/N = S^2 = 78.710956$

$XN/Q^2 = (\alpha\mu)^2 = 2.254148$

---

$S = \hbar\alpha c/Gm_pm_e = \alpha\mu\,(m_o/m_p)^2 = r_ec^2/m_pG = \alpha^{-23}\,\mu^{-3}$

$e^2 = \hbar\alpha c = -18.636938\ [ML^3/T^2]$ ;  $m_e^2 = \hbar c/G$ ;  $e^2/m_er_e = c^2$

$\{\ SG/c^3 = 0.749712 \sim 3/4\ [T/M]\ \}$

FASTSLOW FAST AND SLOW UNIVERSES

Just as spatially, there must be figure and ground, so temporally there must be figure and ground. In temporal patterns this is achieved by a fast time system and a slow time system. In the human body the fast system is the nervous system and the slow system is the motor system. In a railroad the fast system is the telegraph system, the slow system is the train system. In an airline the fast system is the radio-radar communication system and the slow system is the aircraft transportation system. The two systems are linked by schedules and time-tables. In the physical universe the fast system is the electromagnetic/radiative universe and the slow system is the gravitating/mechanical universe.

Originally our unit of the second

Humans must operate primarily in the mechanical/acoustical universe rather than in the electormagnetic/radiative universe and this creates a distinct bias in our descriptions. We thus find ourseves located on the space-time event diagram in a region that favors short spaces and long times. (cf Harrison chapter 2). This is reflected in the units with which we designate **c**, the velocity of light. If we were in a 'balanced' region, the velocity of light would be something like a few space units per time unit. Instead we designate the velocity of light as 30,000,000,000 cm/sec ($3 \times 10^{10}$ cm/sec), indicating a bias toward very small space units or very large time units or both. When the universe is measured, we find that its observable limits are something like $10^{27}$ cm and its age something like $10^{10}$ years or $10^{17}$ sec., again the ratio of units, universe size to age = about $10^{10}$.

because ... developed late?

If we claim that 30 cm or one foot is the proper scale for our everyday spatial descriptions, then to remove our space-time bias we should select one nanosecond as the proper unit of time. The velocity of light would then be close to 1 foot/nanosecond. Or if we feel that one second is the proper time unit for our descriptions, then to remove the bias, we should select the length unit to be thirty billion centimeters (three hundred thousand kilometers or roughly the distance to the moon). It is interesting that the new stages of human experience and even industrial development are properly described with less biased units. In the design of advanced integrated circuits, it is found that the velocity of light enters as a design constraint. In order to get operations that can be performed in a nanosecond, the length of the links can be but a few centimeters, so the 30 cm-- 1 nanosecond system of units becomes the natural one for our thinking when considering high speed computer operations. Present and anticipated operations in cislunar space, on the other hand, lead us to thinking about systems whose locations are best described in terms of distances measured in light-seconds. For example, 24 hour satellites are located at a distance of about 0.1 light-second above the earth and transmission times involved are of the order of a fifth of a second. We are learning that as we extend our domain of operations we must increasingly come into ~~accord~~ balance with the world's realities.

The 1/g and e/r ... come into coincidence as we approach the limits

what about Planck units?

We conclude that our bias presents to us a very elongated spatial universe, a $10^{10}$:1 ratio of axes in a space-time ellipse. However, this large space-time 'elliptical bias' of our event region may be just the condition that has permited us awareness of the very large and the very small in the universe. If we had begun as creatures with 'balance' in our perception space, then our perception of the universe might have been scalewise limited for all time to the narrow neighborhood set by our balanced units.

TWO REGIONS IN THE SLOW/FAST UNIVERSE

In those regions of the world that our experience has encountered so far we find that the mechanical/acoustical universe is the slow universe and the radiative universe is the fast universe. However when we study the conditions interior to the stars, the opposite condition obtains. Acoustical energy and information traverses a star in an hour or so, convective phenomena are the high speed phenomena. On the other hand, because of the high opacity of stellar material, the radiative transfer of energy and information is extremely slow. It is estimated that it takes about 10 million years for radiative energy to make its way from the solar core to the surface. This is a speed of $10^{10}$ cm in $10^{14}$ seconds. A star's elliptical bias is much less than ours, but there is still considerable imbalance.

Natural Units

Planck time $10^{-42}$ sec    Age of U $10^{17}$ sec or $10^{59}$ p.l.u.

Planck length $10^{-33}$ cm    Size of U $10^{27}$ cm or $10^{60}$ p.l.u.

$S^{1/3}$

Mass $10^{-4}$ g    M of U $10^{56}$ g    $10^{60}$ p.l.u.

Human [illegible] $10^{8}$ $10^{9}$ p.l.u.

[illegible] $10^{51}$ p.l.u.

Human size $10^{35}$ p.l.u.

$S^{2/3}$

$M \times T = C$

[illegible] $10^{9} \times 10^{51} = 10^{60}$

What else but man [illegible] universe?

82a
also 1996 #27

FRACAGE1.WP6 October 27, 1995 REV October 19, 1996

# A FRACTAL AGE OF THE UNIVERSE

An alternate approach to determining the age of the Hubble universe is to consider its fractal nature; that is, properties of its parts being similar to those of the whole. Let us ask how long it would take for a Planck particle to expand to the size of a baryon, specifically, for the Planck length, $\sqrt{(Gh/c^3)}$ to grow to the size of the electron radius, $r_e$.
$\sqrt{(Gh/c^3)} = L_p = -32.791341$ and $r_e = -12.55068$ $\log_{10}$(cgs) values

What are the boundary conditions governing such expansion?

The Heisenberg uncertainty principle provides us with the inequality,

$$\frac{ML^2}{T} \geq h \qquad (1)$$

which places a lower bound on all action. The left member is equivalent to,

$$\frac{M}{L}\frac{L^3}{T} = \frac{M}{L}\frac{V}{T} \geq h \qquad (2)$$

where V is volume.

The Schwarzschild inequality $GM/c^2R \leq 1$, when substituted in equation (2) gives,

$$\frac{c^2}{G}\frac{V}{T} \geq \frac{M}{L}\frac{V}{T} \geq h \qquad (3)$$

This says that the <u>minimum</u> volume rate of expansion V/T is equal to $\Psi = Gh/c^2$, whose $\log_{10}$ value is $-55.105861$ $cm^3/sec$. This implies in turn that the <u>maximum</u> time taken for the expansion is $T = V/\Psi$ (Whether or not there is inflation). With $V = r_e^3 = -37.650205$, T becomes 17.455656 seconds or 9.056 billion years.

The value of 9.056 billion years is the age of the universe which corresponds to a Hubble Age of 13.584 billion years and to a Hubble constant of 71.994 km/sec/mpc.

Cosmological Theories are based on the assumption of homogeneity. The universe is filled with a homogeneous fluid when to the...

∃ Non homogeneous Models

But now emphasize the structure ~~of the~~ ⊂ cosmos

But ∃ fractals so instead of assuming homogeneity we can that the fractal nature allow

THE FRACTAL ASSUMPTION

$$\frac{\text{What happens } \epsilon}{\text{What happens } U} \quad I \text{ a scale factor}$$

I sotropic with x, y, z

h in about

Generalized Isotropic with respect to other direction or $T, t, \tau$

BUT ∃ some items that apply to all levels

e.g. $v \le c$ $\quad \frac{M}{L} \le \frac{c^2}{G}$ $\quad E \cdot T \ge \hbar$ $\quad \frac{M L^2}{T L} \ge \frac{\hbar}{c}$

$$ML \le \frac{c}{\hbar} \qquad ML \ge \frac{\hbar}{c}$$

$$M^2 \le \frac{c^3}{c\hbar} = \frac{1}{\ell_0^2} \qquad \frac{L}{M} \ge \frac{G}{c^2} \qquad \frac{M}{L} \le \frac{c^2}{G}$$

$$M^2 \ell_0^2 \le 1 \qquad \frac{m_0}{\ell_0} \le \frac{c^2}{G}$$

$$\boxed{M \le 65}$$

ε, Sch & Hes Bounds Universal

$$\frac{M/m_0}{L/\ell_0} \le 1$$

$$\boxed{\frac{M}{m_0} \le \frac{L}{\ell_0}} \quad \text{prove \#16}$$

$37 \le 42$

$57 \le 60 \qquad \frac{M}{m_0} \le \frac{t}{t_0} \qquad \begin{matrix} 17 \\ 43 \\ 60 \end{matrix}$

This value of 9.056 billion years is the age of the universe which corresponds to a Hubble Age of 13.584 billion years and to a Hubble constant of 71.994 km/sec/mpc.

According to the current relatavistic cosmological model, the Hubble age of the universe calculated from the value of the Hubble constant is 3/2 greater than the actual age. [That is at the critical density of matter that closes the universe ($\Omega = 1$), the Hubble Time is 3/2 the time elapsed since the big bang.] Observations made on cepheids by Wendy Friedman and associates of the Carnegie Institution, reported in the June 1996 Carnegie publication, "Spectra", lead to a value of the Hubble constant of 73 with a 15% uncertainty. This gives a Hubble time of 13.40 billion years or a time since the big bang of 8.93 billion years. Sandage, also of the Carnegie Institution, reports in the same issue, a value of 57 km/sec/mpc with an uncertainty of 7%, based on type Ia supernovae. This corresponds to a Hubble age of 17.16 billion years or a time from the big bang of 11.44 billion years. When compared with the age of stars in globular clusters of 15 billion years, we have the problem of "being older than your mother", stars whose age is greater than that of the universe.

The following table compares the FRACTAL age derived here with those calculated from cepheids and from type Ia supernove.

| | FRACTAL | CEPHEIDS | SUPERNOVAE |
|---|---|---|---|
| HUBBLE CONSTANT | 71.96 k/s/mpc | 73 k/s/mpc | 57 k/s/mpc |
| HUBBLE AGE | 13.584 B.Y. | 13.40 B.Y. | 17.16 B.Y. |
| TIME FROM BIG BANG | 9.056 B.Y | 8.93 B.Y. | 11.44 B.Y. |
| UNCERTAINTY | < 1 % | 15 % | 7 % |

# THE HUBBLE PARAMETER AND FUNDAMENTAL CONSTANTS

It has been shown[1] that a joint implication of the Heisenberg and Schwarzschild inequalities is that the average rate, $\Delta V / \Delta T$, in increase of volume of an expanding mass system is greater than or equal to $\psi = G\hbar/c^2$. That is,

1) $$\Delta T \leq \frac{\Delta V}{\Psi} = \frac{V_f - V_o}{\Psi}$$

where $\mathbf{V_f}$ is the final volume and $\mathbf{V_o}$ is the initial volume. Interpretating $\Delta T$ as the time elapsed since the volume was equal to the initial value $\mathbf{V_o}$, a bound on the maximum age of the system is given by equation 1).

First, consider the case of the initial volume being that of the Planck particle,

$$V_o = \left(\frac{G\hbar}{c^3}\right)^{\frac{3}{2}}$$

which has the $\log_{10}$ value of -98.374635, and the final volume being that of a baryon,

$$V_f = r_e^3$$

which has the $\log_{10}$ value of -37.650204. $\mathbf{V_o}$ is negligible with respect to $\mathbf{V_f}$, hence,

$$\Delta T \leq \frac{r_e^3}{\Psi}$$

Using the $\log_{10}$ value, -55.106271, for $\psi$, gives $\log_{10} \Delta T = 17.456057$ seconds as the maximum time or age since the expansion of the system. This is equivalent to 9.056387 billion years.

What is of interest here is that this is remarkably close to the age of the universe from the big bang to the present. From determinations of the Hubble parameter using cepheids, Wendy Freedman et al find for the age since the big bang a value of 9.18 billion years (± 10%)[2]. Kirshner using type II supernovae derives a value of 8.93 billion years.[3]

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[1]See Scraps 1995 #82 and 1996 #27

[2]Physics Today, August 1999, p20

[3]Physics Today, May 1996, p19

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The following table compares the Cepheid, Type II supernova, and "Heisenberg-Schwarzshild" values:

| | CEPHEIDS | II SUPERNOVAE | "H-S" |
|---|---|---|---|
| AGE OF SYSTEM | $9.18 \times 10^9$ years | $8.93 \times 10^9$ years | $9.056387 \times 10^9$ years |
| HUBBLE TIME | $13.77 \times 10^9$ years | $13.40 \times 10^9$ years | $13.58 \times 10^9$ years |
| HUBBLE CONSTANT | 71±7 km/s/mpc | 73±7 km/s/mpc | 71.977 km/s/mpc |
| UNCERTAINTY | 10% | 15% | < 1% |

It must be repeated here that the H-S determination is for a hypothetical universe, the others for the "Hubble Universe".

---

The H-S derivation led to a value of $\log_{10}\Delta T = 17.456067$ seconds. Converting from seconds to Planck time units, $t_o$, ( $\log_{10} t_o = -43.268366$ seconds) gives $\log \Delta T = 60.724433$, which is a dimensionless quantity. One third of this value is 20.241477 which is equal to $\log_{10}\sqrt{(\alpha\mu S)}$. Where $\alpha$ is the fine structure constant, $\mu$ is the ratio of proton to electron mass, and S is the ratio of coulomb to gravitational force. We conclude:

$$\Delta T = (\alpha\mu S)^{3/2}\, t_o \text{ seconds}$$

Is this a fractal invariant, isomorphic between different scales, or a just a highly improbable numerical coincidence? It raises many questions!

HUBBLE03.WPD SEPTEMBER 19, 1999

# THE HUBBLE PARAMETER AND FUNDAMENTAL CONSTANTS OF PHYSICS

REVISED

*Number is the infrastructure of everything.* –Pythagoras
*As above, so below.* –Hermes Trimegistius

From the Heisenberg and Schwarzschild inequalities it can be shown that,

$$\frac{V}{T} \geq \frac{G\hbar}{c^2} = c l_o^2 = \frac{l_o^3}{t_o}$$

where V has the dimensionality $[L^3]$, T has dimensionality [T], G, ħ, and c are respectively the gravitational constant, Planck's constant, and the velocity of light; $l_o$ is the planck length and $t_o$ the planck time. Hence,

$$\frac{T}{t_o} \leq \frac{L^3}{l_o^3}$$

In particular, if L is taken equal to $r_e$, the electron radius,

$$T \leq \frac{r_e^3}{l_o^3} t_o = (\alpha \mu S)^{\frac{3}{2}} t_o$$

where α is the fine structure constant, μ the proton to electron mass ratio, and S the coulomb to gravitational force ratio.

The $\log_{10}$ value of T becomes 17.345065 seconds, or $\log_{10}$ 9.956955 years, which is equal to 9.056387 billion years. The interesting thing about this maximum value of T is that it is close to modern approximations of the time since the big bang, or "age of the universe". Indeed, if we take recent values derived from observations of 800 cepheids in 18 galaxies out to 25 megaparsecs[1], the age of the universe comes out to be 9.18 billion years, (with a Hubble time of 13.77 billion years). This value is derived from a Hubble parameter = 71±7 km/sec/mpc.[1] When the above value of 9.056387 billion years is converted to a Hubble parameter, it turns out to be 71.977 km/sec/mpc. If this is not just a numerical coincidence, and the present value of the Hubble parameter is indeed 71.977 km/sec/mpc, then there are some disturbing implications.

Pursuing this line of investigation, we find that the above value of T arises also from other levels of the inequality.

$$T \leq \frac{r_e^3}{l_o^3} t_o; \quad T \leq \frac{l_a^{\frac{3}{2}}}{l_o^{\frac{3}{2}}} t_o; \quad T \leq \frac{l_U}{l_o} t_o$$

where $l_a$ is a stellar radius, and $l_U$ is the radius of the Hubble universe. In each case the value of T is 9.056387 billion years.

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[1]Key Project, Wendy Freedman et al. Physics Today Aug 1999, p 19

MODELS01.P51 DISK: EPIONTOLOGY January 31, 1992

# "TALL SKINNY BOX" REVISITED

Models are constructed as analogues, as metaphors, out of words, out of symbols, out of equations, out of archetypes,...
A model is a bridge between human understanding and a cosmos. A cosmos is multi-faceted, it can accept many projections, i.e be modeled in many ways. Examples are the spiritual world, the Great Pyramid, both can accept many projections. Humans as finite creatures must select facets to serve as the total, it is our finiteness that underlies our requirement of consistency.*

In selecting a cosmos and a model for it, we are trying to understand ourselves for we are also a cosmos. Thus a model is a device to match four cosmoses. Man and World, Material and Spiritual.

cosmota ?

The value of a model is measured basically by three parameters:

- Comprehensiveness or Inclusiveness (how many fits) i.e. the extent of the domain or range of phenomena fitted.
- Precision or Accuracy (how good the fits) i.e. the degree of closeness of fit
- Simplicity or Succinctness (how straight the edges) i.e. the number of axioms ("epicycles") in the model; the number of inputs, of arbitrary constants, etc.

also prediction

There is also the matter of consistency, of which there are two kinds, self or internal and consistency with other models. (This is the domain of Ratna Sambhava). The criterion of consistency is related to the value of monism, the goal of total unity within the one. However, sometimes unity (monism) is a synonym for simplicity.

Other values, such as utility, range of applicability, or elegance are in large measure determined by the above three.

If we imagine a "cognition space" of three dimensions along whose axes are the measures of the above three parameters, then the value of a model is measured by the volume of the model in such a space. However, the reciprocal of simplicity must be used as the third axis.

In such a space we used to say the the notion of God, as a model or explanation, was like a tall skinny box. The inclusiveness was almost unlimited, the simplicity was in one sense ultimate, but the precision was almost entirely lacking, in that no predictions could be made with the model. A replacement hypothesis or model in modern times is the notion of 'Chance'. Its volume, like God's is very large in IP/S space. Its inclusiveness is somewhat less, its simplicity is about the same, but its precision is much greater. In any event at the present, the two models with the greatest volume are God and Chance. [i.e. Dice]

The approach of Karl Popper is to look at the negations of the parameters: What is the extent of non-fits or contradictions of the model, what is the extent of precision. Negation either delimits the inclusiveness or stretches the precision.

* There's really no such thing as inconsistency
only there are different views
of a more profound whole.

What is the plural of cosmos? – a word for which ∄ a plural
of universe?

ONPATERN.P51 DISK: EPIONTOLOGY 10/22/~~87~~ 92

# O N P A T T E R N S

A pattern is a distribution in space of a set of nodes. If viewed with low resolving power, the various linkages connecting the nodes are invisible, and even more invisible are the various traffics that flow along the linkages from node to node. If viewed with high resolving power, the pattern may not be perceived at all, and its existence demonstrated only by a step by step process, node by node. *

The recognition of pattern is a fundamental cognitive operation, where the key word is 'recognition'. In order for a pattern--whether static or dynamic--to be recognized it must belong to the class of previously perceived and remembered patterns. But perception of a pattern does not automatically take place in response to the occurrence of the pattern. Only certain patterns are perceived or remembered. Which ones? Generally, in order to be remembered the pattern must either posses a simple structure or a high frequency of occurrence. That is to say that the greater the information content of the pattern the more repetitions are required for its perception and registration in memory.

How does a pattern cross over the threshold to perception and recognition? We tautologically say we recognize the familiar. What makes something familiar? One thing is frequency of occurrence. The more common and ubiquitous a pattern, the more likely we are to encounter it and the more readily become familiar with it. Certain simple patterns, linear patterns like triangles and squares and patterns possessing symmetries like circles are most apt to be recognized. Do we recognize them because they are simple or do we label them simple because they are so common and hence familiar?

Complex, subtle, and shimmering patterns are usually unpercieved or ignored as useless. Only simple and universal patterns are accepted because these are the species of pattern that are accessible to all. These are the patterns recognized by the epistemology of science--which emphasizes repeatability and ubiquity. But the ease of perception or recognition of a pattern may have little to do with its basic importance or significance. Science may assume that the more ubiquitous the pattern, the more important, but we may take the occurrence of genius in human populations as a counter example. The deepest effects may result from complex shimmering patterns that only momentarily "tune in" but set up brief and powerful resonances with far reaching consequences. No statistical tests would convince us of their importance or even of their existence. ~~These~~ such patterns lie beyond the ken of the scientific method.

* Science operates in this fashion

PATTERNS

PATERNO3.P51 EPIONTOLOGY November 13, 1992

Our mode of interacting with the world may be described as the search for, and the creation of, patterns. The patterns we discern in nature and the patterns we create constitute a multi-dimensional spectrum with a twilight zone wherein we are unsure which patterns we have perceived and are indigenous to the world and which patterns we have ourselves constructed and projected onto the world.

At one extreme there is a school that holds all patterns are of our own construction. The world is a great void capable of receiving and incorporating whatever we project on it. At the other extreme is the obverse school that holds the world is a great smorgasbord from which we select all patterns. It consists of myriads of patterns only a small subset of which we can recognize and assimilate. This school holds we create nothing only select what preexists.

> In his *Accent on Form* L. L. Whyte regards pattern as the dynamic idea of the science of the future, just as number, space, time, atom, energy, organism, mind, unconscius mind, historical process and statistics have each in turn been the dynamic ideas of the past, serving as he says, "directly as instruments for understanding the universe. To understand anything, one must penetrate sufficiently deeply towards the ultimate pattern. Only a new scientific doctrine of structure and form, i.e. pattern, can suggest the crucial experiments which can lead to the solution of the master problems of matter, life and mind."
>
> See Diagram by Keith ALbarn and Jenny Miall Smith p137

See also MYSTCONG.WPW 93-40

SCIFIWN.P51 DISK:ESSAYS1-P51 August 14, 1991

SCIENCE FICTION WITH NUMBERS

Every vital area of human endeavor possesses a penumbra of speculation. However, the relation between the hard core of a discipline and its penumbral sunyata varies from the sharply defined orthodox/heresy relation in theology to the fuzzy non-fiction/fiction frontier in literature. In general, the more blurred the boundary the more vital the area.

In the case of science, the relation between its hard core of what-is-science and its penumbra of speculation is unique. Science idealizes open endedness so it proclaims to have no orthodoxy. But through its traditional publication procedures, it supports a powerful curia of journal editors with almost absolute control of imprimatur. [insert Max Planck's quote and the cold fusion story here] How then, does science maintain its vitality? Rather than with unrestricted commerce across a broad fuzzy frontier, science maintains a symbiotic trade relation, mostly export with occasional reluctant imports, with a second carefully defined but distinctly separate discipline called science fiction. In effect science has created a medieval castle protecting itself within the walls of the keep and insulated further from the outside by the bailey of science fiction. Except for occasional missiles hurled over the walls by the catapults of mathematics research [e.g. fractals] and technology, does anything get into the keep that has not passed through the bailey.

cf [illegible] Friends Service Committee

Perhaps this description explains why speculative ideas such as those of Fred Hoyle, who is both a scientist and a science fiction author (as many scientists are), receive negative notice. Hoyle finds there is no place to stand between the bailey and the keep. Science's limited relationship with speculation--speculation must be kept private--has restricted its progress as much as theology's love affair with the orthodox has limited it. Science needs a domain for speculation other than that of science fiction. It needs a non-private respected publishing domain.

∃ a journal for this area

cf Einstein on imagination

COSNOTE1.P51 DISK:COSNUMBERS June 7, 1991

Reality is a consensus derived from temporal and spatial continuity. But all continuity, both temporal and spatial is illusory. Hence, to ~~the~~ think about the universe at all we must consider its *measure*. Where by measure is meant, something like Lebesgue measure.

Both space and time are dyadic in nature. Space is divided into extension and separation, time is divided into duration and interval ("while and until"). If these dyads are viewed with higher resolving power, the concept of density is involved. In the case of physical space, matter density, $\rho$. When $\rho = 0$, there is pure separation, when $\rho > 0$, there is some sort of extension. Similarly with time. The Kepler-Newton law, granular

**(1)**
$$T = 2\pi \frac{R^{3/2}}{\sqrt{GM}}$$

states that time $\propto \rho^{-1/2}$. Thus when $\rho = 0$, T is infinite. Spatial separation is associated with infinite time or eternity. But when $\rho > 0$, time is finite having duration and space possesses extension.

Cf Einstein's existence = Matter | Space-time

Aristotle based the idea of change on motion, in fact holding they were equivalent. (What about color change?) Assuming he is right, then all change is related to velocity, which is space/time.

**(2)**
$$\frac{SPACE}{TIME} = \frac{\rho}{\rho^{-1/2}} = \rho^{3/2}$$

But this quantity is assumed in relativity theory to be bounded. In particular linear velocities are bounded by c, the velocity of light. We conclude that $\rho^{3/2}$ is bounded by some appropriate power of the velocity of light.

$$\frac{\frac{GM}{R^2}}{\frac{GM}{c^3}} = c = \frac{R}{T}$$

3) $\frac{GM}{c^2 R} < 1$

$$\frac{\frac{GM}{c^3}}{\sqrt{\frac{L^3}{GM}}} = \frac{(GM)^{3/2}}{c^2 L^{3/2}} = R\rho^{1/2}$$

$G\rho < \left(\frac{c}{R}\right)^2$ or $\frac{R}{c} = T < \frac{1}{\sqrt{G\rho}}$

$R < \frac{c}{\sqrt{G\rho}}$

$R^2 < \frac{c^2}{G\rho}$ $\rho < \frac{1}{G}\left(\frac{c}{R}\right)^2$

Reality is a front

$\rho^{3/2} < \left(\frac{c}{R}\right)^3 G^{-3/2}$

as a velocity

$\rho^{3/2} < c^3$

Vol. $\rho^{3/2} < \left[\frac{c}{\sqrt{G}}\right]^3$

[velocity]

See also
NOVC0502.WPW 05/11/93 # 35

COSMODEL.P51 DISK:COSNUMBERS May 4, 1991

My speculative model of the universe agrees with the idea of the big bang and the expansion, but modifies the expansion from being monotone or inflated to being oscillatory. The first bang resulted in expansion, then after a certain amount of cooling, part of the kinetic energy of expansion was 'absorbed' being ~~locked~~ condensed into the 'packaging energy' of fundamental particles. The loss of kinetic energy was sufficient to allow gravity to overcome expansion and contraction began. The contraction continued until a close-packed density of the fundamental particles was reached. At this point the collisions of the particles led to release of the packaging energy of a portion of the particles and a second bang occurred with expansion beginning again. The principal modules at this point were the fundamental particles.

This process was iterated, with successive modules—atoms, molecules, stars, galaxies,,,— being formed at each alteration of expansion and contraction. Each module marks a moment of maximum expansion, while the distributions of the modules are vestiges of the configurations imposed at maximum contraction. There is evidence of a recent contraction in a distribution pattern of galaxy clusters resembling that of close packed polyhedra.

We are now observing an expanding phase in which the largest modules are clusters ~~of galaxies~~. Bubbles defined by "great walls" of galaxies

This process creates a fractal-like universe.

SWRZLIM1.WP6 October 27, 1995

# THE SCHWARZSCHILD LIMIT

THE BLACK SHIELD

The Schwarzschild limit is a gravitational potential bound that divides the universe as we experience it from the counter-intuitive realm of black holes, white holes and worm holes, from the realm of unimaginable densities, sizes, and times. It is represented by the equation:

$$\frac{GM}{c^2R} = 1 \qquad (1)$$

where G is Newton's gravitational constant, c is the velocity of light and M and R are the respectively the mass and size of the body.

There are three important watersheds that occur at the bound:

1. The gravitational energy of a body is equal to its total energy.

$$\frac{GM^2}{R} = Mc^2 \qquad (2)$$

the left member being the gravitational energy and the right member the total energy. On "our side" of the bound the total energy exceeds all other forms of energy, on the "black" side of the bound the gravitational energy is the greatest. This leaves us with a semantic paradox regarding the word total: In fact,"Total" energy, $Mc^2$, is but a label for a particular kind of energy.

2. The gravitational radius is equal to the metric radius,R.

$$\frac{GM}{c^2} = R \qquad (3)$$

On the experienced side of the bound the gravitational radius is always less than the metric radius; the situation is reversed on the black side.

3. The light travel time is equal to the density or Schuster time.

$$2\pi\frac{R}{c} = 2\pi\frac{R^{3/2}}{\sqrt{GM}} \qquad (4)$$

The brevity of c time compared to $\rho$ time is reversed on the black side of the bound.

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SCHILD01.WPD DECEMBER 1, 2000

# THE SCHWARZSCHILD BOUND

The Schwarzschild bound, $M/R = c^2/G$, may be derived in four basic ways:

1) Balance of forces $GM^2/R^2 = c^4/G \implies M/R = c^2/G$
   The contractive gravitational force balancing the expansive space force

2) Equipartition of energy $GM^2/R = Mc^2 \implies M/R = c^2/G$
   The gravitational energy equal the rest energy

3) Frequency resonance $R^3/GM = R^2/c^2 \implies M/R = c^2/G$
   The Kepler density time equal to the motion time

4) Equality of radii $GM/c^2 = R \implies M/R = c^2/G$
   The gravitational radius equal to the geometric radius

All of these equations state that an object in the first quadrant will expand, actually accelerate; an object in the second quadrant will acceleratingly contract; an object on the bound will either be stable or expand at a constant rate or contract at a constant rate.
In addition to the above four, the criteria may be formulated in terms of a critical density

$\rho_c = H_o^2/G$ where $H_o$ is the Hubble parameter and $\rho_c = M/R^3$

---

Five basic frequencies [or times] when equated [at resonance] give us the axes defining the basic octants. The basic times are:
1) $t = R/c$, 2) $\tau = (G\rho)^{-1/2}$, 3) $T = GM/c^3$, 4) $Z = \hbar/Mc^2$, 5) $B = \hbar R/GM^2$

1) = 2) gives the Schwarzschild bound 1) = 3) gives the Schwarzschild bound
1) = 4) gives the Heisenberg bound 1) = 5) gives the $M = m_o$ axis
2) = 3) gives the Schwarzschild bound 2) = 4) gives $MR^3 = G\hbar^2/c^4$ [6]
2) = 5) gives $M^3R = \hbar^2/G$ [7] 3) = 4) gives the $M = m_o$ axis
3) = 5) gives $M^3/R = \hbar c^3/G^2$ [8] 4) = 5) gives the Schwarzschild bound

[6] x [7] gives $MR = \hbar/c$, the Heisenberg bound [6]/[7] gives the Schwarzschild bound
[6] x [8] gives $M^4R^2 = \hbar^3/Gc$ {9} [6]/[8] gives $R^4/M^2 = G^3\hbar/c^7$ {10}
[7] x [8] gives the $M = m_o$ axis [7]/[8] gives the $R = l_o$ axis

{9} x {10} gives [6] {9} / {10} gives [8]

All axes, including [6],...{10} pass through the Planck particle as origin.

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COSQUAD1.WP6 August 3, 1997

# THE FOUR PHYSICAL COSMOLOGICAL QUADRANTS
## PART I

PART II 58
Part III 60
Part IV 1998 # 50

The Heisenberg inequality, $ML \geq \hbar/c$, and the Schwarzschild inequality, $M/L \leq c^2/G$, define four quadrants: In the first quadrant both of these inequalities hold and the result is the familiar universe of direct observation consisting of planets, stars, galaxies, clusters, etc. In the second quadrant the Schwarzschild inequality is reversed. This is the domain of black holes. In the third quadrant both the Schwarzschild and the Heisenberg inequalities are reversed, a possible domain of dark matter. In the fourth quadrant only the Heisenberg inequality is reversed. Inhabitants of this domain could have unlimited size but only minimal mass.

In the diagram the Schwarzschild and Heisenberg axes mark the divisions into the four quadrants. The intersection of the two axes marks the position of the Planck particle, a virtual particle whose mass, size, and characteristic time are determined by the values of the three fundamental dimensional constants of physics, the velocity of light c, Newton's gravitational constant G, and Planck's constant $\hbar$.

| | |
|---|---|
| $M/L > c^2/G$, $ML > \hbar/c$ | $M/L < c^2/G$, $ML > \hbar/c$ |
| Mass > 10^-4.662 gm | Size > 10^-32.791 cm |
| No size bounds | No mass bounds |
| DOMAIN OF BLACK HOLES | UNIVERSE OF STARS, GALAXIES |
| No atoms, no molecules | |
| $M/L > c^2/G$, $ML < \hbar/c$ | $M/L < c^2/G$, $ML < \hbar/c$ |
| Size < 10^-32.791 cm | Mass < 10^-4.662 gm |
| No mass bounds | No size bounds |
| DOMAIN OF DARK MATTER? | LOW MASS ENTITIES OF ANY SIZE? |
| No atoms, no molecules | photons, gravitons ? |

NO PARTICLES ?

Could be appearance + extinction $\leq 10^{-43}$ sec lifetime any mass

If the inequalities hold for all particles and all aggregates, then there can be no atoms to the left of the Schwarzschild Limit. What is the relation of the particles of the Standard Model to these quadrants?

COSQUAD2.WP6 August 15, 1997

PART 3 #00

# THE FOUR PHYSICAL COSMOLOGICAL QUADRANTS
## PART 2.

As shown in Part 1. the Heisenberg inequality, $ML \geq \hbar/c$, and the Schwarzschild inequality, $M/L \leq c^2/G$, define four quadrants. In Part 2 the values of energy, force, and pressure in these four quadrants are investigated.

Pressure is defined as force/unit area, which is dimensionally equivalent to energy/unit volume.

$$P = \frac{Force}{unit\ area} = \frac{Energy}{unit\ volume} = \frac{M}{LT^2}$$

PRESSURE

$$P = \frac{ML}{T^2}\cdot\frac{1}{L^2} = \frac{ML^2}{T^2}\cdot\frac{1}{L^3} = \frac{M}{LT^2}$$

The <u>total</u> <u>energy</u> of a mass M is equal to $Mc^2$, and the negative or outward pressure resulting from the total energy will be

$$P_T = \frac{Mc^2}{L^3} = \rho c^2$$

where $\rho$ is the mass density. The <u>gravitational</u> <u>energy</u> of a mass M with size L is equal to $GM^2/L$, and the positive or inward pressure resulting from the gravitational energy will be

$$P_G = \frac{GM^2}{L^2}\cdot\frac{1}{L^2} = \frac{GM^2}{L^4} = G\rho^2 L^2$$

The ratio of the gravitational pressure to the total pressure is

$$\frac{P_G}{P_T} = \frac{\frac{GM^2}{L^4}}{\frac{Mc^2}{L^3}} = \frac{GM}{c^2L}$$

Since $GM/c^2L = 1$ on the Schwarzschild Limit, $P_G$ will equal $P_T$ on this boundary. In the first quadrant, (the observable universe), the outward pressure $P_T$ will be greater than the inward pressure $P_G$. The net effect will thus be expansion. In the second quadrant, (realm of black holes), inward pressure $P_G$ will be greater and the net effect will be contraction or collapse.

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COSQUAD3.WP6 August 15, 1997

# THE FOUR PHYSICAL COSMOLOGICAL QUADRANTS

PART 2 # 58

PART 4

## PART 3.

As shown in Part II, in the first quadrant the total energy exceeds all other energies including the gravitational energy, this assures that $P_T$, the outward or expansive pressure will dominate. It is consequently expected that all first quadrant bodies should expand. However, the question immediately arises: what makes it at all possible for entities in the first quadrant such as, planets, stars, galaxies,..to be stable, not to expand, even to exist at all?

When Einstein applied his general theory to cosmology, he was disturbed that his equations implied that the universe was either expanding or contracting. (This was before Hubble and Humason had detected that the local universe was actually expanding.) He instituted a "fudge factor", $\Lambda$, the so-called cosmological constant, to stabilize the universe. The sign of $\Lambda$ was chosen to neutralize either expansion or contraction. This factor was later seen to be unnecessary and Einstein called it the greatest blunder of his theory. But was it?

The equations of Part II lead to the same results as Einstein's equations in general relativity. In the first quadrant everything must expand unless countered by some other factor. What then allows astromomical bodies to exist? What is Einstein's fudge factor, $\Lambda$ ?

Possible answers to this question include:

- Primordial high density "seeds" created local regions where gravity dominated the overall expansive force. (dark matter?)

- Total energy is expended or consumed in some manner, (rotation, radiation,..?) reducing the expansive component to less than the pull of gravity.

- The action of other forces, particularly coulomb forces, create additional "Schwarzschild Boundaries" within the first quadrant, for example the $GM/c^2L \leq \alpha^2$ boundary governing 'normal' matter.

The various stages of stellar evolution, expansion through the red giant stage, novae, supernovae, collapse to dwarf stage, neutron star, etc. may result from alternating local dominance of $P_T$ and $P_g$ all contained within the first quadrant.



- The universe will expand forever see part IV

The conventional choice of sign for gravitational force has been the minus sign. Most likely this convention derived from the earth centered view that gravity acts to bring objects to a lower elevation, and since down has been traditionally associated with minus and up with plus, gravitational force received the minus sign. But this seems to be the wrong choice when the earth centered view is abandoned. It is more in accord with the equations to posit expansion as negative and contraction (gravity) as positive. To see this, consider the two first quadrant equations $F_x=Mc^2/R$, the expansive force, and $F_g=Gm^2/R^2$, the contractive gravitational force. If M/R in the expansion equation is taken as negative then $M^2/R^2$ in the contraction equation becomes positive. The usual assumption of contraction as negative precludes use of this mathematical convention.

Extending the convention of contraction as postitive and expansion as negative, we might consider coulomb forces as "orthogonal" to gravitational forces and could consistently write for positive and negative charge, ie and -ie respectively. Then the interaction of like charges would give:

$$ie \times ie = -e^2 \quad \text{repulsion or expansion}$$
$$\text{and } -ie \times -ie = -e^2 \quad \text{again repulsion}$$

while unlike charges give:

$$ie \times -ie = +e^2 \quad \text{attraction or contraction}$$

Energy in non-bonded form expands P-SPACE
Energy in bonded form (i.e. matter) contracts P-SPACE

Matter is energy bonded by one or more of the 4 forces

How does energy → matter, i.e. become bonded? Fusion?
How does matter → energy, i.e. become un-bonded? Fission?

See also 1997 #55, #58, and 1998 #50

COSQUAD4.WPD December 30, 1998

THE COSMOLOGICAL QUADRANTS— PART IV

The four quadrants are both local and non-local. They apply to all positions and scales from fundamental particles to the universe. Wherever the total energy is locally greater than the gravitational energy, expansion results. Wherever the gravitational energy locally dominates, contraction results. The resulting behavior in any domain is the result of the averaged net energy over that domain. The universe, for example, will expand or contract according as to whether,

$$\frac{GM^2}{R} < Mc^2 \quad \text{or} \quad \frac{GM^2}{R} > Mc^2$$

For a constant mass, it follows that if R is increasing (expansion) that $GM^2/R$ will decrease and expansion will indefinitely continue. For expansion to cease, mass must be created at a greater rate than R increases and for a length of time sufficient for M/R to become greater then $c^2/G$. Only in domains where mass is rapidly coming into existence will there be contraction and hence the formation of material bodies. Without the operation of forces other than gravity, all existing objects would persist only when $M/R = c^2/G$. Otherwise they would either expand indefinitely or become black holes.

A second first-quadrant condition is that the product time x energy be greater than $\hbar$. This condition in the case of gravitational energy or contraction is,

$$\frac{tGM^2}{R} > \hbar$$

If R is increasing then either the time period **t** or the mass must increase to preserve the inequality. A second way to view this is to note that a time related to density (rather than motion) must also slow with expansion. Density time or $\tau$ time is given by,

$$\tau = \sqrt{\frac{4\pi R^3}{GM}} \quad \text{or} \quad \tau \propto \rho^{-\frac{1}{2}}$$

A constant mass with R increasing effects a decrease in density which in turn demands that $\tau$ increase. This means that the tick of the clock slows down. In an expanding universe the rate at which physical processes operate will be slowing unless there is a large rate of increase in mass. This effect could well explain why the age of stars in high density regions appears to be older than the age of the universe. That is, local clocks could run at different rates at different epochs. Another aspect involving two kinds of time is that with the uniform rate "proper" time, **t**, preferred by cosmologists, inflation or an increase in dR/dt, would take the form of a constant $dR/d\tau$, where $\tau$ is decreasing in rate because of expansion.

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In accord with the concept that the four quadrants are non-local, applying to all domains whatever their size, the expansion rates and times may be congruent. We may thus calculate these rates and times for first quadrant entities such as expansion from a Planck particle (corresponding to the big bang) to a baryon (corresponding to the present) and expect the same times to be reflected in other domains including the universe itself. Indeed the expansion time calculated for planck particle to baryon is 9.057 billion years[1] . This corresponds to a Hubble age of 13.59 billion years and a value of the Hubble parameter of 71.96 kilometers/ second per megaparsec. [Freedman et al based on observations of Cepheids find a time from the big bang of 8.53 billion years and a Hubble time of 13.40 billion years derived from a value of the Hubble parameter of 73 kilometers per second per megaparsec , with an uncertainty of 15%.][2]

Another question confronting present day cosmology is the apparent or real value of curvature being close to zero. That is, why is space-time flat? What physical (or mathematical) principle sustains the universe holding to flatness? At this stage we can only note that in flat spaces alone are shape and size independent. In other spaces with positive or negative curvatures change the size and the shape changes. Is there some trade-off relation between information and and energy content? implied here

In non-flat topology
i.e. if size ↑
curvature changes
⇒ Matter is created
or destroyed

Mostly flat - except
when creation occurs

Other scraps in this series include:
Part I 1997 #55, Part II 1997 #58, Part III 1997 #60

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[1] See items 1995 No. 82 and 1996 No. 27

[2] Spectra, Publication of the Carnegie Institution of Washington, June 1996

DIRAC.WPD

Dirac equation
Dirac comb
Dirac delta function
Fermi–Dirac statistics
Dirac sea
Dirac spinor
Dirac measure
Bra-ket notation
Dirac adjoint
Dirac large numbers hypothesis
Dirac fermion
Dirac string
Dirac algebra
Dirac operator
Abraham-Lorentz-Dirac force
Dirac bracket
Fermi–Dirac integral
Negative probability
Dirac Picture
Dirac-Coulomb-Breit Equation

"The aim of science is to make difficult things understandable in a simpler way; the aim of poetry is to state simple things in an incomprehensible way. The two are incompatible."[36] Q

Religious views

Heisenberg recollected a conversation among young participants at the 1927 Solvay Conference about Einstein and Planck's views on religion. Wolfgang Pauli, Heisenberg and Dirac took part in it. Dirac's contribution was a criticism of the political purpose of religion, which was much appreciated for its lucidity by Bohr when Heisenberg reported it to him later. Among other things, Dirac said:

" I cannot understand why we idle discussing religion. If we are honest—and scientists have to be—we must admit that religion is a jumble of false assertions, with no basis in reality. The very idea of God is a product of the human imagination. It is quite understandable why primitive people, who were so much more exposed to the overpowering forces of nature than we are today, should have personified these forces in fear and trembling. But nowadays, when we understand so many natural processes, we have no need for such solutions. I can't for the life of me see how the postulate of an Almighty God helps us in any way. What I do see is that this assumption leads to such unproductive questions as why God allows so much misery and injustice, the exploitation of the poor by the rich and all the other horrors He might have prevented. If religion is still being taught, it is by no means because its ideas still convince us, but simply because some of us want to keep the lower classes quiet. Quiet people are much easier to govern than clamorous and dissatisfied ones. They are also much easier to exploit. Religion is a kind of opium that allows a nation to lull itself into wishful dreams and so forget the injustices that are being perpetrated against the people. Hence the close alliance between those two great political forces, the State and the Church. Both need the illusion that a kindly God rewards—in heaven if not on earth—all those who have not risen up against injustice, who have done their duty quietly and uncomplainingly. That is precisely why the honest assertion that God is a mere product of the human imagination is branded as the worst of all mortal sins.[39] ”

Heisenberg's view was tolerant. Pauli, raised as a Catholic, had kept silent after some initial remarks, but when finally he was asked for his opinion, said: "Well, our friend Dirac has got a religion and its guiding principle is 'There is no God and Paul Dirac is His prophet.'" Everybody, including Dirac, burst into laughter.[40]

The Dirac large numbers hypothesis (LNH) refers to an observation made by Paul Dirac in 1937 relating ratios of size scales in the Universe to that of force scales. The ratios constitute very large, dimensionless numbers: some 40 orders of magnitude in the present cosmological epoch. According to Dirac's hypothesis, the apparent equivalence of these ratios might not be a mere coincidence but instead could imply a cosmology with these unusual features:

* The strength of gravity, as represented by the gravitational constant, is inversely proportional to the age of the universe: G \proportional to 1/t\,;
* The mass of the universe is proportional to the square of the universe's age: M \proportional to t^2. no $\propto t^3$

Neither of these two features has gained acceptance in mainstream physics and, though some proponents of non-standard cosmologies refer to Dirac's cosmology as a foundational basis for their own ideas and studies, some physicists harshly dismiss the large numbers in LNH as mere coincidences more suited to numerology than physics. A coincidence, however, may be defined optimally as 'an event that provides support for an alternative to a currently favoured causal theory, but not necessarily enough support to accept that alternative in light of its low prior probability.'[1] Research into LNH, or the large number of coincidences that underpin it, appears to have gained new impetus from failures in standard cosmology to account for anomalies such as the recent discovery that the universe might be expanding at an accelerated rate.[2]

LNH was Dirac's personal response to a set of large number 'coincidences' that had intrigued other theorists at about the same time. The 'coincidences' began with Hermann Weyl (1919),[2][3][4] who speculated that the observed radius of the

$L_U = L_x$    $E_x = E_{Ge}$

universe might also be the hypothetical radius of a particle whose energy is equal to the gravitational self-energy of the electron:

$$\frac{r_H}{r_e} \approx 10^{42} \approx \frac {R_U}{r_e},$$
$$r_e = \frac {e^2}{4 \pi \epsilon_0 m_e c^2},$$
$$r_H = \frac {e^2}{4 \pi \epsilon_0 m_H c^2},$$
$$m_H c^2 = \frac {Gm_e^2}{r_e}$$

where re is the Classical electron radius, me is the mass of the electron, mH denotes the mass of the hypothetical particle, rH is its electrostatic radius and RU is the radius of the observable universe.

The coincidence was further developed by Arthur Eddington (1931) [5] who related the above ratios to N, the estimated number of charged particles in the Universe:

$$\frac {e^2}{4 \pi \epsilon_0 Gm_e^2} \approx \sqrt {N} \approx 10^{42}.$$

In addition to the examples of Weyl and Eddington, Dirac was influenced also by the primeval-atom hypothesis of Georges Lemaitre, who lectured on the topic in Cambridge in 1933.[2] The notion of a varying-G cosmology first appears in the work of Edward Arthur Milne a few years before Dirac formulated LNH. Milne was inspired not by large number coincidences but by a dislike of Einstein's General theory of relativity.[6][7] For Milne, space was not a structured object but simply a system of reference in which Einstein's conclusions could be accommodated by relations such as this:

$$G = \left(\frac{c^3}{M_U}\right)t,$$

where MU is the mass of the universe and t is the age of the universe in seconds. According to this relation of course, G increases over time.

[edit] Dirac's interpretation of the large number coincidences

The Weyl and Eddington ratios above can be rephrased in a variety of ways, as for instance in the context of time:

$$\frac {ct}{r_e} \approx 10^{40},$$

where t is the age of the universe, c is the speed of light and re is the Classical electron radius. Hence, in atomic units where c=1 and re=1, the age of the Universe is about 1040 atomic units of time. This is the same order of magnitude as the ratio of the electrical to the gravitational forces between a proton and an electron:

$$\frac{4 \pi \epsilon_0 G m_p m_e}{e^2} \approx 10^{-40}.$$

Hence, interpreting the charge e of the electron, the mass mp/me of the proton/electron, and the permittivity factor 4??0 in atomic units (equal to 1), the value of the gravitational constant is approximately 10-40. Dirac interpreted this to mean that G varies with time as G \approx 1/t\,, and thereby pointed to a cosmology that seems 'designer-made' for a theory of quantum gravity. According to General Relativity, however, G is constant, otherwise the law of conserved energy is violated. Dirac met this difficulty by introducing into the Einstein equations a gauge function ? that describes the structure of spacetime in terms of a ratio of gravitational and electromagnetic units. He also provided alternative scenarios for the continuous creation of matter, one of the other significant issues in LNH:[2]

* 'additive' creation (new matter is created uniformly throughout space) and
* 'multiplicative' creation (new matter is created where there are already concentrations of mass).

[edit] Later developments and interpretations

Dirac's theory has inspired and continues to inspire a significant body of scientific literature in a variety of disciplines. In the context of geophysics, for instance, Edward Teller seemed to raise a serious objection to LNH in 1948 [8] when he argued that variations in the strength of gravity are not consistent with paleontological data. However, George Gamow demonstrated in 1962 [9] how a simple revision of the parameters (in this case, the age of the solar system) can invalidate Teller's conclusions. The debate is further complicated by the choice of LNH cosmologies: In 1978, G. Blake [10] argued that paleontological data is consistent with the 'multiplicative' scenario but not the 'additive' scenario. Arguments both for and against LNH are also made from astrophysical considerations. For example, D. Falik[11] argued that LNH is inconsistent with experimental results for microwave background radiation whereas Canuto and Hsieh[12][13] argued that it is consistent. One argument that has created significant controversy was put forward by Robert Dicke in 1961. Known as the anthropic coincidence or fine-tuned universe, it simply states that the large numbers in LNH are a necessary coincidence for intelligent beings since they parametrize fusion of hydrogen in stars and hence carbon-based life would not arise otherwise.

Various authors have introduced new sets of numbers into the original 'coincidence' considered by Dirac and his contemporaries, thus broadening or even departing from Dirac's own conclusions. Jordan (1947) [14] noted that the mass ratio for a typical star and an electron approximates to 1060, an interesting variation on the 1040 and 1080 that are typically associated with Dirac and Eddington respectively. Various numbers of the order of 1060 were arrived at by V. E. Shemi-Zadah (2002) [15] through measuring cosmological entities in Planck units. P. Zizzi (1998) argued that there might be a modern mathematical interpretation of LNH in a Planck-scale setting in the context of quantum foam.[16] The relevance of the Planck scale to LNH was further demonstrated by S. Caneiro and G. Marugan (2002)[17] by reference to the holographic principle. Previously, Carneiro (1997)[18] arrived at an intermediate scaling factor 1020 when considering the possible quantization of cosmic structures and a rescaling of Planck's constant.

Several authors have recently identified and pondered the significance of yet another large number, approximately 120 orders of magnitude. This is for example the ratio of the theoretical and observational estimates of the energy density of the vacuum, which Nottale (1993)[19] and Matthews (1997)[20] associated in an LNH context with a scaling law for the cosmological constant. Carl Friedrich von Weizsaecker identified 10120 with the ratio of the universe's volume to the volume of a typical nucleon bounded by its Compton wavelength, and he identified this ratio with the sum of elementary events or bits of information in the universe.[21] T. Goernitz (1986), building on Weizsaecker's work, posited an explanation for large number 'coincidences' in the context of Bekenstein-Hawking entropy.[22] Genreith (1999)[23] has sketched out a fractal cosmology in which the smallest mass, which he identified as a neutrino, is about 120 orders of magnitude smaller than the mass of the universe (note: this 'neutrino' approximates in scale to the hypothetical particle mH mentioned above in the context of Weyl's work in 1919). Sidharth (2005)[24] interpreted a typical electromagnetic particle such as the pion as a collection of 1040 Planck oscillators and the universe as a collection of 10120 Planck oscillators. The fact that a number like 10120 can be represented in a variety of ways has been interpreted by Funkhouser (2006)[25] as a new large numbers coincidence. Funkhouser claimed to have 'resolved' the LNH coincidences without departing from the standard model for cosmology. In a similar vein, Carneiro and Marugan (2002) claimed that the scaling relations in LNH can be explained entirely according to basic principles.[17]
[edit] References

Higgs

GENEVA — Scientists hunting for an elusive subatomic particle say they've found "intriguing hints" – but not definitive proof – that it exists, narrowing down the search for what is believed to be a basic component of the universe. The researchers added that they hope to reach a conclusion on whether the particle exists by next year.

1. The latest data show that the mass of the Higgs boson – popularly referred to as the "God particle" – probably falls in the lower end of the spectrum of mass that can be produced by smashing protons together in the huge Large Hadron Collider, researchers from two independent teams said Tuesday.

The two teams said their data indicates the particle itself may have a mass of between roughly 114 and 130 billion electron volts. One billion electron volts is roughly the mass of a proton. The most likely mass of the Higgs boson is around 124 to 126 billion electron volts, the teams said. Until Tuesday, the most likely mass was seen as between 114 and 141 billion electron volts. There is still a small possibility that the Higgs could be much more massive and found above 476 billion electron volts, physicists said.

The revelations Tuesday were heavily anticipated by thousands of researchers who hope that the particle, if it exists, can help explain why there is mass in the universe. British physicist Peter Higgs and others theorized the particle's existence more than 40 years ago to explain why fundamental particles – building blocks of the universe – have mass.

Both of the research teams work at CERN, the European Organization for Nuclear Research near Geneva. CERN runs the $10-billion Large Hadron Collider under the Swiss-French border, a 17-mile (27-kilometer) tunnel where high energy beams of protons are sent crashing into each other at incredible speeds.

Collisions between protons smashed in the collider produce energy that in turn creates other particles. On rare occasions, this energy could produce the Higgs particle – if it exists.

Fabiola Gianotti, an Italian physicist who heads the team running the ATLAS experiment, said "the hottest region" is in lower mass ranges of the collider. She said there are indications of the Higgs' existence and that with enough data it could be unambiguously discovered or ruled out next year.

The results rule out several mass or energy ranges for the Higgs with a high degree of confidence, Gianotti said.

"The most important result is that we have been able to restrict the most likely mass region to a very narrow range," she said.

Afterward, Guido Tonelli, lead physicist for the team running the separate CMS experiment, outlined findings similar to those of the ATLAS team, saying the particle is most likely found "in the low mass region" among the spectrum of possible Higgs masses.

CERN's director-general, Rolf Heuer, said "the window for the Higgs mass gets smaller and smaller."

"But be careful – it's intriguing hints," he said. "We have not found it yet, we have not excluded it yet."

Determining what mass the Higgs has helps focus scientists' search for other new physics. For example, a Higgs with a mass around the range of 124 to 126 billion electron volts is "not so bad

...r supersymmetry," said Heuer, referring to another theory that predicts a partner particle for each one that has already been identified.

The collaborations for the ATLAS and CMS experiments each involve about 3,000 scientists and engineers. They are leading the search for the Higgs, but there are also are several other experiments at CERN looking into other mysteries of the universe.

"We need to get a lot more collisions next year to get a definitive answer to the Shakespearean question, 'To be or not to be,' " Heuer said of the Higgs. "Both experiments have shown that next year very likely we will get an answer that is very solid."

The Higgs boson is hard to find not because it is especially tiny, but rather because it is hard to create, said physicist Howard Gordon of the Brookhaven National Laboratory in Upton, New York, who works with the ATLAS experiment.

Physicists smash protons together at very high energy, and only a minority of collisions will create a Higgs boson. The more energy involved, the higher the fraction of collisions that will make a Higgs.

Frank Wilczek, a Nobel laureate and physics professor at the Massachusetts Institute of Technology, said finding the Higgs boson would tie up a loose end of the so-called standard model of physics, which requires that a Higgs-like particle exists.

Proving the Higgs exists would be "a vindication of the equations we've been using all these years," he said. "Since the equations have worked so brilliantly now for decades, it's really nice to dot the i's and cross the t's," he said.

In addition, if the mass of the Higgs is within a certain range, that would support some other theories that go beyond and improve the standard model, he said. Those theories predict the existence of still other particles to be found. That would mean the Large Hadron Collider "will have another wave of brilliant discoveries in the future," Wilczek said.

The mass range reported Tuesday is "perfect" to meet that requirement, he said.

"Because it fits together so beautifully with everything else we know ... I'm certainly inclined to believe it," he said. He called Tuesday's presentations "awesome ... just beautiful work."

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Associated Press Writer Malcolm Ritter in New York contributed to this report.