
FOREWORD

Have you wondered if there was a recipe for the universe and what it is created out of?
Do you want to know why every atom is a perfect duplicate of every other atom, how many there are and where they get their mass?
Are you concerned that science lacks answers to fundamental questions like “What unifies the four forces of nature?”
Do you want to know the history of the universe, how big it is and what will become of it?
One of the author’s early questions was “where is the center of the universe?” The question seems naïve, but do you know the answer?
Do you want science to contribute to our understanding of whom we are and why we are here?

THE LANGUAGE OF NATURE
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1 INTRODUCTION

Scientists are actively engaged in understanding new observations regarding our universe. There is agreement that achieving a new level of understanding may require an extension to what is currently known about fundamental interactions, matter and energy. This book is a summary of work by the author building on the best measurements made by physicists, astronomers and cosmologists. Historically, a culture's cosmology was an explanation of the origin and a justification for its most significant beliefs. Understanding nature's language goes further. With it, we can read the book of nature and participate in the unfolding of nature's potential. A no-nonsense engineering approach is used that simplifies nature to a few simple relationships. Of specific interest are the topics of force unification, gravitational theory and the definition of space and time. It also addresses several topics at the forefront of current research like dark energy and cold dark matter. Of course these are physical matters but the author addresses what this means to life and what it is reasonable to believe regarding philosophy's "enduring questions".

Man invented language, developed an alphabet and then used the alphabet in creative ways to communicate. As a child we learn a language. It is an extremely useful tool but we didn't invent the language. Physics is the same way. It has a language and an alphabet that it shapes into words and a significant story. One difference, however, is that we are one of the things it shapes and if we want to understand ourselves and the things around us we must learn the language. Nature starts with the whole, separates it into parts and then fits the parts together in different ways to make the universe we observe. This is a little like a picture puzzle. The picture is cut into pieces and then re-assembled. In the process, it becomes clear that the pieces are meant to fit together and the proof is simply that the picture is once again whole.

This book is written in seven sections. Sections 1-3 focus on several topics that are very basic to science but the author felt were missing or incomplete. The first goal of section 1 is to introduce a way to calculate the mass of particles like the neutron, proton and electron. The second goal is to calculate the forces that attract some of these particles to each other and understand where the forces come from.

Section 4 applies fundamental relationships to one large example, the universe. In the process of understanding energy and forces, constants were discovered that are important to cosmology. Easy to understand equations are involved and again the proof of whether the contributions are correct is simply, the data.

Section 5 demonstrates that the fundamentals presented in sections 1-4 apply to atomic binding energy and elemental abundance.

Section 6 and 7 are somewhat speculative but they present theory regarding perception and life. The author read about DNA but felt that the critical question "How does it construct our physical and mental reality?" was not addressed satisfactorily.

1.1 MOTIVATION AND SUMMARY

This book presents a new and relatively simple approach to understanding nature. It is written at the high school/college level but takes some effort to understand because it is a new approach to physics. The author realizes that this is a bold claim but data and observations in the field of physics, cosmology, and some aspects of the life sciences fit this theory remarkably well. Computer modeling was carried out to explore the basic processes and verify their accuracy. The author presents the following findings:

Sections 1-3

1. The number of particles in the universe is divided into parts that make up the whole. Using the language analogy, an alphabet was found that describes fundamental particle energies. The discovery process involved information theory developed by Claude Shannon [30] and others [1].
2. The net energy of the universe is zero. Mass and fields are equal and opposite energies, balancing to zero. The theory described is consistent with quantum mechanics but provides a different approach.
3. Fundamental energies are combined into "words" that we observe as the neutron, proton and electron. Space and time are the physical order of the words.
4. The strong forces, weak force, electromagnetic force and gravitational force are united by information extracted from a proton model constructed from the alphabet.

Section 4 and 5

5. The current size and age of the universe are modeled from proton mass model energies and the fundamentals of gravitation. The model presented agrees with data and explains dark energy and cold dark matter. Current topics in cosmology are discussed, including inflation and primordial neucleosynthesis.
6. Atomic binding energy and elemental abundance are modeled using a probabilistic approach consistent with the theory above.

Section 6 and 7

7. Perception is fundamental, based on quantum mechanics and the nature's language. It is equivalent to light being absorbed and emitted by the 3^{rd} quantum level of the 2^{nd} electronic shell. The secret of complex perception is that our minds understand "linked probabilities" that consist of fundamental information units.

8. The body uses linked probabilities (DNA) to allocate cells and build the body. The substance of the universe is energy but the language of life is probability. The electron is special because it is imbedded in molecules that link probabilities into the words of nature's language.
9. There appear to be two fundamental levels in nature. (a) An underlying information level, which creates organizes and orchestrates events and (b) a space and time level that we perceive around us. Together the two forms comprise a dynamic reality capable supporting life and thought.

1.2 ORGANIZATION OF THIS DOCUMENT

Throughout this document, tables and figures from Microsoft Excel ® spreadsheets are included and referenced that the author used to discover these concepts. Appendixes contain pertinent spreadsheet results not reproduced in the text. Once the author discovered the language of nature it was used to model many basic processes. A web site, www.viXra.com contains detailed papers by the author containing further information: To access these: www.vixra.org and search for Gene H. Barbee.

A Top-Down Approach to Fundamental Interactions **[14]**
Starting with data from WMAP [11] that allows an estimate of the number of protons in the universe (exp(180)) [Section 8 Appendix 1, topic 8.6], where exp stands for the natural number 2.712^(180) the author explored how this number is used by nature to represent fundamental particles. This reference described models for the neutron and proton mass based on Shannon type information theory. In addition, it proposed a way of unifying the electromagnetic, weak, strong and gravitational forces.
On the Source of the Gravitational Constant at the Low Energy Scale **[15]**
This publication summarizes arguments for a low energy gravitational scale and offered an understanding of the weak and long range character of gravitation. Physics has struggled with the reconciliation of general relativity with the other fundamental interactions (strong force, weak force and electromagnetic force). The reason for the difficulty is that general relativity and gravitation is the geometry of space and time and does not appear to originate at a reasonable energy at the quantum level. The accepted gravitational theory had the energy scale far above the energy of a proton. The author proposed a lower energy scale and offered a relationship between the quantum scale and the scale of the universe that appears to resolve this conflict.
On Expansion Energy, Dark Energy and Missing Mass **[17]**
This publication summarizes and extends this theoretical groundwork to the field of cosmology. Information from the proton mass model is applied to the beginning, expansion of the universe and observables from the field of astronomy. The fundamentals of space and time are described including the relationships that accurately model expansion, temperature, gravitational history and helium abundance. Results from an expansion model are compared to values reported in WMAP analysis and CMAGIC studies [11][12]. Three models of expansion are compared and a proposal regarding dark matter is discussed. Reference 2 analyzed the kinetic and potential energy changes during expansion and showed that there is no dark energy (dark energy fraction is 0).

Furthermore, information is presented that questions the WMAP conclusion that only 0.046 of the universe is normal protons. Based on this document, it appears that the baryon (proton) fraction is 0.5 and the cold dark matter fraction is 0.5.

The Effect of He4 Fusion on Primordial Deuterium **[25]**

Literature regarding primordial nucleosynthesis was reviewed that states that measured primordial deuterium is a sensitive test that limits the baryon (proton) mass fraction to 0.04. Literature does not account for He4 fusion which releases approximately 1.6 MeV. When this energy is added to temperature curves for early expansion the temperature increases and deuterium photo-disintegrates. However, as the temperature finally falls due to expansion deuterium production recovers to the measured residual values. Calculations also show that the photon/baryon number ratio does not restrict the baryon fraction from reaching 0.5.

A Simple Model of Atomic Binding Energy **[18]**

The purpose of this document is to verify the value 10.15 MeV from the proton mass model. This is the value that changes and causes the atomic binding energy curve [27]. The model presented is a probabilistic model that follows the same fundamentals of Section 2 below.

Semi-Fundamental Abundance of the Elements **[19]**

This document again is offered as support for the proton mass model and the model of atomic binding energy. It provides a probabilistic model of fusion using barrier energy from the binding energy curve model. It models the abundance of the elements produced during the life cycle of stars [10][26][27].

Life from Information **[23]**

Since the advent of quantum mechanics it has been known that probabilities (information) are fundamental to the universe. Life is of course made out physical components but they fit together in an uncanny way. The author studied how the eye senses four light frequencies and interprets them as color vision. It is not unreasonable to think that the other senses are similar and that the brain is a great integrator and manipulator of information because it uses the language of nature.

Camp Four **[24]**

Science is climbing and the author anticipates what the view might be as we summit. This FQXi [32] essay theorizes that information based reality is central to our existence. Our physical nature is complementary but the mind's ability to create information appears to be fundamental to nature. We do not know why nature chose to use the number exp(180) to create everything but the components fit together and we observe the result. It is not unreasonable to believe that information operations that created nature are very much like our mind's ability to create information.

Baryon and Meson Masses Based on Natural Frequency Components **[22]**

The purpose of this document is to extend the approach used to develop the proton mass model to data gathered for the hundreds of mesons and baryons observed at high energy labs [20]. Although the work is somewhat tentative most of the particles have "mirror" particles that allow nature to balance properties (particles with properties can be created from zero only if there is a "mirror" particle). This supports the author's view that one-half of the mass in the universe is protons and the other half is cold dark matter.

Written explanations are kept to a minimum and are admittedly hard to read. The reader can use the written text, figures and appendixes but must study and think about the concepts to make progress. This may be a task similar to climbing Mount Everest---not meant for everyone and only to be accomplished after rigorous work.

2 SECTION 2 ENERGY

2.1 INTRODUCTION

Science lacks basic equations to calculate the mass of the neutron, proton, electron and other fundamental particles. It also lacks a unified theory linking the four forces (also called interactions) of nature together. In addition, science doesn't help us understand what the universe is made of. If it is made from "energy", it is logical to ask "where did that come from?" Why are there so many "constants" of nature and why do we have to resort to measuring them rather than being able to calculate them. We know that nature is very precise and mathematical, but scientists don't agree on a unifying theory. This doesn't contribute much to our attempts to answer fundamental questions about our existence. Scientific American[1] published a review of the status of physics in their Millennium Special Issue. The article by Steven Weinberg was titled "*A Unified Physics by 2050?"* Unfortunately, for many, waiting that long is not very satisfying. The author has no doubt that quantum mechanics is valuable but as will be shown, we don't have to use anything deeper than high school physics and algebra but a new approach is required.

2.2 NATURE'S LANGUAGE

The next few paragraphs are written at a high school level to make sure they are easy to understand. If this is too simple, you can skip to the next section.

Open a Microsoft Excel ® spreadsheet on a computer and type the following:
=exp(180)
The computer will return a very large number. This is the number of protons in the universe and it is the whole that is broken down into pieces of a puzzle that we will put back together. The number 180 is where nature's language begins.
Think about what exp(N) means. Exp stands for the natural number e to the power N. N is the exponent. The number e is called that natural number and has the value 2.718. The natural number occurs when something increases in proportion to itself. If mice have unlimited food, their number increases in proportion to the number of mice. The population would increase exponentially exp(N). The beautiful spiral of a conch shell is another example of the natural number e. The radius increases exponentially as the angle from the center increases. It is also known as the Archimedean spiral.
Now type the following into the spreadsheet:
=exp(90)
Again, the computer will return a large number. The number, believe it or not, represents the proton but I will have to show you the parts. The proton is a particle and forces attract particles and cause them to moves in circles. I will also show you that field energy associated with the forces are also characterized by the number exp(90). Natures

[1] Weinberg, S., *A Unified Physics by 2050?,* Scientific American End of the Millennium Special Issue, December 1999.

language separates N=180 into 90+90. If we consider fields as opposite particles, we could also write 90-90=0. The zero is where the universe starts.
Now type the following into the spreadsheet:
=1/exp(90)
You have just written a probability. A probability is a ratio of one outcome divided by all possible outcomes. We use the symbol P to represent probability. You have also written the gravitational coupling constant. This is the constant that scales quantum gravity to large scale gravity and it is the reason that gravity is very weak compared to the other forces of nature (electromagnetic, strong, and strong residual).
Now think about exponents. The N in the relationship exp(N) is an exponent. An exponent of this type is also called a natural logarithm. When we add logarithms N1+N2, we are actually multiplying exp(N1)*exp(N2). Type this into the spreadsheet:
=90+90
=exp(90)*exp(90)
=exp(180)
Note that exp(90)*exp(90)=exp(180)
Look at the large number=1.22e39. In this case, the e stands for "move the decimal point 39 places to the right" or some people might say "it has 39 zeroes after 1.22".
Type the following into the excel spreadsheet:
=ln(1.2204e39)
The computer will return the number 90. The computer command ln stands for natural logarithm. It is the opposite command of exp(N). In other words, ln(number) returns the exponent N for exp(N).
Now type:
=1/1.2204e39 and note that it returns 8.19401e-40. Of course the e-40 means the decimal place is move 40 places to the left, making this a very small number.
Now type equal minus ln(8.19401e-40):
=-ln(8.19401e-40) and note that the spreadsheet returns 90.
The minus sign before ln(number) means that it will return 1/ln(number). Below, we will us the relationship N=-ln(P) extensively. N will be a number I call information and P is a probability.
Now type the relationship E=e0*exp(N) into the computer with e0=2.02e-5 and N=0.296. This is typed:
=2.02e-5*exp(0.296) and the computer returns 2.72e-5. This is the field energy of the electron in MeV.
Now think about numbers. Nature's language uses base 10 numbers just like our fingers. I don't know why because there are other bases. For example, some computers uses base 2 and this makes them digital computers and numbers are either 1 or 0.
We used the energy unit MeV above. It stands for million electron volts. One electron volt (eV) is the energy required to move an electron across one volt. Think about a 1 volt battery. It has a positive and negative end but the electron is attracted to the positive end because it is negative. You can move the electron against the force resisting it to the negative end but you have to expend energy. Since one eV is a very small energy, physicists often use MeV.

I will now revert to college level or what I call "engineering 101" language.

NATURE'S LANGUAGE

In the diagram below, ln stands for natural logarithm (the inverse of e^N written as exp(N)), where e is the natural number e (2.718). Information theory and thermodynamics use the same relationship S=-ln P, where P is a probability and we will use the same relationship except S will be N. Probabilities are generally one outcome divided by all possible outcomes. We will use the relationship E=e0*exp(N) extensively with a pre-exponential e0.

Comparison		
Information Theory	S= -ln P	S is called information
		P is a probability
Thermodynamics	S=- ln P	S is called entropy
		P is a probability
Language of Nature	N= -ln P	N is called information
		P is a probability
		P=1/exp(N)
		P=e0/E=v0/v
	E=e0 exp N or N=ln E/e0	

Figure 2:1 Comparison with Information Theory

It has been well known since the early days of quantum mechanics that nature is probability based (information based). The author's proposal for correlating energy values is similar and summarized in the above diagram. The logarithmic relationships are a little confusing and one can remember that improbable outcomes contain more information. In the work that follows N measures information.

2.3 N FOR FUNDAMENTAL ENERGY DATA

A great deal of effort went into correctly identifying N for particles and energies we observe. This was similar to breaking a code. The particles below come from the field of high energy physics and are studied in high energy collisions. They are called elementary particles or fundamental particles. The proton is known to contain three quarks but their energies are not well known because they are not observed outside the nucleus of atoms.

Energy data [4][20][27][35] for each particle or energy are listed in rows in the table below and we calculate N from N=ln(E/e0). The constant e0 used was 2.02e-5 MeV and will be explained below. The proposed N values are shown in column 2. Look at N and decide if there is a pattern you recognize.

unifying concepts.xls cell aw48			Proposed	IS Hughes
		Particle Data	Energy	Bergstrom
		Group energy	E=eo*exp	Randall
Identifier	N	(Mev)	(Mev)	energy
			e0=2.02e-	(Mev)
0.0986	0.0986			
e neutrinc	0.000	2.00E-06		3.00E-06
E/M Field	0.296	0.0000272	2.72E-05	
	(3*.0986=.296)			
ELECTRO	10.136	0.51099891	0.511	
mu neutri	10.408	0.19	0.671	less than 0.2
Graviton*		1.75E-26	2.683	
Up Quark	11.432	1.5 to 3	1.867	1.5 to 4.5
vt ?	12.432	18	5.076	less than 35
Down Qua	13.432	3 to 7	13.797	5 to 8.5
Strange q	15.432	95+/-25	101.947	80 to 155
Charmed	17.432	1200+/-90	753.29	1000 to1400
Bottom Qu	19.432	4200+/-70	5566.11	4220
Top Quarl	21.432		41128.30	40000
W+,w- bos	22.099	80399	80106.98	81000
Z	22.235	91188	91787.1	91182
HIGGS	22.575	125300	128992.0	105000
* sum of 3 Ns of 10.431+10.333 (2.68/exp(60)=2.3e-26 mev)				
Mw/Mz	Weinberg radians		sin^2 theta	
0.87275	0.509993	0.48817152	0.23831	

Figure 2:2 Fundamental Particle Table

2.4 ENERGY

The energy of each fundamental particle is related to N with the following equation:
Energy= E0*exp(N) where exp stands for the natural number, 2.718 raised to the power N.
Energy (eV) = 20.247ev *exp (N) where the unit of energy is electron volts (eV)
Energy (MeV) = 20.247e-6 *exp(N) (e-6 means the decimal place is moved 6 positions to the left).

Look at the series generated. The energy for each N is shown in the fourth column from the left and can be compared with data from various sources in columns 2 and 5. The best data is in column 2 from the Particle Data Group abbreviated PDG [20]. Associating a natural logarithm N with a certain particle was a little like decoding. The key to understanding was finding a recognizable particle. Note the value N=10.136. Note also N= 0.296 and that E=2.02e-5*exp(0.296)=27.2e-6 MeV. This is the electromagnetic field energy. The electron has an electromagnetic field and associating these two N

values was a major clue. Once we recognize the electron N=10.136 we do the following calculation based on the measured energy of the electron, 0.5109989 MeV [20]. The constant e0=E/exp(N)=0.511/exp(10.136)=2.025e-5 MeV. The above decoding operation was iterative. In other words, different values of e0 had to be explored to find the e0 that makes the field 27.2e-6 MeV and the electron 0.510999 MeV, its exact measured mass. Once it was found, e0 was used to determine N for all the other particles. Above, the electron field energy N =0.296=3*0.0986. Later, the significance of N= 0.0986 will be explained, but it is numerically equal to ln (3/e)=ln(3)-1, why I do not yet know.

Sometimes in the text that follows, the author abbreviates the particles to 11, 15 etc. rather than writing 11.432, 15.432, etc. every time. The fractional part of the number is 0.4319=1/3+0.0986=1/3+ln(3/e). We recognize a logarithmic pattern for the quarks. The particles represented by numbers N= 11, 15 and 19 are one family of quarks. Note that the three quarks 11+4=15+4=19 form a series and are separated by N=4. The particles 13+4=17+4=21 are a second family of quarks. Also, we recognize the Higgs (N=22.5) that was reported as 125300 MeV in July 2012. The bosons are variations on N=22. The energy at N=12.432 has a special significance defined below as a kinetic energy operator.

Review: How do know that E=2.025e-5*exp(N)? We recognize that e0/E is a probability P and P=1/exp(N). This makes E=e0*exp(N). This parallels thermodynamics and information theory, a nice result since we are trying to unify physics with other disciplines that use probabilities.

2.5 INFORMATION OPERATIONS

One goal of this work is to understand steps involved in the origin. The following table describes what the author calls “Information Operations”. Information operations act upon “the whole” to create parts. Conversely, the parts make up the whole. The parts are similar to an alphabet and words of a language and can be combined to make things we observe. The steps involved will be labeled:

Information Operations >Energy Interaction >Neutrons, Protons and Electrons

In section 2 topic 2.2, I made the bold claim that the proton was represented by the number 90. Nature uses information operations on the value exp(90) to create components of protons called quarks that are inside atoms. Just like any language there are some rules. The rule (actually a conservation rule) for dividing the natural logarithm 90 into smaller information units is that the numbers for the parts always add to 90. The basic information unit is called N, where N= - ln P=1/ln P were P is a probability. Where these operations originate is unknown but one way to think about them is as an alphabet that can be combined into words of a language. Another way to think about them is they are a code that underlies physical existence. The first operation creates the four dimensions of the universe (three distance dimensions and one time dimension). The energy for N=22.5 is the Higgs energy.

						Fundamental N values
	Operatio	Operati	Operation 4		Operation 5	
Higgs X dimension	22.5	10.167	5.167	15.333	0.0986	15.432
		12.333		12.333	0.0986	12.432
Higgs Y dimension	22.5	10.167	3.167	13.333	0.0986	13.432
		12.333		12.333	0.0986	12.432
Higgs Z dimension	22.5	10.167	3.167	13.333	0.0986	13.432
		12.333		12.333	0.0986	12.432
		0.667		0.667	0.0750	0.075
Time	22.5	11.500				
		10.333		10.333		10.333
Total	90	90		90		90

Figure 2:3 Information Operations

*The numbers are natural logarithms, abbreviated **ln**. Addition of natural logarithms means that Probability=1/exp(N)are multiplied". Conserving the value 90 means that the probability of the components multiplied together is 1/exp(90).*

1) Start with the number 180. Section 8 Appendix 1 topic 8.6 reduces data from WMAP [11] and shows that exp(180) is the number of particles in the universe (the whole). Use N=90 to define two opposite types of energy; mass energy and field energy. Represent positive mass by the number Nmass= 90. Balance to zero by representing fields with the value Nfields=-90.
2) Operation 1: Separate N=90 into four N value=90/4=22.5. Operation 2 and 3: Further divide 3 values of 22.5 into 10.167 and 10.333. The fourth 22.5 divides into 11.5 and 10 but the 11.5 becomes 5.167+3.167+3.167 in operation 4 and is added back to form the values 15.33, 13.33 and 13.33. Operation 5: Divide the number 1 into 6 segments of ln(3/e)= ln(3)-1=0.0986 each and a remainder 0.075.
3) Add 0.0986 to each creating the right-most column of numbers called Fundamental N values.
4) The 10.333 at the bottom of the table will become an electron.

The total N for each column is conserved to the value 90.

2.6 THE ENERGY INTERACTION

The energy interaction is another fundamental operation required to form the proton from the number 90.

Information operations >Energy Interaction >Neutrons, Protons and Electrons

After information operations, the particles labelled "Fundamental N Values" have energy but have not yet been imbedded in fields. In an energy interaction, pairs of N values exchange the number N=2. Quantum mechanics uses circles (the time for a wave to travel around the circumference of a circle is t=2piR/C, where C is the speed of light) to

describe fundamental energy quanta. **The "energy interaction" produces the same result as quantum mechanics**. The energy interaction appears to be the origin of quantum mechanics or perhaps a parallel. I prefer the energy interaction as the origin because it contains the energies involves. Frequency labeled v=1/t gives energy through the equation E=hv where h is Heisenberg's reduced constant (h=H/(2pi). Each energy value in the table is also known to be a wave and the principle is called particle/wave duality. Waves are probabilities where psi=exp(+iv dt) and psic=exp(-iv dt) and i is the imaginary number. P=psi*psic is associated with one *complete* circle and frequency v is 1/time to complete the circle (There is more on this subject in Section 8 Appendix 1 topic 8.1). The frequency v allows probabilities to represent energy quanta. Don't worry about the imaginary number, it won't be used again and we will always deal with a complete circle.

Operation 6: Form an Energy Interaction
The number 2 is added to N1 to give N3
And the number 2 is subtracted from N2 to give N4

		mev			mev		
		E=e0*exp(N)			E=e0*exp(N)		
N1	13.43	13.80	E1 mass	N3	15.43	101.95	E3 field
N2	12.43	5.08	E2 ke	N4	10.43	0.69	E4 field

Figure 2:4 Energy Interaction Between Pairs

The incoming N's exchange the number 2 with the outgoing N's (one N increases and the other decreases). The table above is read, "A 13 mass interacts with a 12 kinetic energy operator imbedding itself in a 15 field energy and a 10 field energy. The 13 particle receives kinetic energy". N conservation (15+10=13+12) and energy conservation acting together create an orbiting particle with kinetic energy. The energy interaction is similar to a known physics process called a gauge transition.

Results of the above energy interaction				
	(difference ke)			
	E3+E4-E1-E2		E3 field1	
E1 mass	ke	E2 ke		E4 field2
mev	mev	mev	mev	mev
13.80	83.76	5.08	-101.95	
				-0.69
Sum of energy from above table				
E1+difference ke		102.63	E3+E4	-102.63
Energy is conserved since 102.634=102.634				

Figure 2:5 Result of Energy Interaction

The figure above contains results of the Figure 2:4 energy intereaction. A quark with mass 13.8 Mev receives kinetic energy 83.7 MeV and kinetic energy 5.07 MeV but is imbedded in two fields of energy -101.9 MeV and -0.687 MeV. Energy is conserved since 13.7+83.7+5.07 MeV=101.9+0.687 =102.634 MeV.

The value 83.76 MeV is the kinetic energy difference 83.7 MeV= 101.9+0.7 -13.8-5.1MeV. The quark mass with its kinetic energy is pulled inward by the field energy 101.9 MeV. The energy associated with N=12.432 (5.07 MEV) is also kinetic energy discussed later. We can name the components: The two fields in this example become a strong energy field -101.9 MeV and a component of the gravitational field -0.687 MeV. The mass coming out of the reaction is a particle called a down quark, one of three quarks in a proton.

Below we calculate the time for a 13 particle to revolve around a circle at velocity C. H is Heisenberg's constant, 4.136e-21 mev-sec and E is 101.97 MeV. H/E = 2*pi*R/C. We know H/E but don't know R. However, we can calculate it from H/E and the result is R=HC/(2 pi)/E. E equals (E*E)^.5 = (E*m/g)^.5. What is g?
Gamma (g) is a number smaller than 1 that tells us how far a particle with velocity moves into the fourth dimension (the time dimension). The easiest definition is g=m/(m+ke). This is an opportunity to explain what exchanging N=2 in the energy interaction means. Since we are dealing with logarithms, we can use 1/exp(2)=gamma=0.1353. The N=13 quark that has mass 13.797 MeV is given kinetic energy by receiving N=2 and now has energy m/g = 13.797/0.1353=101.947. E and E*m/g both equal 101.947 MeV.

The time for one cycle of the wave is 2*pi*R/C=1/frequency
R is the radius of a quantum circle
The time is also H/E where H is Heisenberg's constant = 4.136e-21 mev-sec.

Using the same example as detailed in operation 6:			
Field energy E		101.947	mev
2*pi*R/C	time	4.057E-23	seconds
H/E	time	4.057E-23	seconds
R=H*C/(2*pi)/E		1.936E-15	meters

Figure 2:6 Time around the Quantum Circle

If we didn't know Heisenberg's constant H, but do know R we can calculate it recognizing that a wave traveling around the circle has energy. That is: H=2pi*R/C*E=4.136e-21 MeV-sec. Heisenberg's constant is a fundamental value in quantum mechanics.

2.7 NEUTRON MASS MODEL

The small box below will be used to describe and name the energies. Each of the four positions in the box has a non-interchangable meaning. The box labelled E1 is always a mass (in this case a quark). The box labelled E2 is always a kinetic energy operator. E3 is a field energy and E4 is a second field energy. We will call the two incoming N values and the two outgoing N values a quad. These values are the source of the energies inside

the box. Four values make one "quad" and describe one quark circle (orbit) and its associated field energies.

		mev			mev		
		E=e0*exp(N)			E=e0*exp(N)		
N1	13.432	13.797	E1 mass	N3	15.432	101.947	E3 field
N2	12.432	5.076	E2 ke	N4	10.432	0.687	E4 field

Here are the N's from Figure 2:5 that we will assemble into a neutron:

Fundamental N values		
15.432		
12.432		
13.432		
12.432		
13.432		
12.432		
0.075		
10.333		
90		

Literature indicates that there are three quarks in the neutron. The neutron is formed in the energy interaction. Subsequent decay of the neutron forms the electron and proton. The following figure, entitled the "Neutron Mass model" shows the energy components at the completion of the energy interaction. The quarks are at higher energy than some might say but since creation they have transitioned to lower values while preserving mass plus kinetic energy.

N for Proton Energy Interactions			
mass	Energy-r	S field	Energy
ke		G field	mev
15.43	101.95	17.43	753.29
12.43	5.08	10.43	0.69
13.43	13.80	15.43	101.95
12.43	5.08	10.43	0.69
13.43	13.80	15.43	101.95
12.43	5.08	10.43	0.69
		-0.30	-2.72E-05
		equal and opposite ch	
10.41	0.67	0.07	
-10.33	0.00		
10.14	0.51	10.33	0.62
0.20	0.00	0.30	2.72E-05
90.00		90.00	

Figure 2:7 Neutron Mass Model Part 1

Mass, Kinetic Energy and Fields for Neutron						
						Gravitational
		Residual ke				Field
Mass	Difference KE			Expansion	Strong field	
mev	mev	mev	mev	KE	MeV	MeV
101.95	641.88				-753.29	
						-0.69
13.80	78.69				-101.95	
						-0.69
13.80	78.69				-101.95	
						-0.69
		10.15		10.15		
0.00	0.00			10.15		
0.62	0.00		0.00		0.00	
						-0.62
130.16	799.25	**939.57**	0.00	20.30	-957.18	-2.68
		NEUTRON MASS				
				Total m+ke		
					Total negative	
				959.87	-959.87	0
				MeV	MeV	Net

Figure 2:8 Neutron Mass Model Part 2

Figure 2:3 values are shown on the left on the Neutron Mass model above. Each pair separated by a line engages in an energy interaction resulting in the quads shown in part 1 of the table. Again the total for the columns on the left is 90.

Part 2 of the Neutron Mass Model will now be discussed. The quarks have energy 101.9, 13.8 and 13.8. The difference kinetic energy column has several components.
Kinetic energy for each quad =E3+E4-E1-E2-E2. Two E2's are added back to form the column labelled Residual kinetic energy (10.15 MeV) and two other E2's are placed in the column labelled Expansion kinetic energy (20.3 MeV). Sections 4 and 5 below will use these two values extensively.

The 10.33+0.075=10.408 at the bottom of the Figure 2:3 is the basis for the electron. The bottom quad is for the electron before it has decayed from the neutron.

In Figure 2:8, mass is positive energy, kinetic energy is positive but field energy is labeled negative, balancing net energy to zero. The values toward the left side of the box, labeled mass and kinetic energy are balanced by fields on the right hand side of the box. The three quark masses total 130.163 MeV and together have 799.2 MeV plus 10.15 MeV of kinetic gives the neutron mass 939.5653 MeV, the neutron's exact measured mass [20]. Each neutron also has 20.3 MeV associated with it making the total 959.866 MEV. The total field energy is 959.866 MeV, made up of negative 957.28 MeV of strong+weak potential energy, and negative 2.68 MeV of gravitational field. Considering total field energy negative, the net energy is zero.

The value 4*5.07=20.3 MeV has two important functions. It is the energy that will expand the universe but it is lost from the neutron itself. This means the neutron is missing 20.3 MeV of energy. This is the source of the strong residual force (weak force) that causes neutrons and protons to be attracted to each other and form atoms. Exactly 10.5 MeV of the neutron's kinetic energy and can be released during fusion, causing the binding energy curve for atoms.

Overall, the Neutron Mass model not only represents neutron mass but all the energy that positions the neutron in space, including the gravitational field.

2.8 PROTON MASS MODEL

The neutron transitions to a proton by separating 0.622 from the neutron to form the "electron quad" and emitting one neutrino of energy 0.671 MeV. These components give the proton mass (939.5653-0.622-0.671=938.27 MeV). Refer to the column labeled neutrinos in the Proton Mass table. After the initial interaction and formation of the proton, there are three neutrinos. One of the neutrinos has energy 0.048 MEV, one has energy 0.622 MEV and the third has energy 0.0015. These are the only particles left in space besides the proton, neutron and electron after the energy interaction.

N for Neutron Energy Interactions			
mass	Energy-r	S field	Energy
ke		G field	mev
15.43	101.95	17.43	753.29
12.43	5.08	10.43	0.69
13.43	13.80	15.43	101.95
12.43	5.08	10.43	0.69
13.43	13.80	15.43	101.95
12.43	5.08	10.43	0.69
10.41	0.67	0.07	
-10.33			
10.33	0.62	0.00	0.00
0.00	0.00	10.33	0.62
↓		↓	
90.00	sum	90.00	

Figure 2:9 Proton Mass Model part 1

Mass, Kinetic Energy and Fields for Proton						
						Gravitational
		Residual ke				Field
Mass	Difference KE			Expansion	Strong field	
mev	mev	mev	mev	KE	MeV	MeV
101.95	641.88				-753.29	
						-0.69
13.80	78.69				-101.95	
						-0.69
13.80	78.69				-101.95	
						-0.69
		10.15		20.30	expansion pe	
arge				0.00	expansion ke	
		-0.67	0.67	v neutrino		
129.54	799.25	**938.27**	**PROTON MASS**			
0.51	0.11	e neutrino			0.00	-0.62
ELECTRON		2.5E-05				
130.05		938.27	0.67	20.30	-957.18	-2.68
				Total m+ke		
					Total Negative	
0.51	0.11	938.27	0.7	**959.87**	**-959.87**	0.00
				MeV	MeV	Net MeV

Figure 2:10 Proton Mass model part 2

The proton and electron "come out" of the neutron as a further interaction occurs that lowers the energy. The calculated neutron mass is 939.565 MEV while the proton mass is 938.27 MEV. Neutron decay is well understood to involve energies of the electron and anti-neutrino. The Proton Mass model shows that the proton is also made up of a 15 and two 13 particles. There are differences in the two particles related to their charge and masses. The three sets of interactions for the quarks are straightforward from the author's explanation of interactions. The N's must total N=90. The quarks total (10.43+17.43) + (10.43+15.43) + (10.43+15.43) = 79.59. This leaves 10.33 + 0.075=10.408 available to make a total of 90 before the electron separates.

Nature forms a new quad conserving N total in the column= 90. The value N=-10.33 is borrowed from zero, returned as N=10.33 and becomes 10.14+2*0.098.

N	E (MeV)	N	E (MeV)	E (MeV)	E (MeV)
		-0.30	2.72E-05		
		equal and opposite charge			
10.41	0.67	0.07			
-10.33	0.00				
the electron separates here					
10.14	0.51	10.33	0.62	**0.51**	0.11
0.20	0.00	0.30	2.72E-05	ELECTRON	

Figure 2:11 Electron Mass

The electron is now involved in an energy interaction that imbeds it in an electromagnetic field 2.7e-5 MeV. To prepare for the interaction, a particle with N=10.333 loses N=0.0986*2 to become N=10.136 for the electron with mass 0.511 MeV. The table is read "N=10.14 interacts with N=2*0.0986 to give the electron a mass of 0.511 MEV imbedded in electromagnetic field energy 2.72e-5 MEV and gravitational field energy 0.622 MeV". The electron contains excess kinetic energy 0.1114 MeV, given off as photons/temperature. The value 0.111 MeV is important to binding energy and fusion (Section 5 topic 5.1 and topic 5.2).

2.9 PROTON, NEUTRON AND ELECTRON MASS COMPARISONS

Values from figures "Neutron Mass model" and "Proton Mass model" are compared with PDG values [20] below:

		Calculation (mev)		
Data (mev)			measurement	
Particle Data Gro		Present	(mev)	error
0.511		0.511	-1.3E-06	1.3E-07
0.511		0.511		2.4E-07
		(mev)		
939.57		939.57		
938.27	pdg	938.27	-1.4E-10	6E-10
939.57	nist	939.57	-7.1E-06	0.000023
938.27	nist	938.27	-2.3E-07	0.000023

Figure 2:12 Accuracy of Mass Calculations

2.10 CONSERVED QUANTITIES

There are several conserved quantities, foremost among them is that overall N must be zero, overall energy, E=e0*exp(N)-e0*exp(N)=0 and probability P=1. With N=0, P= 1/exp(N)= 1/exp(0)=1. In addition, there are other conserved quantities such as charge

and angular momentum. When the initial 180=90+90 separation occurred, it made the probability of one proton P=1/exp(90)*1/exp(90)=1/exp(180) because it has improbable mass 1/exp(90) and improbable fields 1/exp(90). P= 1 is preserved by the ratio P=1=exp(180)/exp(180). The numerator is a huge set (exp(180) =1.49e78) of exact duplicate neutron. I believe based on kinetic energy analysis presented in Section 4 that half of these neutrons are cold dark matter. Subsequent decay of the neutrons produces protons, electrons and neutrinos. Think about the creative potential of this many particles (you). Overall:

Information Operations >Energy interaction >Neutrons and Protons >Physical Universe

3 SECTION 3 FORCES

In this section, the following topics are presented:

1. Data from the Proton Mass model unifies the four fundamental forces.
2. The weak residual force is due to 20.3 MeV missing in the overall energy balance (959.87 MeV).
3. After the energy interaction all particles are imbedded in a field with energy 3*0.687+.622=2.68 MeV. This is identified as the gravitational field energy and the basis for quantum gravity with fundamental radius 7.35e-14 meters. The gravitational coupling constant 1/exp(90) links the quantum level to large scale gravitation and weakens the affect of gravity since it is shared between 1.49e78 cell surfaces.
4. The Planck scale is currently thought by many to be the source of the gravitational constant. This concept should be re-considered in light of modern cosmology.

3.1 THE R EQUATION

Particles with kinetic energy are positioned in orbits by forces. Quantum physics describes the particle as contained in a potential energy well [3].

The R equation defined the radius of a quantum mechanical "circle". The time t for a wave travelling at C to move around the circle is 2*pi*R/C. This time is equal to H/E [Figure 2:6]. Equating H/E=2*pi*R/C and solving for R gives the R equation. The result gives R=HC/(2pi)/(E*E)^.5. In most cases one of the E's in the equation takes on the value mass/gamma.
Gamma (g)=m/(m+ke)=(1-(v/C)^2)^0.5
V is the velocity of the particle divided by the speed of light C. A convenient constant is HC/(2pi)=1.973e-13 MeV-m.

The R equation is central to fundamental forces with different inputs, all derived from the Proton Mass model.

Where: H=Heisenberg's constant
M=mass (energy) of the particle. If the particle is moving fast relativistic mass is m/gamma.
E=field energy that causes the particle to move in a circle.
R=maximum probabilistic position of the particle.
R=HC/(2*pi)/(E*m/g)^0.5

We will refer to this equation as the R equation. Section 8 Appendix 1 topic 8.4 contains a derivation attributed to Feynman [2].

3.2 FORCE UNIFICATION DATA

The proton is thought to be a primary manifestation of the underlying laws and as such contains information that determines many aspects of nature. The Proton Mass model above is the source of constants for unification of forces.

	Mass (m) (MeV)	Ke (MeV)	gamma (g)	R meters	Field (E (MeV)
Gravity	938.27	9.8	0.990	7.354E-14	-2.683
Electron	0.511	1E-05	1.000	5.291E-11	-2.722E-05
Strong	129.541	799.251	0.139	2.093E-16	-957.185
Strong	928.121	10.151	0.989	1.430E-15	-20.303
residual					

Figure 3:1 Data from Proton Mass Table

Review the Proton Mass table and you will see the above values. The strong force is from the quark sums below:

Mass	Differen	Strong field	
mev	KE Mev	MeV	
101.95	641.88	-753.29	
13.80	78.69	-101.95	
13.80	78.69	-101.95	
129.54	799.25	-957.18	

Before considering gravitation more thoroughly, it is instructive to review other interactions.

3.3 UNIFICATION OF FORCES

The fundamental forces of nature are simply Force= Field Energy divided by Radius (F=E/R). This makes the R equation basic to force unification.

Force Table			Strong
			MeV
Higgs energy (mev)			128992.05
Field Energy E (mev)			957.18
Particle Mass (mev)			129.54
Mass M (kg)			2.31E-28
Kinetic Energy (mev)			799.25
Gamma (g)=m/(m+ke)			0.1395
Velocity Ratio		v/C=(1-(g)^2)^.5	0.9902
R (meters) =((HC/(2pi)/(E*M/g)^0.5)			**2.0928E-16**
Force	Newtons	F=E/R*1.6022e-13	7.3280E+05
Inertial F	Newtons	F=M/g*V*2/R	711048.53
Force=3.16e-26/Range^2 (nt)			721486.6
Coupling constant derived from this work			1.0157
Derived c^2 (E*R) mev m			2.00E-13
Derived c^2 joule m			3.21E-26
Derived exchange boson (mev)			942.881
HC/(2p	3.16153E-26	Nt m^2	
	(4.13e-21*3e8/(2*pi())*6.24e12)		
*published c^2 mev m			
*published c^2 joule m			

Figure 3:2 Force Table part 1

Force Table		Gravity	Electro-magnetic	Strong residual
Field Energy E (mev)		2.683	2.72E-05	20.303
Particle Mass (mev)		938.272	0.511	928.1207
Mass M (kg)		1.673E-27	9.11E-31	1.65E-27
Kinetic Energy (mev)		9.720	1.361E-05	10.1513
Rydberg energy from PDG			1.361E-05	
Gamma (g)=m/(m+ke)		0.990	1.000	0.989
Velocity Ratio v/C=(1-(g)^2)^.5		0.1428	0.0073	0.1467
R (meters) =((HC/(2pi)/(E*M/g)^0.5		7.354E-14	5.291E-11	1.430E-15
Force	F=E/R*1.6022e-13	**	8.242E-08	2275.20
Inertial	F=M/g*V*2/R*1/exp(90) n	3.452E-38	1.55E-03	1.05E+05
Force=3.16e-26/Range^2 (nt)		**	1.1E-05	15459.4
Derived coupling constant		1/exp(90)	136.959	0.1472
Published coupling constant (PDG)			137.036	
Derived c^2 (E*R) mev m			1.44E-15	2.90E-14
Derived c^2 joule m			2.31E-28	4.65E-27
Derived exchange boson (mev)			0.004	138.019
*Published c^2 (E*R) mev m		1.17E-51	1.44E-15	1.56E-14
*Published c^2 joule m		1.87E-64	2.31E-28	2.5E-27
*Published Range (m)		8.98E+25	5.29E-11	
*http://www.lbl.gov/abc/wallchart/chapters/04/1.html				
** See text				
F=Gmm/R^2 (nt)=6.674e-11*1.673e-27^2/7.354e-14^2=3.45e-38 nt				
E/M R minus proton			5.291E-11	

Figure 3:3 Force Table part 2

In Figure 3:2 Force Table part 1, the R equation is arranged in a column of calculations. The inputs are: M (energy of the mass), E (energy of the capturing field) and kinetic energy. The R equation is near the center of the vertical column with inputs above and relativistic effects below the equation. The total particle mass including its kinetic energy is held in position by the four fundamental forces. These four forces are aspects of the energy interaction and are referred to as the strong force, residual strong (weak force), electromagnetic force, and the gravitational force.

Heisenberg's reduced constant (H/(2pi) is represented by the symbol, "h" and E=hv, where v is frequency. The R equation positions mass at a maximum probability distance, R representing the orbits' three dimensionality [Section 8 Appendix 1 topic 8.4].

For gravity R=7.35e-14 meters is of extreme interest. It is fundamental to gravity, space time and the starting point for expansion.

The field energies for three strong interactions and their associated particles are from the Proton Mass model. They are referenced to the Higgs energy since it is considered by many to be the source of field energies and particle masses. A force coupling constant is calculated to be 1.00 and derived c^2 (E*R) values are presented in MeV-m and joule-m. The author did not find published values for comparison (quarks are not independently observable). The lower hierarchy electromagnetic coupling constant is well known and the author's calculations substantially agree.

The traditional relationship F=hC/R^2 is too simple to characterize gravity since gravity involves defining a radius and a proton with potential energy falling to that radius. Justification for replacing the coupling constant with the value 1/exp(90) is presented below.

Strong Force

The strong energy comes from the proton mass table. Together with the R equation, they define quark orbits inside the atoms. The resulting R is on the order of 2e-16 meters. There are actually three variations of the strong force because there are two types of quarks involved and three different kinetic energies. It appears to the author that they combine but there is a concept called confinement that hides the true nature of the "color" forces.

Strong Residual Interaction

Refer to the Proton Mass table again.

	Mass (m) (MeV)	Ke (MeV)	gamma (g)	R meters	Field (E (MeV)
Gravity	938.272	9.72	0.990	7.354E-14	-2.683
Electron	0.511	1E-05	1.000	5.291E-11	-2.722E-05
Strong	129.541	799.251	0.139	2.093E-16	-957.185
Strong residual	928.121	10.151	0.989	1.430E-15	-20.303

The residual strong force (sometimes called the weak force) is determined by a mass of 928.12 MeV, a kinetic energy of 10.15 and field energy 20.30 MeV. The sum of all the field energies is more strongly negative than the total energy of the proton with its kinetic energy. Energy is missing in each proton but not missing from the total 959.86 MeV. The lack of balance in energy causes an inward force we know as the weak force. We can combine the quarks and their strong residual field energy into a "bundle of quarks". The bundle acts like a particle with kinetic energy 10.15 MeV orbiting in field energy 20.3 MeV. There is a diagram of this in Appendix 4. The same is true for the neutron. When nuclei bond together in nuclear reactions, the nucleons come close enough together to "see" the deficit. This imbeds the mass 928.12 MeV in a 20.3 MeV field with 10.15 MeV of kinetic energy and determines, a radius of 1.43e-15 meters (he radius of the atomic nucleus). This is of course not new to physics, but the origin of the 20.31 MEV is new and comes from the Proton Mass model. The strong residual force F=hC/R^2=

15467 NT requires the coupling constant 0.147 and the derived c^2= 2.9e-14 MeV-m is similar to the published value 1.56e-14 MeV-m.

The atomic binding energy curve is considered to be a result of the strong residual interaction. The key value is the kinetic energy 10.151 MeV associated with the proton that is partially released in atomic fusion. Section 5 topic 5.1 describes a simple model using the value 10.15 MeV as the basis for binding energy. In this model 10.15 MeV is the kinetic energy that changes as atoms fuse. (928.121 MeV+10.151 MeV =938.272 MeV).

Electromagnetic Force

The electromagnetic force is the result of N=3* 0.0986=0.296 being lost from the 10.432 particle to become the electron (10.136). This gives the electron its negative charge. The electromagnetic energy of the field attracting the electron is E=e0*exp(0.296) =27.217e-6 MeV. This is the published value for the electromagnetic field.

The electromagnetic force constant

The fundamental constant (a different e0 than in Section 2) that governs electromagnetism (including charge and the electrical field) is included in Figure 3:2 Force Table. The following table shows calculation of the permittivity constant but it must be recognized that there are small quantum affects not included since the electron's orbitals are very complicated.

F=(1/(4*pi*e0)*q^2/r^2

e0=(1/4*pi*F)*q^2/r^2

F=8.2414e-8 newtons and r=5.2911e-11 meters

q in Coloumbs=1.6022e-19=F*r/27.217e-5/1e6

e0= (1/4*pi*F)*q^2/r^2=8.853e-12 nt/m^2

Compares with PDG 8.854e-12 nt/m^2.

Figure 3:4 Calculation of Permittivity Constant

Once e0 is known, the classical equation is used to calculate the electrostatic force i.e.

F= (1/(4*pi*e0)*q^2/r^2)

The proton has equal but opposite charge from the electron because charge conservation requires these two particles to balance after the interaction that separates them. Since the proton is made up of kinetic energy and quarks, the quarks must carry the charge. To this point, we have introduced no measured values to derive fundamental constants. (If one is tempted to call the charge of the electron (1.602e-19 coulombs) a measured value, recall that the definition of coulombs comes from the definition of the electron volt).

3.4 GRAVITY

The fourth and smallest fundamental force is gravity. The striking things about gravity are its long range and its weakness. Because it affects all mass, gravity's cumulative force is pervasive.

3.5 CALCULATION OF GRAVITATIONAL FORCE WITH ACCEPTED COUPLING CONSTANT

The gravitational coupling constant α_G is the coupling constant characterizing the gravitational attraction between two elementary particles having nonzero mass. The value α_G is a fundamental physical constant and a dimensionless quantity, so that its numerical value does not vary with the choice of units of measurement:

α_G =Gm$_e$^2/(hC)=(m$_e$^2/m$_p$^2)=1.752e-45

where G is the Newtonian constant of gravitation; m_e is the mass of the electron; C is the speed of light in a vacuum; ħ is the reduced Planck constant; m_p is the Planck mass.

This coupling constant can be understood as follows:

3.6 FUNDAMENTAL GRAVITATIONAL RADIUS

1		
http://en.wikipedia.org/wiki		
alphaG=(mp/me)^2=1.752e-45		
mp/me=1836.	where mp/me=proton/electron	
alphaG=1836.15^2*1.752e-45=5.907e-39		
F=(5.9068e-39)*hC/R^2		

WMAP data [11] was used to estimate the number of protons in the universe. The possibility that the result exp(180) was significant in other ways was explored. Note: The author uses the term proton to mean proton like mass in the work below. This is necessary because later in this document proton like mass is separated into protons and cold dark matter. Using an information based approach Section 2 identified components that allowed the author to model the mass of a proton Figure 2:10. It appears that the proton is a manifestation of fundamental laws and as such contains basic information about four interactions. Would you be surprised if we refer to the Proton Mass model again for the source data?

	Mass (m) (MeV)	Ke (MeV)	gamma (g)	R meters	Field (E (MeV)
Gravity	938.272	9.72	0.990	7.354E-14	-2.683
Electron	0.511	1E-05	1.000	5.291E-11	-2.722E-05
Strong	129.541	799.251	0.139	2.093E-16	-957.185
Strong residual	928.121	10.151	0.989	1.430E-15	-20.303

The initial interaction concludes with the energy associated with 10.432*3 and one 10.136 in the right hand column of the Proton Mass table. These fields totaling 3*0.687+0.622= 2.68 MEV is the gravitational fields in the Force Table.

The Force Table is the source of the gravitation constant G. The calculation that follows means we do not have to rely on measuring the gravitational constant.

The field energy 2.683 MeV underlies the quantum mechanics for a fundamental radius r and a fundamental time t. The fundamental gravitational radius is associated with the gravitational field energy 2.683 MeV from the Proton Mass table as shown below:

Identify the radius and time for the gravitational orbit described above				
Fundamental radius=1.93e-13/(2.68*2.68)^.5=7.354 meters				
Fundamental time=7.354e-14*2*PI()/(3e8)=h/E=4.13e-21/2.68				
Fundamental time	1.541E-21	seconds		

If R for the force calculation is 7.35e-14 meters, as proposed above, the force is:

F=(5.9068e-39)*hC/R^2				
	hbar		6.5821E-22	mev-sec
	hbar in NT-m-sec		1.05E-34	NT m se
	hbarC in NT-m^2=K		3.16E-26	NT m^2
F=(5.9068e-39)*K/R^2				
F=(5.9068e-39)*3.16e-26/(7.35e-14)^2=3.39e-38 NT				
3.453E-38	NT			

Figure 3:5 Fundamental Gravitation Force

This result agrees with the simple Newtonian force:

F=Gmm/R^2 (nt)=6.67428e-11*1.6726e-27^2/7.35e-14^2=3.452e-38 nt

The gravitational constant is calculated below and agrees with the published constant. G=F*R^2/M^2/exp(90). The small factor 1/exp(90) is explained in topic 4.1.

GRAVITY	
	proton
Proton Mass (mev)	938.272
Proton Mass M (kg)	1.673E-27
Field Energy E (mev)	2.683
Kinetic Energy ke (mev)	9.720
Gamma (g)=M/(M+ke)	0.9897
Velocity Ratio v/C=(1-g^2)^0.5	0.1428
R (meters) =(HC/(2pi)/(E*E)^0.5	**7.354E-14**
F (NT)=M/g*(v/C*C)^2/R/exp(90)	3.452E-38
HC/(2pi)=1.97e-13 mev-m	
Calculation of gravitational constant G	
Inertial Force=(M/g*C^2/R)*1/EXP(90)	3.452E-38
Radius R (Meters)	7.354E-14
Mass M (kg)	1.673E-27
G=F*R^2/M^2=NT m^2/kg^2	**6.674E-11**
Published by Partical Data Group (PDG	6.674E-11
PE fall MeV	19.34
Ke fall MeV	9.720
F =PE/R *1.6022e-13 NT	3.4524E-38
PE/R=(19.34*1.603e-13/7.3543e-14/exp(90))	

Figure 3:6 Origin of the Gravitational Constant

3.1 SCALING CELLULAR GRAVITATION VALUES TO LARGE SCALE GRAVITATION WITH 1/EXP(90)

This section explains the factor 1/exp(90) used in the calculating the gravitational constant. Consider large mass M (for our purposes the mass of the universe although this is quite presumptive) broken into exp(180) cells, each with the mass of a proton. Fill a large spherical volume with exp(180) small spheres. We are considering the surface of many small cells as a model of the surface of one large sphere. For laws to be uniform throughout the universe there can be no preferred position. A surface offers this property but the equivalent surfaces of many small spheres also offer this property as long as we do not distinguish an edge. As such a "many small cells" surface model is useful if the fundamentals of each cell are known.

In general relativity the metric tensor is based on (ds^2). The surface area of a 2-sphere can be broken into many small spheres with an equal surface area. Let small r represent the radius of each small cell and big R represent the radius of one large sphere with the same surface area containing exp(180) cells. Position a proton like mass on the surface of each cell. The total energy will be that of one protons/cell plus a small amount of kinetic energy. *At a particular time in expansion*, we will evaluate the gravitational constant G of a large sphere and compare it with G of many small cells.

Area=4 pi R^2

Area=4 pi r^2*exp(180)
A/A=1=R^2/(r^2*exp(180)
R^2=r^2*exp(180)
r=R/exp(90) surface area substitution
M=m*exp(180) mass substitution

For gravitation and large space, we consider velocity V, radius R and mass M as the variables (capital letters for large space) that determine the geodesic. With G constant, M=m*exp(180) and the surface area substitution R=r*exp(90), the gravitational constant would be calculated for large space and cellular space as follows (small r,v and m below are for cellular space):

At any particular time in expansion:

Large space		Cellular space with substitutions
RV^2/M	G=G	r*exp(90) *v^2/(m*exp(180)) (rv^2/m)/exp(90)

This is the source of 1/exp(90). When measurements are made at the large scale as must done to determine G, the above derivation indicates that we should multiply cell scale values (rv^2/m) by 1/exp(90) if we expect the same G. Geometric and mass relationships give the cell "cosmological properties".

The above table shows the origin of the gravitational constant 6.67428e-11 [20]. The author believes this is a successful theory of quantum gravity including a fundamental determination of the constant.

3.2 QUANTUM GRAVITY

Science has a "problem" with quantum gravity. The problem is that forces are described by force carrying "bosons" but no force-carrying quantum can travel quickly enough in our large universe to carry the gravitational force. Gravity is different because it is very weak and long-range. General relativity deals with the problem by stating that the geometry of space-time is responsible for gravity. This makes gravity different from the other forces hindering unification. Literature for many years has indicated that the Planck scale is the source of the gravitational constant. The work below differs:

A possible candidate for gravitational energy scale

Nomenclature and review

Constants
\h 6.5821E-22 MeV-sec =reduced Heisenberg
E 1.2200E+22 MeV =Planck energy E

M 2.18E-08 kg Compton mass
(Compton mass=1.22e22 MeV*1.78e-30 kg/MeV)
G 6.670E-11 nt m^2/kg^2 gravitational constant
C 3.00E+08 m/sec

Relationships
Compton wavelength=GM/C^2
GM/C^2 =6.67e-11*2.18e-8/3e8^2
L=GM/C^2=1.62E-35 meters
L=Ch/E=h/MC=1.62E-35 meters
L=h/MC=GM/c^2=1.61E-35 meters
G=hC/M^2

First compare the quantum mechanical (qm) action at two levels, the Planck scale and the much lower level (2.683 MeV) proposed above. Momentum (p) =E/C and action is 1.0 when momentum*radius/h=pR/h=1.

Planck energy E (MeV) =1.2200E+22
L=Planck length (meters) =1.62E-35
Planck momentum p=E/C =4.07E+13
p*L MeV-sec =6.58E-22
qm action= p*L/\h =1.00E+00

Proposal		**(cell d305 "unified")**	
Field Energy		2.683	mev
constant	HC/(2pi)	1.97E-13	mev-m
	R=constant	7.35E-14	m
	Field side	R side	
	H/E	2*pi*r/C	
time (t)	1.54E-21	1.54E-21	sec
Proposal p	(p=E/C)	8.95E-09	mev-sec/m
p*R/h		1.00	
qm test	M/C^2R^2/h	6.58E-22	mev-sec
qm test/h	M/C^2R^2/h	1.00	

Figure 3:7 QM Test for Gravitation

Above, the Proton Mass model gives the field energy 2.683 MeV as the basis for gravitation. This field energy is associated with a quantum circle with radius of 7.35e-14 meters. Figure 3:9 shows the test for action. The proposed lower energy scale for gravity also meets the test. Since either level could be a candidate for defining quantum gravity based on action one question we must addresses is: Can we substitute this low energy scale for the Planck scale energy? The proton mass (1.67e-27 kg) is analogous to the

Compton mass, i.e. proposed mass is 938.27 MeV, not 1.22e22 MeV (1.67e-27 kg, not 2.17e-8 kg). Compare the calculation for gravitational constant for the Planck scale and the proposed mass level and note that they differ by the factor 1/exp(88).

Compton mass 2.18e-8 kg

G= hC/M^2
G= (6.58e-22*3e8/(2.18e-8)^2*1.603e-13)
G= 6.66E-11 nt m^2/kg^2

Proposed mass 1.67e-27 kg

G= hC/M^2
G= (6.58e-22*3e8/(1.67e-27)^2*1.603e-13)/exp(88.03)
G= 6.66E-11 nt m^2/kg^2

The large factor required for the same G does not agree with the coupling constant exp(90) as it should, further deepening our belief that the Planck scale source for gravity needs to be re-considered. It is clear that that early scientists selected the Planck scale without understanding cosmology. This left present day scientists searching for quantum gravity and unable to define a fundamental coupling constant.

There is a historical perspective to this understanding. When physicists dealt with one electron and its field energy, they knew they were working with the quantum scale and it was reasonable to assign an electromagnetic based Compton mass and wavelength. However, very early physicists may not have yet understood that gravity is the geometry of space time. It was reasonable, as a working assumption, to assign a Compton wavelength to gravitational mass and calculate Planck scale energy.

However, it now must be recognized that for equal gravitational constant the radius of curvature and mass are vastly different between the large and small scale. Also, it was unfortunate that the great physicists of the 1900's did not have the advantage of WMAP [11] and Cmagic [12] expansion models, nor did they have the advantage of knowing the approximate number of protons in the universe. Perhaps they couldn't compare cellular scale space to large space because they lacked information.

Because this is new and some may have difficulty with a new coupling constant 1/exp(90) that connects the quantum level with large scale gravitation, the author included several examples in Appendix 2 (Section 9). The examples show the use of the small factor 1/exp(90) to determine Earth's gravitational field and universe size geodesics. Expansion energy is further discussed. Furthermore, it is shown that time dilation, a basic concept of time and space, are the same for special relativity and general relativity throughout expansion. The last example shows the use of 1/exp(90) in a calculation for the Schwarzschild radius (used to predict the size of black holes).

3.3 **FORCE SUMMARY**

In summary, the language of nature uses numbers (information) to represent fundamental quantities of energy in the universe. Mass and energy are created by information operations. Energy interactions place particles in fields and duplication of particles fill our universe with creative potential.

The energy interaction and the Proton Mass table show us that each proton is left with a weak potential energy deficit of 20.3 MEV. The deficit is associated with the strong residual energy (weak energy) that explains binding energy and elemental abundance. Today the particles are separated from each other in a universe still expanding, but some of the kinetic energy has been converted to gravitational potential energy.

The electromagnetic field is created by the interaction 10.431-0.295 >10.136. The electromagnetic field is the only field that can attract or repel and the term charge is used to describe the property an electromagnetic field is attracting to or repelled by. The electron is assigned negative charge 1 and the proton is assigned positive charge 1 to satisfy zero net charge conservation. Both fields are required in the proton mass table for it to balance to zero. Protons contain only quarks and kinetic energy and this suggests that quarks are charged mass, just as electrons are charged mass.

The force table appears to show force unification, a long time goal. The key was finding constants in the Proton Mass model. Forces are simply energies divided by R and all forces including gravity are treated the same at the quantum level. The gravitational coupling constant 1/exp(90) required an understanding of cosmology. The author uses a cellular model that describes gravity, space, time, expansion, kinetic and potential energy at the quantum level. Using a small cell of radius r to simulate a large radius R (literature would call this the radius of the universe) is critical to understanding cosmology. In this model, the universe is filled with the *surface* of many small cells that are equivalent to the *surface* of one large sphere. This is important conceptually because we can be inside the universe (something we all observe), each surface can be identical and the concept that there is no preferred location can be preserved. The relationship between many small cells and one large sphere requires the geodesics of cells to be multiplied by the small factor 1/exp(90), the gravitational coupling constant [topic 3.1 above]. Expansion of each cell involves the kinetic energy of a proton like mass on the surface of each cell. The model's geometrical and numerically similarity allows many small cell surfaces to represent large scale cosmology. Overall:

Information Operations >Energy Interaction >Neutrons, **Protons, and Electrons > Fundamental Forces**

4 SECTION 4 COSMOLOGY

In the previous section, the author calculated a fundamental radius r=7.35e-14 meters for gravity. The author believes that the space we walk around in is expanded from exp(180) cells of this initial radius. Also, the Proton Mass model gives us the expansion energy 20.3 MeV. If this value is accurate, it should give us the size of the universe we see. The expansion process is based on converting kinetic energy to potential energy against a gravitational force defined by the Force Table, Figure 3:3.

4.1 INFLATION AND EXPANSION

The sequence of events surrounding the beginning is summarized below.

1. First event: Separation of N=90 into smaller values of N. The separation of N=90 into four values of 22.5 each creates the four dimensions. There are three equal and orthogonal dimensions (3 space and 1 time dimension). The ratio of time to distance is the constant C, the speed of light [Section 8 Appendix 1 topic 8.2].
2. Second event: Information operations separate the logarithmic value 90 into components. The energy interaction gives basic mass components kinetic energy. Balance mass with kinetic energy against fields with net energy equal to zero. Conserve P=1 by placing exp(180) particles in the four dimensional universe. The R equation and the gravitational field give a distance of 7.34e-14, filling a 3 dimensional universe with cells, each containing a proton like mass.
3. Third event: Each cell expands using the energy in the Proton Mass model. The present size of the universe based on cells of radius 0.55 meters/cell*exp(60) is 6.33e25 meters. Primordial nucleosynthesis releases 1.6 MeV (on the average) for each nucleon. This process uses the weak energy.
4. Fourth event: Gravitational accumulation occurs after the plasma subsides, resulting in clusters, galaxies, stars and planets. These stars eventually "light up" under heat and pressure, again using the weak force.

Justification for the cosmological principle

The cosmological principle states that overall, particles are uniformly distributed throughout space. Science uses the word principle when the basic reason for an observation is obscure. Cosmologists [10] believe there was a rapid period of expansion in the beginning. One reason they believe this is that it would smooth out variations. According to conventional cosmology, the universe was expanding at superluminal velocity (larger the C) and an inflationary period (perhaps no longer that a fraction of a second) would allow areas to remain uniform that lose contact. Some also feel that it would prevent an immediate collapse before expansion really begins because gravity is strong when particles are close together. The author believes that inflation is a proton and cell duplication process filling the universe with spheres of radius 7.35e-14 meters, each containing a proton like mass.

Fundamental radius=1.93e-13/(2.68*2.68)^.5=7.354e-14	meters

Figure 4:1 Initial Radius of Each Cell

The initial radius of each cell is the fundamental gravitational radius described in Section 3 topic 3.6. A filled sphere where volume V is proportional to R^3 and also proportional to exp(180)*r^3. This makes R=r*exp(60) the equation for determining large R from cell radius r. The first meaningful radius is exp (60)*7.35e-14 meters=8.4e12 meters. At this radius, the cells just touch. Based on geometry the sphere would have exp(60) cells from "center to edge". The author believes this is the period called "Inflation" by cosmologists

4.2 FUNDAMENTALS OF EXPANSION

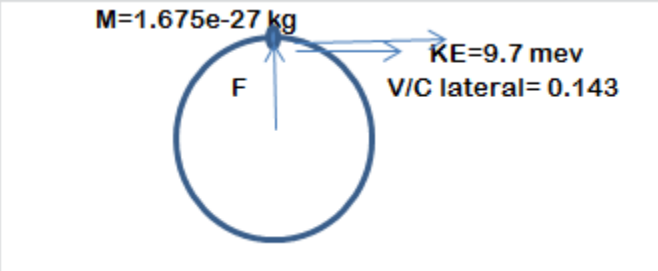
The next step is expansion that increases the universe to its present size. Simple kinetic energy and potential energy equations are applied to expanding cells. Each particle of mass m has kinetic energy and a velocity, V tangential to the cell surface. Important values for the model originate in the Proton Mass model. The model shows protons with about 20 MeV that fall into "orbits" with 9.8 MeV of kinetic energy and 9.8 MeV of potential energy. Initially the mass on the cell surface has high velocity (0.14C) and inertial force equivalent to gravity. Tangential kinetic energy (topic 4.3.2 below) decreases directly with expansion ratio and defines an orbit that maintains the gravitational constant at G. This "orbit" is again a model since it is temperature and pressure associated with kinetic energy that drives expansion. After expansion, potential energy allows protons to fall (accelerate) toward each other and establish orbits as mass accumulation occurs. It is this energy that we see when orbits are established around galaxies and planetary systems. It is also this energy that provides pressures and temperatures high enough to initiate fusion.

Cell Diagram

Initial cell radius is 7.35e-14 meters. Initial forces in the cell are balanced and initially are 3.45e-38 newtons. With an initial kinetic energy of 9.8 MeV, the initial expansion velocity can be calculated.

Gamma (g)=938.27/(938.27+9.8)=0.9897

V/C=(1-0.9897^2)^.0.5=0.143.



PE expansion=integral F dR

KE=mv^2/2

Figure 4:2 Cell diagram showing tangential kinetic energy

Kinetic energy decreases as expansion occurs. The derivation below is based on gravitation constant G remaining constant (small g below stands for the relativistic term gamma).

But the universe expan		rv^2/(M/g0)		
G remains constant G=rv^2/(M)		Ke and velocity decrease		
RV^2/(M)=rv^2/(M)		9.75	ke	
RV^2=rv^2				
(v/V)^2=(r/R)				
(v/V)=(r/R)^.5		0		
ke=ke0*(r/R)				

Figure 4:3 Kinetic Energy decreases with Expansion

Expansion is outward, characterized by time and consistent with kinetic energy being converted to potential energy. Because we are dealing with cells, the velocity is lower than C. This is a great advantage since it will allow us to calculate energy changes.

Expansion commences, neutrons start to decay and the temperature decreases. Later, synthesis of deuterium takes place, He4 forms and after a jog upward, further cooling takes place. The total of all of the mass remains 959.866 MEV, balanced by 959.866 MEV of field energy. During expansion, energy is conserved, i.e., the sum of kinetic energy and potential energy are constant.

4.3 DERIVATION OF EXPANSION EQUATIONS

The goal below is to model expansion of a small cell that provides values scalable to the universe.

Nomenclature

(all calculations are MKS)
t-time
g=dimensionless time=time/alpha time
Lower case r is a cell radius
Upper case R=r*exp(60)
R1 radius is first expansion component
R3 radius is second expansion component
H3 is Hubble's constant for R3

First expansion component; R1
(r/r0)^3 increases as (t/alpha)^2 (kinetic energy requirement)
r=r0*g^(2/3)
R=r0*exp(60)*g^(2/3)
r0=1.93e-13/(2.683*2.683)^.5=7.35e-14 m
R1=(7.35e-14*exp(60))*g^(2/3)

Second expansion component: R3
dr/(r*dt)=H3
dr=H3*r*dt
dr=H3*alpha*r *dg (dt=alpha dg)
dr=H3*alpha*r0*g^(2/3) *dg
r=H3*alpha*r0*g^(5/3)/1.6666
R3=H3*alpha*(7.35e-14*exp(60))*g^(5/3)/1.666

r1+r3=(7.35e-14)*g^(2/3)+(7.35e-14)*g^(5/3)*H1*alpha/1.666
R1+R3=r1*exp(60)+r3*exp(60)

Figure 4:4 Derivation of Expansion Equations

Integral dr adds a late stage term that expands with time, after integration, raised to the power (5/3).

Fundamental time and initial time

Identify the radius and time for the gravitational orbit described above				
Fundamental radius=1.93e-13/(2.68*2.68)^.5=7.354		meters		
Fundamental time=7.354e-14*2*PI()/(3e8)=h/E=4.13e-21/2.68				
Fundamental time	1.541E-21	seconds		

Figure 4:5 Fundamental Time

The author uses dimensionless time, g=time/alpha in expansion equations, i.e. R=r0*g^(2/3). (Note: this g is not gamma.) Define alpha as initial time. Time=1.54e-21 seconds*exp(N) where N increases from 45 to approximately 90. Dimensionless time g starts at 1 when time is multiplied by exp(45) at the beginning. This makes alpha=1.54e-21*exp(45)=0.0538 seconds.

Expansion constant H3

The expansion model will be called the "R1+R3" expansion model.

R0=7.35e-14*exp(60)=8.39e12 m, where r0=7.35e-14 m.

R1+R3=8.39e12*g^(2/3)+8.39e12*g^(5/3)*H3*alpha/1.66

The second part of the equation above R3=8.39e12*g^(5/3)*H3*alpha/1.666 contains alpha and unknown, H3. Alpha and H3 are evaluated with WMAP data. Decoupling,

equality and Hubble's constant match data with alpha=0.0583 seconds and H3=3.24e-18/sec. If these value are used the resulting expansion curve compares favorably with both the WMAP concordance model and the Cmagic model [12]. The concordance model is based on Pebbles [10] with cosmological parameters from WMAP.

R3=8.39e12*g^(5/3)*3.24e-18*0.0538/1.666

R1+R3 was calculated with increasing time ratio until overall H was 2.26e-18 [7]. Matching calculated H with measured H gives R1+R3= 6.33e25 meters at 4.42e17 seconds (14 billion years). R3 is now 0.46 of the total radius but expanding faster (5/3 power). Hubble's constant for R3 expansion matches data with H1=1.3e-18/sec, H3=3.24e-18/sec and H overall=2.26e-18/sec.

The concordance equations can be simplified. The second component (lambda component) called RL below is a function of omega lambda=0.72 and time t, Hubble's constant 2.26e-18/sec and time^(5/3), similar to R3.

R=5.89e13*t^(2/3)
R=0.72*2.26e-18*7.044E13*t^(5/3)

4.4 EXPANSION TABLE

The following two tables put the derivations above into action. There are many results in tables below for R1+R3 expansion. The first table starts at the fundamental radius and progresses to the right as time advances. The author uses a natural logarithmic scale with time=exp(45+c)*1.54e-21 seconds. Dimensionless time (g) = time/0.0583 starts with 1. If c above is a small value, the model contains more incremental steps. Rows in the model contain values of interest. Cell radius is r1+r3, using the derivation above. Rtotal = (r1+r3)*exp(60). Ke orbit is scaled to lower values by ke=9.78*7.35e-14/(r1+r3). Gamma=938.27/(938.27+ke). V/C=(1-gamma^2)^.5. Fgravity=M*V^2/(r1+r3)/exp(90), where M=1.67e-27 kg. With the above relationships, the calculated gravitation constant G=F/M^2*(r1+r3)^2/exp(90) is constant throughout expansion. The highlighted rows are kinetic energy and potential energy. Potential energy=PE+F*(delta R)/2*6.12e12 MeV/(NT-m) with initial force F=3.44e-38 NT. Energy in the table below is MeV and force is in Newtons (NT).

alpha (initial time in sec		0.0538	Start		
logarithm used to increase time (LN)			45	45.24475	45.4895
time–seconds		EXP(LN)*1.54e-21	0.053846	0.06878	0.08785
t fundamental		1.54E-21	1.54E-21	1.54E-21	1.54E-21
g time rati	1	time/alpha	1	1.28E+00	1.6315
Cell radius	7.35E-14	R=R1+R3	7.35E-14	8.66E-14	1.02E-13
1.310E-18		R1	7.35E-14	8.658E-14	1.019E-13
		R3	7.37E-33	1.11E-32	1.67E-32
R universe	6.325E+25	(R1+R3)*exp(60)	8.40E+12	9.89E+12	1.16E+13
			0	3.05E+07	2.81E+07
Proton	938.27	mass mev	938.272	938.272	938.272
0.987	0.9897	gamma (g)	0.9897	0.9912	0.9925
ke orbit	9.781	mev	9.78	8.31	7.05
V/C orbit	0.1433		0.1433	0.1322	0.1219
velocity	3.00E+08	m/sec	4.30E+07	3.96E+07	3.65E+07
Fgravity (nt)		F=M V^2/R/exp(90	3.44E-38	2.49E-38	1.80E-38
Fg=GMM/R^2/exp(90)		1	3.456E-38	2.494E-38	1.799E-38
Fi=MV^2/R/exp(90)		1	3.438E-38	2.487E-38	1.7951E-38
Dark energy PE		FINAL PE Mev	1.1E-12	1.02E-12	9.37E-13
Pe=Pe+dPE=Pe+Fi dR/2			0.00E+00	1.45E+00	2.69E+00

Figure 4:6 Expansion Table first few Steps

Expansion table (last few time steps)

R1+R3 is estimated to be about 6.33e25 meters at 14 billion years. The column labeled NOW is for measured value H= 2.26e-18/sec and H1 and H3 are highlighted to the right.

alpha (initial time in sec		0.0538	Last few ste	NOW		
logarithm used to increase time (LN)			88.32075	88.5655	90	
time–seconds		EXP(LN)*1.54e-21	3.51E+17	4.48E+17	1.88E+18	
t fundamental		1.54E-21	1.54E-21	1.54E-21	1.54E-21	
g time rati	1	time/alpha	6.52E+18	8.32E+18	3.49E+19	2.25E-18
Cell radius	7.35E-14	R=R1+R3	4.24E-01	5.54E-01	3.54E+00	
1.310E-18		R1	2.566E-01	3.020E-01	7.859E-01	1.31E-18
		R3	1.67E-01	2.52E-01	2.75E+00	3.24E-18
R universe	6.325E+25	(R1+R3)*exp(60)	4.84E+25	6.33E+25	4.04E+26	2.25E-18
			1.42E+08	1.52E+08		
Proton	938.27	mass mev	938.272	938.272	938.272	
0.987	0.9897	gamma (g)	1.0000	1.0000	1.0000	
ke orbit	9.781	mev	1.68E-12	1.29E-12	2.01E-13	
V/C orbit	0.1433		2.77E-12	2.36E-12	9.06E-13	
velocity	3.00E+08	m/sec	17.93	15.69	6.21	
Fgravity (nt)		F=M V^2/R/exp(90	1.04E-63	6.09E-64	1.49E-65	
Fg=GMM/R^2/exp(90)		1	1.040E-63	6.093E-64	1.494E-65	
Fi=MV^2/R/exp(90)		1	1.04E-63	6.09E-64	1.49E-65	
Dark energy PE		FINAL PE Mev	1.00E-11	1.16E-11	2.98E-11	
Pe=Pe+dPE=Pe+Fi dR/2			9.66E+00	9.66E+00	9.66E+00	

Figure 4:7 Expansion Table last few Steps

The radius of each cell is now 0.55 meters and the velocity related to the reduced kinetic energy is 15.7 m/sec.

4.5 EXPANSION COMPARISONS

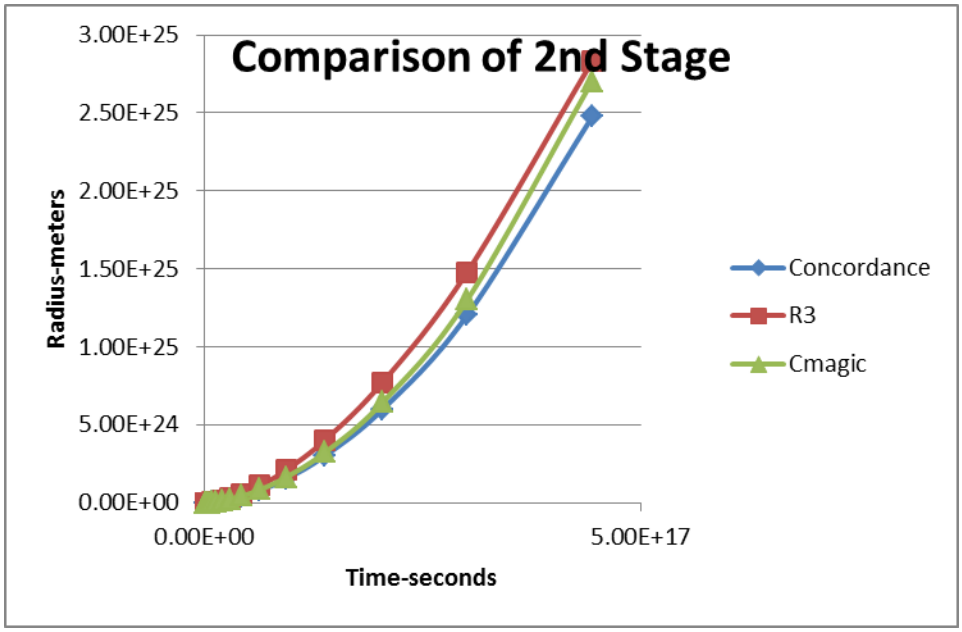


Figure 4:8 2nd Stage Expansion Comparison

The R1+R3 model can be compared with the concordance and Cmagic models.

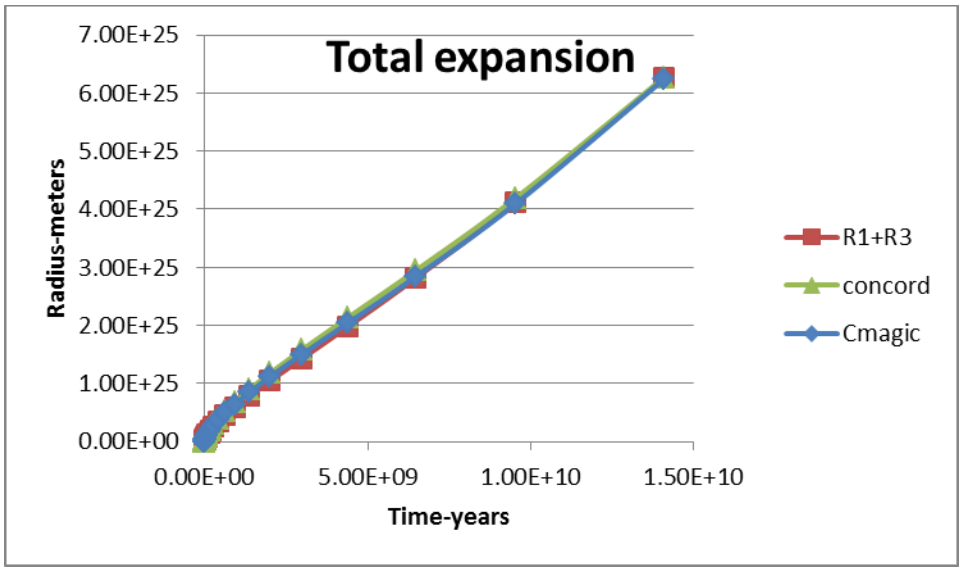


Figure 4:9 Total Expansion

4.6 DETAILED EQUALITY TO DECOUPLING SIMULATION

WMAP used the difference in time between two important transitions to determine the size of the acoustic induced temperature spots detected by radiometers. The two transitions were 1) equality of photon mass and baryon mass when acoustical waves develop and 2) decoupling when the universe became transparent as the plasma clears. When photon mass density matches and falls below mass density a condition known as equality has occurred. Acoustic oscillations are no longer dampened and wave propagation at velocity 3e8/3^.5 m/sec begins. These waves enlarge and are visible in the cosmic background radiation (CMB) [10][6] as the plasma clears at decoupling. Results for the concordance expansion calculations are shown with a light background. Below the concordance block, the author's R1+R3 results are shown (darker background). Although the expansion curves end at the same radius, there are small differences. However, the differences do not affect the spot size in radians. Equality and decoupling values are shown in red. (To fit this document, the author hid most of the spreadsheet columns.)

Concordance	3196		4.13E+01	Saha concordance
1.30E+22	1.68E+22	2.18E+22	6.16E+22	Decoupling r (meters)
4835.43	3729.32	2876.20	1017.28	Expansion ratio
1.32E+04	1.02E+04	7.84E+03	2.77E+03	T concordance (K)
6.52E+19	2.99E+19	1.37E+19	6.09E+17	Photon density n/m^3
1.36E-16	6.25E-17	2.87E-17	1.27E-18	proton mass density
1.98E-16	7.01E-17	2.48E-17	3.89E-19	photon mass density
1.46E+00	1.12E+00	8.66E-01	3.07E-01	photon/mass density
0.00E+00	2.09E+20	5.17E+20	4.10E+21	Wave progression (m)
0.0000		0.0038	0.0106	Angle radians
6.12E+19	2.81E+19	1.29E+19	5.71E+17	
R1+R3			4.37E-01	Saha proposal
1.09E+22	1.42E+22	1.84E+22	5.20E+22	Decoupling r (meters)
5720.61	4412.12	3402.87	1203.67	Expansion ratio
1.44E+04	1.11E+04	8.59E+03	3.04E+03	T proposal (K)
8.59E+19	3.94E+19	1.81E+19	8.01E+17	Photon density n/m^3
2.26E-16	1.04E-16	4.77E-17	2.11E-18	proton mass density
2.86E-16	**1.01E-16**	**3.58E-17**	**5.62E-19**	photon mass density
1.26E+00	9.73E-01	7.51E-01	2.66E-01	photon/mass density
0.00E+00	2.09E+20	5.17E+20	4.10E+21	Wave progression
0.0000	0.0023	0.0045	0.0126	Angle radians

Figure 4:10 Simulation of WMAP Results

Photon mass density above is given by the following equation with units kg/m^3.

Photon mass density=8*pi/(HC)^3*(1.5*B*T)^4*1.78e-30 kg/m^3.

Units: MeV^4 kg/(mev^3-m^3)=kg/m^3

B is the Boltzmann constant 8.62e-11 MeV/K.

http://hyperphysics.phy-astr.gsu.edu

Mass density in kg/m^3:

Mass density=0.5*1.67e-27*exp(180)/volume

The SAHA equation for the electron is used to determine when decoupling of radiation occurs [4]. A SAHA value nearing one indicates that the plasma clears.

SAHA Value=4*2^0.5/PI()^0.5*1/3.63e20*1.6e-9*(T/0.511)^(3/2)*EXP(1.36e-5/(8.62e-11*T))

Equality of photon mass density and mass density occurs at radius 1.1e22 meters for the R1+R3 model. From this point waves progress until the temperature reaches 3040 K. At this point the SAHA equation indicates that decoupling occurs. The R1+R3 radius is 5.2e22 meters at decoupling. The wave has enlarged to 3.35e21 meters and this value divided by 2*pi*5.2e22=0.0109 radians. This matches the observed peak CMB anisotropy. The value 0.5*1.67e-27 kg*exp(180)/volume for mass density is half the total mass based on a proton. This is another clue that baryons are more numerous than WMAP analysis indicates but more information is provided below.

The acoustic mass that accumulated at decoupling caused light released from the higher density spot to be red shifted. The red shift measured by WMAP was 74 micro-degrees for the dominate wave component. The author evaluated the spot temperature utilizing equations from Bennett [11]. The estimates below are for the spot size determined above with cluster mass estimated by density at decoupling multiplied by the spot volume.

simple cell dt158					
	Spot Radius	Spot Volume		Volume at Decoupling	
	meters	m^3		m^3	
	4.364E+21	3.48E+65		6.48E+68	
Density decoupling=0.5*1.67E-27*EXP(180)/8.04e(				(Kg/m^3)	1.92E-18
	Spot mass = spot density* spot volume			Kg	6.68E+47
f(M/spot)=1+1/(1-(2*6.675e-11*Spot Mass/(spot dia*3e8^2)))^0.					1.06E+00
T(micro K)=(2.725-2.725/(1+(f(M/spot)-1)/2000))*1e6					85

Figure 4:11 CMB Radius and Temperature

This indicates that the temperature matches WMAP measurement of the peak wavelength when spot mass is similar to a cluster.

4.7 EXPANSION KINETIC ENERGY AND POTENTIAL ENERGY

Since expansion is well characterized (and agrees with the author's calculated expansion), one can simply calculate expansion kinetic energy and expansion potential energy as a function of time and determine if initial KE is in fact converted to potential energy. Comparison of expansion kinetic with potential energy in the author's expansion

model is included in the table above (the KE line and the PE line are highlighted in gold). The initial kinetic energy is reduced to the current value (labeled NOW) of 1.29e-12 MeV. The initial resisting force is the inertial force F=MV^2/R=3.44e-38 NT where V is the tangential velocity V/C=0.14 that decreases with increasing R. Final potential energy (integral of FdR) is 9.68 MeV in the NOW column. To obtain this result the author reduced the number of protons to one half exp(180). Why one half? The resisting force is based on each of all exp(180) masses. Details presented in reference 3 suggest that protons (baryons) make up one half of the total mass. The R1+R3 final density is based on all exp(180) masses. This is evidence that the other half of the mass is gravitationally active cold dark matter with mass 1.67e-27 kg with its own energy source (a mirror of the proton perhaps). Changes in energy are plotted below (the horizontal axis units are increments of time and they quickly saturate).

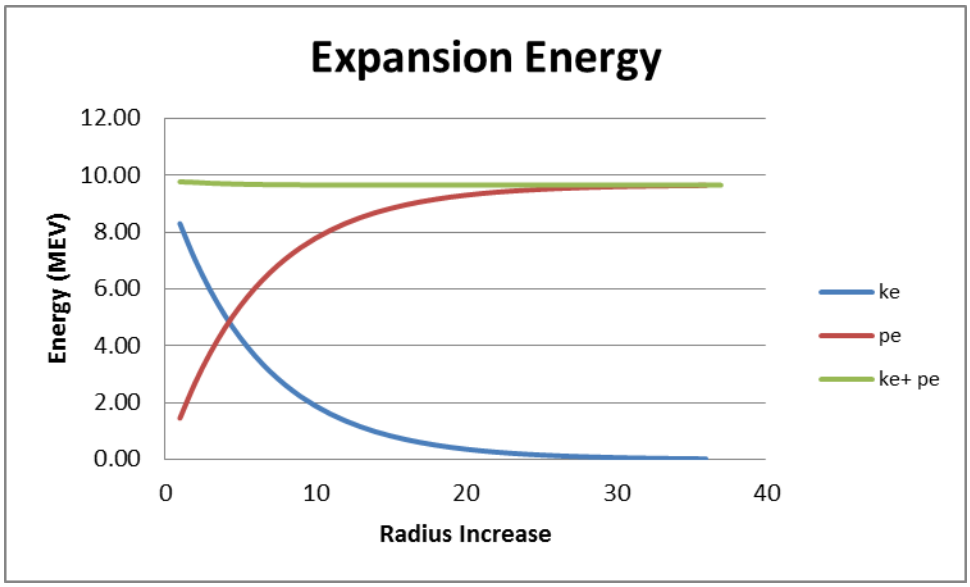


Figure 4:12 Conversion of Kinetic Energy to Kinetic Energy

Dark Energy

The second component of expansion R3 is initially only 8.47e-7 meters and expands to about 2.9e25 meters. WMAP identifies the expansion energy for this component as "dark energy" and assigns a large portion of critical density to it. This expansion is again resisted by gravitational forces (3.44e-38 Nt) and potential energy increases as expansion occurs. When the calculation was carried out, it was discovered that this component requires very little kinetic energy (on the order of 1.29e-11 out of 9.8 MeV). The result is shown below:

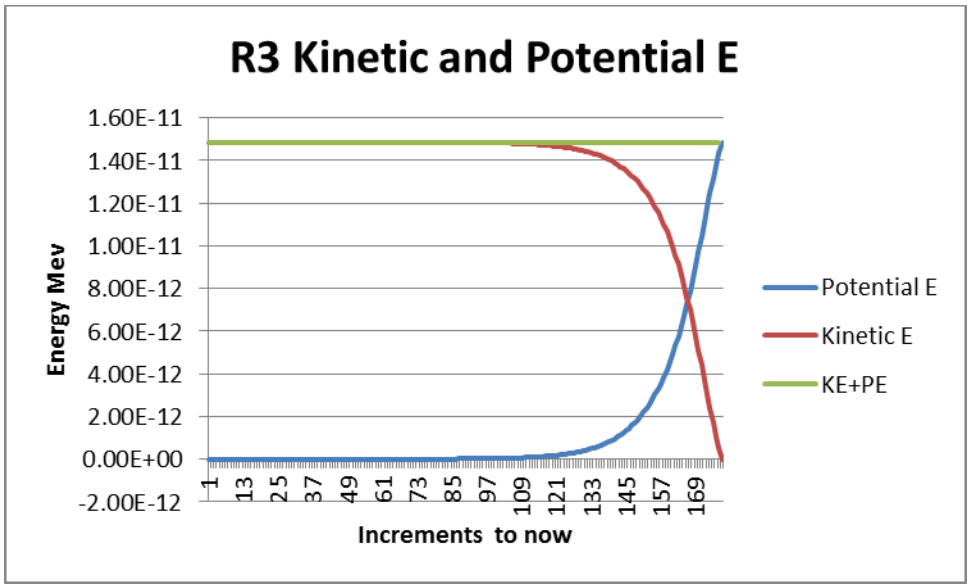


Figure 4:13 Dark Energy

Very little energy is required because the radius is low in the first part of expansion when the resisting force is high. Recall that the WMAP conclusion [7] was the 0.72 of the total energy was missing and a search for "dark energy" was launched. The accepted formula H^2=4/3 pi G rhoC, where H is Hubble's constant and rhoC is critical density assumes that the driving force for expansion is kinetic energy characterized by mass density. It is incorrect to calculate a critical density from H^2=4/3 pi G rhoC since the second part of expansion requires negligible kinetic energy. To the author this means that omega dark is negligible. I am not questioning expansion of the second component and I do not question that the Hubble constant H is the current expansion rate. What is being questioned is that critical density characterizes the energy required.

4.8 COMPARISON OF PROPOSAL AND WMAP

Differences between this proposal and WMAP analysis are summarized below.

WMAP w/o dark	WMAP [7] NOW			Proposal Equality	Now
6.4E+25	6.4E+25	Radius		1.98E+22	6.35E+25
	1.07E+78	Volume (m^3)		3.25E+67	1.07E+78
	0.36	B density=.5*exp(180)/vol		2.29E+10	0.69
6.1E-10	6.1E-10	baryons/photon		4.49E-10	4.49E-10
	5.77E+08	Photon number density		5.1E+19	1.55E+09
?	0.236	Cold matter fraction		0.5	0.5
		CDM density in kg/m^3			1.16E-27
0	0.72	Dark Energy		0	0
2.67E-27	9.5E-27	critical density	1.67e-27*exp(180)/Vo		2.32E-27
?	0.044	Baryon fraction		0.5	0.5
	baryon matter density in kg/m^3				1.16E-27

Figure 4:14 Comparison of WMAP Parameters with R1+R3 Model

WMAP 9 year parameters [13] on the left side of the table above give omega total = 9.5e-27 kg/m^3. Omega dark fraction is 0.718, cold dark mass fraction is 0.235 and baryon mass fraction is 0.046. V^2=8/3 pi G rhoC*R^2 is based on initial kinetic energy becoming potential energy and the author's calculations show that the second component of expansion (dark energy) is essentially zero, making omega dark energy=0. This means 0.72*9.5e-27 kg/m^3=6.83e-27 must be subtracted from critical density. The new value is 9.5e-27-6.83e-27=2.67e-27 kg/m^3. The three columns on the right give values from the proposal at neutron decay, equality and now. Baryon density is given by 0.5*exp(180)/volume at each of the radius values. The important change in temperature for the now condition gives 1.55e9 (photons+neutrinos+electrons)/m^3. With baryon density 0.931 baryons/m^3, the baryon/photon ratio is 0.931/1.55e9=6e-10. This is in agreement with WMAP and other literature. The argument for a higher baryon fraction is that there are more photons so there can be more baryons. Since the proposed critical density without dark energy is 3.11e-27 kg/m^3, the baryon fraction is 0.5. Again, this calculation is very sensitive to temperature since photon density is a function of temperature cubed.

4.9 THE MISSING MASS PROBLEM

In addition to the low fraction (0.044) of protons found in nature discussed above there are other aspects to a problem called the "missing mass" problem. Satellites have thoroughly mapped the cosmic background radiation (COBE, WMAP and PLANCK). Analysis, based on equations from the field of acoustics, has concluded that there must have been gravitational accumulation before equality of mass and photon density. They call one missing component dark energy and the remainder of the mass "cold dark matter" (CDM). Scientists believe that the universe is "flat" (meaning it is not subject to either a big crunch or such rapid expansion that gravitation can't create what we see) but their critical density 9.5e-27 kg/m^3 include unknown components. Results to date as a fraction of critical density (Omega=1) can be summarized: Protons—0.044, Mass---0.27, Remainder--- (dark), Total---1.0.

Primordial nucleosythesis involves calculations that determine when deuterium can exist. This element quickly fuses to He4 once available but has low binding energy and easily photo-disentegrates when the temperature is high. Some calculations show that the proton density must be on the order of 0.04 to agree with measurements of residual deuterium.

Galaxy velocity and luminosity profiles

The orbital velocity measurements of stars in a galaxy (220 kilometers/sec for our sun in the Milky Way) are consistent with Newtonian calculations inward toward the center of the galaxy, but the outer edges of the galaxy show measured velocities too high to be consistent with the light coming from the galaxy. Light emission is thought to trace mass, therefore there must be mass in the galaxy that we can't see. The fact that red shift observation of velocities in the other region of the galaxy are too high to be consistent with either the mass of the galaxy or Newtonian mechanics has led some to explore whether Newtonian mechanics is complete or whether there are exotic forms of mass in our universe. This inconsistency is part of the missing mass problem. An early clue that dark matter indeed exists was the observation of the velocity and luminosity across the diameter of observable galaxies. This work is largely credited to Vera Rubin and astronomers at the University of California Santa Cruz. If a significant amount of dark matter forms a "halo" around observable light matter, the flat velocity profiles and the decreasing light density (MeV/m^2) emanating from the edge of the galaxy can be rationalized.

The author estimated galaxy velocity profiles with a 50% light/50% dark ratio. It seems reasonable that the dark and light particles have no preferred position initially but dark matter particles probably tend to accumulate outside gravitationally bound objects because they move readily through other particles and have no way of losing kinetic energy. This flattens the velocity profiles. If the outer portions are dark, the luminosity will decrease with size. Many simulations of this type have been carried out that point

toward the existence of cold dark matter. In addition, gravitational lensing (the bending of light due to the gravity of cold dark matter also provide evidence that cold dark matter is real.

Dark matter

A "dark" particle could be the same mass as a neutron that does not decay and has zero "cross-section" for absorption. Duplication of particles was probably balanced in such a way that half of the particles were of one type and half were the other type. Reference 22 is the author's analysis of all the baryons and mesons. Understanding and modeling baryons and mesons requires balancing the properties of particles to zero by including duplicate energy opposites. This balancing would be expected to produce a proton "mirror image". See Section 11 Appendix 4, topic 11.

4.10 COMPARISON OF THIS MODEL WITH ACCEPTED VIEWS

The author's cellular model is the only model reviewed below that does not involve velocities larger than the speed of light (superluminal velocity) but of course as all cells expand they are carried away from each other at superluminal velocity. In three dimensions the cells that fill the volume repeat exp(60) times out to the edge of the overall radius for both the light and dark matter expansion. Each small cell contains one proton like mass on its surface and has a small expansion velocity (currently 2.26e-18 m/sec) determined by the base and expanded states presented above for gravity. The author's proposal is based on the inflation phase being identical to duplication of the particles by exp(180). Energy conservation and the source of the cosmic background radiation (CMB) will be addressed in later sections.

Conventional expansion models create space rather than move particles within space and represent space on a large surface rather than space between particles. Since all particles expand, the additive velocity is quite dramatic at the "edge" of the radius that contains the particles. Each light matter model suggests that "space is expanding and carrying light along with it", especially during an inflation phase and early expansion. The author's model labeled R1+R3 differs. A fundamental radius 7.35e-14 meters is defined by gravity and expands. Each radius is associated with a cell that has cosmological properties.

Cosmological parameters determined by the WMAP [11] and Cmagic projects [12] are summarized with rho critical=9.5e-27 kg/M^3. Important parameters updated by 9 year data [13] are Omega total=1, consisting of 0.718 dark mass, 0.235 mass and 0.0464 baryons. Hubble's constant was updated to 2.26e-18/sec. Surprisingly the Cmagic model concludes that the universe is accelerating even more rapidly than the WMAP model. Many have concluded that the source of the acceleration appears to be a cosmological constant that becomes increasingly important as expansion reaches the later stages. Since supernova data is based on luminosity of its "standard candle", the interpretation is mainly based on the final slope of the expansion. Both of these models are partially

supported by the "cosmological constant" historical discussions involving Einstein, Friedman, Mach and others [10].

The table below compares overall characteristics of the models.

Comparison of Expansion Models

Criteria	Proposal	Concordance
Expansion history	Same as concordance/Cmagic fundamentals identified	Concordance
	Current radius 6.3e25 meters	Current radius 6.3e25 meters
	Current H=2.2e-18/sec (WMAP)	Current H=2.2e-18/sec (WMAP)
Potential energy now	Identified as 20.3 mev source from ref Proton	several hundred mev source unidentified
Initial expansion kinetic energy becomes equal	potential energy yes	Planck scale
dark energy	no	yes-source growing
Dark matter	50% dark @ 1.67e-27 kg	yes 0.27 of total
	50% proton mirror	.044 baryons
		.73 dark
Inflation	Yes	yes
	identified as particle duplication	several proposals
Final State of Universe	"flat"	Expansion could continue
	about 4e26 meters	
	Time ratio =90	
Temperature at beginnin	7.60E+10	>1e10 degrees
	heat due to neutrons decaying	
CMB temperature K	2.73*(z-1)	2.73*(z-1)
	radiation source quantified	
Conservation of energy	yes	no
V/C in early Universe	Subluminal within cells	Superluminal
	(Space is expanded gravity r)	space is being created
Helium formation	Sakharov	Sakharov?
	(fractions of seconds after beginning)	
	He4 Fusion is accounted for	?
Mass Accumulation	accoustically initiated →	
WMAP interpretation	accoustic variation at decoupling →	
	power spectrum variations	
	Accumulation of dark matter in cluster augments gravitation redshift	

Figure 4:15 Comparison of Expansion Models

4.11 DETAILED ENERGY BALANCE FOR EXPANSION

The detailed energy balance/particle at different times in the expansion is shown below (all values are in MeV). The overall energy balance is zero during expansion, even though expansion kinetic energy has been converted to potential energy and kinetic energy inside the atom has been converted to external kinetic energy (temperature) due to fusion. Note also that the original neutron decays to a proton without any external release of energy. The reason is that neutrinos are produced that do not appreciably interact with matter. The Proton Mass model shows that the electron quad produces 27.2e-6 MeV of kinetic energy that balances a -27.2e-6 field. As the electron falls into the field, 13.6e-6 MeV will be released as light/heat. Likewise as mass accumulation occurs, some gravitational potential energy will be reconverted to kinetic energy. It is observed that particles falling into a gravitational potential eventually create lateral kinetic energy that allows orbits to be established. In this process, the fall positions the orbiting body at one half of its original height if its energy is conserved. It is clear that expansion kinetic energy is not reversed. Entries in the table could be changed slightly to reflect exactly where the kinetic energy is but the total of gravitational and kinetic gravitational will not change as a result of gravitational accumulation. Note that the kinetic energy to expand each cell is on the order of 9.8 MeV. Particles that fall into orbits as mass accumulation occurs often have kinetic energy/particle on the order of several MeV as shown in the following table for the mass of one proton attracted to a maximum central mass. Particles will fall half way to the center where they establish an orbit with inward and outward forces balanced.

ENERGY BALANCE PER PARTICLE AS EXPANSION OCCURS									
simple cell bk9		Fusion	Fusion		Gravitat	Gravitat	Electror	Total	
begin	Atoms/Str	ke	Heat	e/m	Kinetic	Potentia	neutrinc	mev	
MeV	MeV	MeV	MeV	MeV	MeV	MeV	MeV	MeV	
	131.46							131.46	mass
0	797.96	10.15	0		20.30	0	2E-05	828.41	ke
-2.68	-957.18							-959.87	pot
								0.00	total
after decay to P & fusion to helium				e/m					
(released a	129.54						1.18	130.72	mass
	798.58	8.52	1.63	3E-05	10.15	10.151	0.11	829.15	ke
-2.68	-957.18							-959.87	pot
							CMB	0.00	total
Now	6.26E+25								
	129.54						1.18	130.72	mass
	798.58	8.35	1.8	3E-05	1E-12	20.30	0.11	829.15	ke
-2.68	-957.18							-959.87	pot
								0.00	total
Near end	2.43E+26								
	129.54						1.18	130.72	mass
	798.58	8.35	1.8	3E-05	0	20.30	0.11	829.15	ke
-2.68	-957.18							-959.87	pot
								0	total

Figure 4:16 Overall Energy Balance

Cosmic microwave background (CMB) source

Using the Boltzmann relationship T (K)=ke/(1.5 B), it is possible to assign a temperature to kinetic energy. Cosmologists use the expansion ratio z to scale temperatures.

	KE temperature relationship			
	KE=1.5 B T			
		Beginning		Now
KE	MeV	9.8		1.26E-12
T=Ke/(1.5 B)	K	7.58E+10		9.75E-03

The temperature 7.6e10 K is similar to other literature [10][21]. However, starting with 7.6e10 K and scaling the other way gives the surprising present temperature of 0.01 K. Isn't the present temperature 2.725 K? Electromagnetic waves occur throughout expansion and accumulate. Incremental calculations were carried out for a cell based on the proton producing radiation energy, passing that radiation energy forward in time but reducing the value by expansion. Accounting for radiation, the temperature still follows a downward sloping line. This does not explain the low temperature 0.01K. However, nucleosynthesis of 25% of nucleons to He4 releases a significant amount of energy (1.61 MeV/particle). This increases the temperature as shown in the blue line below and subsequent expansion cools the cosmic background radiation to the measured value 2.73 K. The comparison red curve is from Reference 34. This literature does not increase the temperature when He4 fuses and follows a lower slope until decoupling.

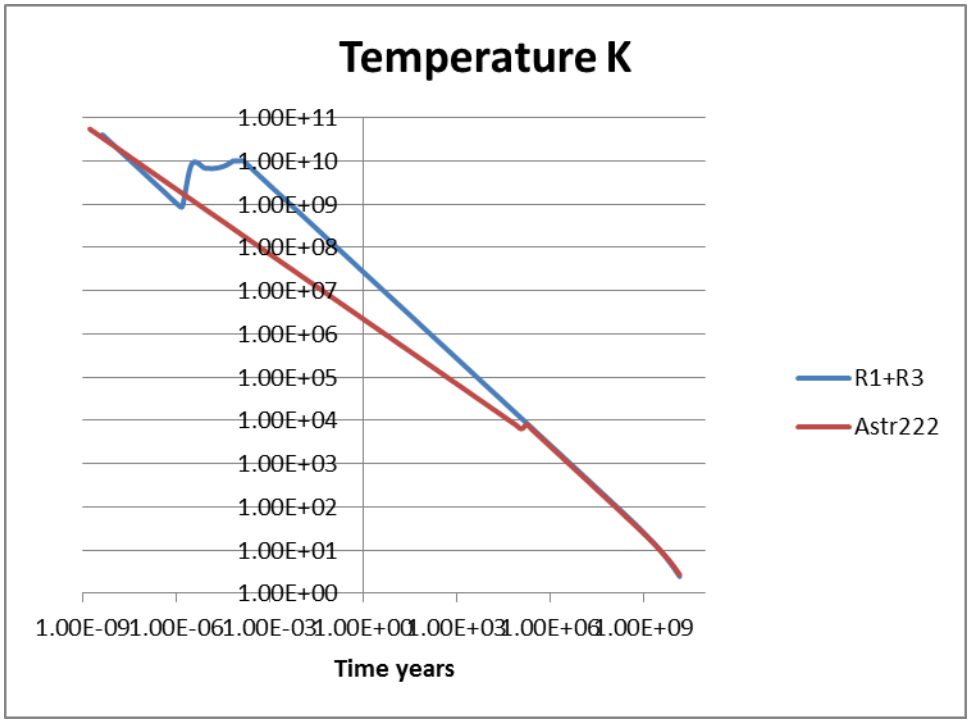


Figure 4:17 Expansion Temperature History including He4 Fusion

4.12 PRIMORDIAL NUCLEOSYNTHESIS

It is well known that approximately 23% to 25% of nucleons found throughout space are in the form of Helium4 atoms. The distribution uniformity indicates that these atoms were formed in the very early universe. In addition, trace amounts of Deuterium, Lithium3 and Beryllium7 are also uniformly distributed. These elements are evidence of a process known as primordial nucleosynthesis that has been well studied and documented. Early work by Andrei Sakharov suggested that high initial temperatures would fuse elements from primordial nucleons and "freeze" their abundances at the observed levels during expansion and cooling. Most literature gives 23% to 25% as the range of He4 and indicates that it is produced in the first 4 minutes or so. He4 releases 7.07 MeV/atom and 0.24*7.07 MeV=1.63 MeV. This is a significant energy compared to 9.8 MeV and adds to temperature.

The author explored a cosmology expansion curve called R1+R3 based on values found in a model of the proton [Section 2 topic 2.8]. The expansion curve is similar to the concordance model [10] with WMAP parameters [11][13]. Temperature histories that include He4 fusion energy all increase to temperatures that photo-disintegrates deuterium leading to potential difficulties explaining measured residual fractions. Topic 4.12.1 explains when residual primordial deuterium originated in the R1+R3 model.

The R1+R3 expansion model starts at a kinetic energy of 9.8 MeV/particle, has omega baryons (protons) =0.5, omega dark matter =0.5 and dark energy =0. The associated temperature history decreases initially but as He4 fusion occurs, the temperature increases before finally decreasing to 2.73 K due to expansion. Surprisingly, literature was found [34] that does not account for fusion energy of He4. In addition, there are claims [10][21] that residual deuterium is a sensitive test that rules out cosmologies that contain more than 0.04 baryon fraction. The view that conventional mass is only 4% of the observed universe, with the remainder "missing" is becoming widely accepted. Another goal was to investigate the claim that a low photon/baryon ratio is required to match measured residual deuterium.

Photo-disintegration of Deuterium

Initial deuterium fraction is limited by photo-disintegration [10][21]. It is well known that deuterium readily fuses to He4 after the temperature falls to approximately 1e9 K. However when He4 fuses energy is released once again the temperature increases to levels that photo- disintegrates the remaining deuterium. This leads to difficulties explaining when the measured residual primordial deuterium originated.

The SAHA equation [10] is utilized to give the early deuterium fraction. D is the deuterium number, N is the total number of nucleons, p' is the proton number, n' is the neutron number, Ob is 9.5e-24 and T is temperature in degrees K.

SAHA=ln((D*N)/(p'*n')=-(25.82-ln((Ob)*(T/1e10)^(3/2))-2.58/(T/1e10)))

The results below answer the question, "where does the measured residual deuterium originate?" Fusion in stars is from hydrogen. The hydrogen contributes protons that must be converted to neutrons by energetic electrons. This is quite a different situation than exists for the first few minutes following primordial He4 formation. In this environment there were still a large fraction of neutrons that had not decayed. A graph of the SAHA criteria for deuterium formation is shown below. The SAHA criteria used is the natural logarithm of the SAHA value. As the SAHA criteria increased to 0, He4 fused and T9 (the temperature divided by 1e9 K) increased. With the addition of fusion energy, the SAHA criteria became negative again and caused photo-disintegration of deuterium. The temperature finally fell due to expansion and the SAHA criteria rose to 0 where deuterium was again formed. It is this deuterium that we measure uniformly throughout space at an abundance fraction of 1e-5.

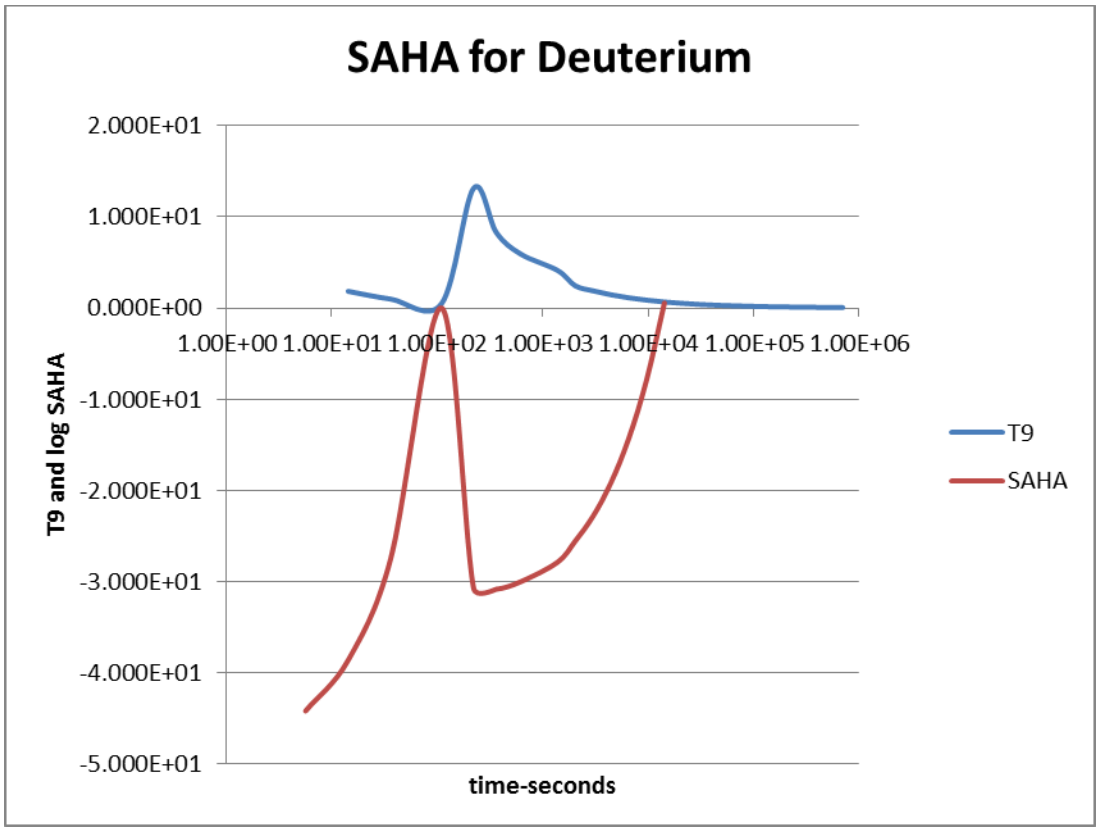


Figure 4:18 SAHA Criteria for Deuterium Photo-disintegration

Primordial fusion of He4 releases a significant amount of energy and must be included when determining temperature curves associated with expansion. After formation of He4, the temperature rises and photo-disintegrates the deuterium. Subsequently, the temperature decreases and deuterium is once again produced. The author's calculations for the deuterium abundance with the R1+R3 model agree with measured values. Section

4 topic 4.8 above concludes that Omega baryons=0.5*exp(180). Simulations of observed primordial nucleosnythesis are substantially consistent with this value and there is no reason to believe that a low baryon/photon number density limits Omega baryons to 0.04 as literature suggests. Details are in reference 25.

4.13 WMAP DATA ANALYSIS USING THE PROPOSED EXPANSION MODEL

Equations from topic 4.3 result in a cosmology model the auther calls R1+R3 allowed a detailed re-analysis of WMAP [11] data. Results (Figure 4:6) are compared in this section. Spot size (anisotropy in the CMB) is a measurement of decoupling radius. According to literature acoustic waves start at equality and are visible at decoupling. The time between these two transitions allow waves to travel 3.18e21 meters at velocity of 3e8/3^.5=1.73e8 meters/second. This gives the estimated size of the spots when they were visible. WMAP reported decoupling at 2970K. Knowing that the temperature ratio is 2970/2.725=1090, the expansion ratio for the spot at decoupling must also be 1090. From the temperature ratio between decoupling and now, it can be inferred that the spots are now 4.3e24 meters.
The highest temperature peak was observed by WMAP against the full sky and the angle the spot subtended was 0.598 degrees or 0.0105 radians. (pi radians per 180 degrees). This measurement allowed an estimate of the size of the universe of about 7e25 meters if the author is interpreting their papers properly. Details of the WMAP analysis are presented below:

WMAP Reported and derived values	
3196	z equality
1090	z decoupling
302.4	acoustic scale
14.116	da angular size dia gigapc
6.920E+22	radius at decoupling meters=14.116*3.08e19/pi
146.6	sound horizon mpc (3.08e19 meters/megaparsec)
4.515E+21	sound horizon (spot size) meters=146.6*3.08e19
4.922E+24	Wmap spot size now=1090*4.5e21
0.0104	spot size in radians=4.5e21/(6.9e22*pi())
7.542E+25	Universe radius now=4.9e24/.0104/(2*pi())
2.301E-18	Hubble's constant =71/3.08e19
13.75	Age of Universe Billion years
6.92852E+25	
7.542E+25	

Figure 4:19 WMAP Reported Spot Size

The author's detailed results presented below compare favorably.

R1+R3 model details:		
Equality	4.61E+12	seconds
Decoupling	2.33E+13	seconds
Radius at decoupling	4.80E+22	meters
Wave travel time (delta	1.87E+13	seconds
Radius of spot R=V*de	3.23E+21	meters
Radius of spot*Rnow/R	4.10E+24	meters
angle of spot radians	0.01071	spot now
	(pi*Radius)/2	
Radius of Universe No	6.10E+25	meters
Now (at matching H0)	2.202E-18	

Figure 4:20 R1+R3 CMB Spot Size Simulation from Figure 4:10

4.14 MASS ACCUMULATION

Plasma exists until the temperature drops enough to allow electrons to form orbits around protons. Radiation pressure prevents gravitational accumulation until radiation is attenuated by expansion. Eventually gravitational forces become dominant and accumulation of mass into clusters, galaxies and clusters begins. It is clear from WMAP that amplification of matter acoustic waves is the primary mechanism that starts mass accumulation. The concentration process later allows stars to "light up" with fusion when they become dense and hot. This is known in the literature as re-ionization. Stars burn up their hydrogen and follow the well documented aging cycle that depends on the kinetics of progressive fusion reactions. Literature cites measurements regarding the abundance of the heavy elements that are produced by these reactions. Once density develops conventional gravitation7al accumulation continues. The approach below should be considered estimates since it is very difficult to calculate processes that are probabilistic.

4.15 FORMATION OF CLUSTERS, GALAXIES AND STARS

The gravitation force from galaxies causes gas to form an orbit from which stars "condense" into large bodies. In the sun and other places where enough temperature (kinetic energy) exists, protons come close enough to "fall into" each other's weak energy deficit. Under these conditions, the proton gains energy. Specifically, it must take in high energy from the environment it operates to initiate fusion. The theory reported in section 5 provides a model of the binding energy curve and fusion kinetics. As the solar process continues stable atoms of heavier atoms are formed. This process is explained and modeled in detail in the section 5.2 that predicts abundance of the elements.

Partitioning the volume into clusters

Accumulation of mass obeys conventional kinematics and Newton's law as bodies fall into gravitational fields. The final state appears to consist of clusters, galaxies, stars and

planets interacting gravitationally in a way that a new semi-stable state is achieved. That state is ideally nested "orbits" in which forces are balanced. Overall movement in the resulting orbital state is neither overall expansion nor contraction. The numbers of spots in the WMAP analysis were probably the seeds of clusters. If the spots represents spheres of early accumulation, the number of spots is (Runiverse/Rspot)^.333 and equal to 2.6e4. WMAP results suggest that the dense (cool) spots observed are associated with clusters in the era of decoupling. This would place the mass of clusters in the right range. (1e47 kg).

Number of Galaxies and Stars

The source of information for the following table is Figure 4:21 above. The ratio of pi*spot size/Jeans wavelength is approximately 1.8e6 according to the following "estimates". (Estimates (in red) are presented with empirical constants for demonstration purposes). If clusters are approximately 1e47 kg, the galaxies would be about 5e40 kg.
At decoupling wave speed drops dramatically as the plasma clears. The Jeans length falls to a fraction of 1e18 meters. This divides the clusters into smaller disturbances that with time form stellar masses due to fractionation of the Jeans length. This divides the 5e40 galaxy mass by about 1e11, giving a maximum probability star mass of 5e29 kg [10].

Detailed WMAP ratios give number of clusters & stars				
Taking values from tab		R1+R2	4.80E+22	
Number of clusters/universe			**2.6E+04**	
		spot (m)	1.62E+21	
		spot*2 (m)	3.23E+21	meters
Number of galaxys/cluster			**1.8E+06**	
	Jeans lo sp	1.33E+18	2.67E+19	meters
red-empiric	Jeans hi sp	5.00E+22		
		Jeans lo (n	2.67E+19	meters
stars/galaxy			**1.1E+11**	
	Jeans fract	1.33E+18	5.60E+15	
http://en.wikipedia.org/wiki/Jeans_instability				

Figure 4:21 Number of Clusters, Galaxies and Stars

Detailed WMAP ratios give mass of clusters & stars based on M universe		
Universe mass (kg)		
1.67e-27 kg*exp(·	2.5E+51	Kg Universe
((4.8e22)/1.62e21	9.5E+46	Kg Cluster
((3.76e21)/2.67e1	5.3E+40	Kg Galaxy
	4.0E+10	numb galaxy
(2.67e19/5.6e15)·	5.0E+29	star mass
	5.0E+21	number stars

Figure 4:22 Mass of universe, clusters and stars

The mass distribution of stars [10] is well estimated by their life cycle data and once again the approach above gives about the right average. Pebbles gives the most prevalent stars a mass of 5e29 Kg. As indicated by photography, galaxies and stars are still in the process of development. Mass accumulation at the star level is from material that has been recycled and concentrated from earlier generations. Spiral galaxies are apparently good concentrators and star development is not only cyclical but very incomplete at the present time as evidenced by Hubble photography. Star counts and surveys of matter indicate that only a small fraction is visible.

Neutron Decay

There is another event occurring during early expansion. The neutron is decaying with a half-life of 886 seconds. The author's neutron mass model changes to the proton mass model with the release of a neutrino with energy 0.671 MeV and an electron (0.551 MeV+.1114 ke) with energy 0.662 MeV (0.671+0.622=1.293). Most of this energy is particles and the end of this event is at about 6000 seconds and at the end of expansion. If it is accounted for as a temperature, the temperature at the end of expansion would be 3.79 K, not 2.73 K. This is important because the photon + neutrino + electron "temperature" is 1.39 times the photon only curve. Temperature is to the power 3 in the equation: Photon density=K*T^3 and this means photon density is 2.68 times higher than 2.725 K based photon density. This small change allows the baryon density to be 0.5 while baryon/photon density is the accepted value 6e-10. These temperature curves are quite meaningful to the question of what kind of mass WMAP is dealing with. Hot matter (protons and electrons) emit radiation, decays from neutrons to protons and partially fuses to He4. The temperature would not jump to the accepted curve if it were cold dark matter.

4.16 COSMOLOGY SUMMARY

1. Expansion and associated energy changes were evaluated using a cellular model based on two expansion components. In this model, there is one proton like mass/cell and all cells are formed by identical laws. Inflation is defined as duplication by exp(180) supported by the cosmological principle. The model predicts that a large radius of 6.3e25 meters characterizes the universe. This agrees with the concordance model using measured values from the WMAP project. The author believes that space is created by exp(180) cells each with an initial radius of 7.35e-14 meters expanding to universe size space.
2. The Proton Mass model is an accurate source of constants for cosmology, including expansion kinetic energy. The manner in which 9.8 MeV gives initial temperatures consistent with He4 formation yet predicts a final temperature of 2.73 K is remarkable. The kinetic energy is enough to expand one half the cells to their present radius of 0.55 meters against gravitational resisting force in a way that kinetic energy is converted to potential energy. Based on the author's WMAP re-analysis, equality of matter and energy density occurs with 0.5*exp(180) protons/m^3.
3. The second expansion component developed late when resisting forces were low. The calculated energy (known as dark energy) was negligible and the author believes that critical density estimates from the equation containing H^2=8/3 pi G rhoC must be revised downward to 2.7e-27 kg/m^3. WMAP identifies density fractions as dark energy (0.72), cold dark matter (0.23) and baryons (0.05). Re-analysis in this document supports the values 0, 0.5 and 0.5 respectively. Cold dark matter could be a "mirror particle" of the proton that interacts only gravitationally.
4. There does not appear to be any missing matter. Dark energy (72% of the problem) is addressed in point 3 above. Cold dark matter is half the baryon fraction and protons are the other half. The author's re-analysis of WMAP data indicated that the proton fraction could be 0.5 and still be consistent with equality and decoupling. Including He4 in the primordial nucleosynthesis changes where residual deuterium forms. The author could find no reason that a low baryon fraction was required to match measurements.
5. Analysis of equality and decoupling using WMAP concepts show that the calculated spot size gives the reported value 0.0109 radians. Also, the spot temperature agrees substantially with the measured value for the first maximum.

5 SECTION 5 BINDING ENERGY AND ABUNDANCE OF ELEMENTS

The author made some bold claims in Section 2 regarding energies associated with the four forces. In particular, the author could not find an exact value for the weak energy in the literature. If the energy deficit 20.3 and kinetic energy 10.15 MeV have merit, we should be able to use them to model binding energy for which very accurate measurements have been made (several significant decimal places). Also, if the language of nature is information (probability) it should apply to these fundamental processes.

5.1 BINDING ENERGY MODEL

The goals of this section are to verify the value 10.15 MeV and present a simple model of atomic binding energy. Literature cites "water drop" models for binding energy that are admittedly empirical. Quantum physicists have suggested that there should be "electron like" shells inside atoms but to the author's knowledge they remain unclear. If there are shells the nucleons should fall into lower energy states releasing the remainder as binding energy. The author explored this possibility. Empirically, the model was successful but no explanation could be found for why a nucleon occupied a given shell. The first part of the binding energy curve rises quickly and then levels off as saturation occurs. When the author compared the shape of the curve to a probability based model a simple relationship was discovered. The basic relationship is again P=1/exp(N) presented in Section 1.

Information contained in the Proton Mass table

Information from the proton mass model is used to understand fundamental interactions. The energy values in the box add to the exact mass of the proton (938.2703 MeV). There are three main components, each with a mass and kinetic energy. The total mass and kinetic energy on the left side of the box (959.56 MeV) is balanced by fields on the right hand side of the box.

Mass, Kinetic Energy and Fields for Proton						
					Gravitational	
		Residual ke				Field
Mass	Difference KE		Expansion		Strong field	
mev	mev	mev	mev	KE	MeV	MeV
101.95	641.88				-753.29	
						-0.69
13.80	78.69				-101.95	
						-0.69
13.80	78.69				-101.95	
						-0.69
		10.15		20.30	expansion pe	
e				0.00	expansion ke	
		-0.67	0.67	v neutrino		
129.54	799.25	938.27	PROTON MASS			
0.51	0.11	e neutrino			0.00	-0.62
ELECTRON		2.5E-05				
130.05		938.27	0.67	20.30	-957.18	-2.68
				Total m+ke		
					Total Negative	
0.51	0.11	938.27	0.7	959.87	-959.87	0.00
				MeV	MeV	Net MeV

Figure 5:1 Repeat of Proton Mass Model

Orbital kinetic energy in the proton

The quark mass plus kinetic energy from the model is 129.5+799.25-.67=928.12 MeV. There is however, an additional kinetic energy of 10.15 MeV that makes up the total mass of the proton (938.27 MeV). This value changes during fusion.

The proton and neutron mass models have a total energy of 959.86 MeV, but the neutron only has only 939.56 MeV. The total energy balance is zero if we consider the 20.3 deficit (959.86-939.56) as a field that surrounds the central mass similar to the manner in which the electromagnetic field surrounds the electron and proton. As nucleons fall into the weak field, the released energy binds the neutrons and protons inside atoms.

Fundamental release of atomic energy

Section 1 identifies exp(180) as the number of protons in the universe based on the results of WMAP [11]. This makes the probability (P) of one proton 1/exp(180). The author believes that nature uses Shannon [15] type information theory and makes N=-ln(P) a fundamental number in the language of nature. Section 2 shows how nature's

particles relate to N=180. For example, the electron, energy and N are related by the relationship E=e0*exp(N) where the number N=10.136 represents the electron since E=2.025e-5*exp(10.136)=0.511 MeV, the energy of the electron. In other words e0/P is the electron energy where e0=2.025e-5 MeV and P=1/exp(10.136).

The fundamentals of binding energy appear to be based on the same approach. For example, the probability of a neutron in lithium3 is given by P=1/exp(2/3). The 2 means there are two types of particles (protons and neutrons) and 3 is the number of neutrons for lithium. Next N=-ln(P)=2/3. Note that in this case N is a number smaller than 1. Following a similar approach in the paragraph above, energy would be modified by P to give the energy release. The value e0 is 10.15 MeV for binding energy, the value given above for "kinetic energy in the neutron orbit". Energy release for the neutron contribution to lithium is 10.15/exp(2/3)=5.21. In the table below the basic probabilistic approach above is applied to the fundamentals of atomic binding energy. Note that heavy atoms can have over 144 neutrons which give a potential release of 10.01 MeV of atomic binding energy, indicating that the curve is approaching "saturation" at 10.15 MeV.

P neutrons			e0=2.025e-5 mev	
neutron	P =1/n	N=- lnP	E=e0*exp(N)	
1E+78	6.71E-79	180		
	P electron			
	3.96E-05	10.136	0.511	Electron
P energy release			e0=10.15	
neutron	P=1/exp(2/	N=-ln(P)	E=e0/exp(N)	
3	0.51	0.67	5.21	Lithium
144	0.99	0.01	10.01	Plutonium

Figure 5:2 Fundamentals of Binding Energy

The values based on the fundamentals above (5.21 for Lithium and 10.01 for Plutonium) will be called the "fundamental release" of atomic energy.

Consider now that neutrons are re-converted protons and both release a part of 10.15 MeV as they fuse. The following calculations illustrate that the total fundamental release is the weighted contribution from the protons and neutrons. The weighted average is darkened in the table below. All energy is quoted in MeV (million electron volts).

protons	(10.15*EXP(-2/protons))			
p		neutrons	(10.15*EXP(-2/neutrons))	
1	1.374	n		1.374
2	3.734	2	3.734	3.734
3	5.211	4	6.156	5.751
4	6.156	5	6.804	6.516
5	6.804	6	7.273	7.060
6	7.273	7	7.627	7.464
7	7.627	8	7.905	7.775
8	7.905	9	8.127	8.023
9	8.127	10	8.310	8.224
10	8.310	11	8.463	8.390
110	9.967	272	10.076	10.044
			(weighted average)	

Figure 5:3 Example calculations for binding energy

Lithium7 has 4 neutrons and 3 protons and the calculation above gives a total binding energy of 5.751 MeV.

release=(p*10.15*EXP(-2/p)+(n*10.15*EXP(-2/n))/(p+n)
Li7 release=5.751=(3*5.211+4*6.156)/7

This is close to the NIST [27] value of 5.644 MeV but the difference is significant and there are two additions needed. The binding energy curve is based on two additional processes: retained energy and isotope number energy.

The re-conversion process

Reference 2 reviewed the neutron to proton decay (conversion) process N > P e- av ke (e- , av and ke refer to the electron, the anti-neutrino and kinetic energy required to balance the process). The electron quad table (reproduced below) indicates that the electron initially has 0.111 MeV of kinetic energy (explained in section 2).

As a proton, the electron quad of the Proton Mass model contains these energies:

N	E (MeV)	N	E (MeV)	E (MeV)	E (MeV)
		-0.30	-2.72E-05		
		equal and opposite charge			
10.41	0.67	0.07			
-10.33	0.00				
the electron separates here					
10.14	0.51	10.33	0.62	**0.51**	0.11
0.20	0.00	0.30	2.72E-05	ELECTRON	

But as a neutron, the electron quad of the mass model contains these energies:

10.41	0.67	0.07	
-10.33			
10.33	0.62	0.00	0.00
0.00	0.00	10.33	0.62

The decay energy balance can be written N (939.565 > P (938.272) + e- (0.511 +.111) +av (0.671). (This accounts for the neutron/proton mass difference of 1.293 MeV). This process is reversed during fusion. The neutrino (v) energy of 0.671 MeV is ejected according to the binding energy model, but regained during re-conversion. At high temperature and pressure there is a chance that the electron/proton can regain the 0.111 ke lost from the decay. The reverse process for the proton to neutron re-conversion is as follows: P (938.272) + e- (0.511) + ke (0.111) >N (938.27) + v (0.671). The re-converted neutron undergoes a properties re-conversion and reverts to a neutron from the standpoint of charge, etc. The kinetic energy it absorbs is the "difference kinetic energy" (0.111=27.2e-6+.622-0.511-2.4e-5). Since it is a subtraction of four values linked with the electron quad, some of the values contain properties (spin and charge) that balance the re-conversion. The proton actually gains the two energy values lost in the decay process from a neutron to a proton (energy 0.6709+0.6224=1.293 MeV. The electron is absent after the conversion to a neutron. It is converted to energy 0.622= 0.511+0.111 MeV. Re-conversion and a gain of energy on the order of 0.111 are pre-requisites for fusion. The process involves new neutrons and protons falling into weak field energy. More than half of the incoming protons become neutrons because neutrons can lose more energy. (See topic 5.1). The other portion of the incoming protons is accepted without conversion.

Summarizing, the requirement for fusion is that the environment must provide energy. In this model, if the electrons and protons gain 0.111 MeV and are densily packed they fuse. This amount of energy required is large compared to the kinetic energy available from even a very hot environment. For example the sun's core temperature of 1.5e7 degrees K provides 0.002 MeV. (A probabilistic process appears to limit the reaction rate. A simplified way to think about this is a Boltzmann probability P:
P=exp(-.011/0.002)=1e-11, where -0.011 MeV is a barrier energy and 0.002 MeV is kinetic energy from the environment. The low probability that the barrier energy will be achieved helps understand why fusion only occurs in very hot places (a description of solar fusion is contained topic 5.2). The barrier energy is very simple in this model. It is the retained kinetic energy described below.

Retained kinetic energy or barrier energy

The incoming protons gain energy from their environment (i.e., the core of the sun). When energy conditions allow, protons are accepted into the developing atom and they retain part of the supplied energy. After considering the fundamental release, the binding energy falls with increasing atomic number (and is quite evident for large atomic

number) as more energy is retained inside the atom. Retained energy follows the relationship: Eretained (MeV) = -0.101/4*protons. This is related to the value 0.111 given in the proton mass model as the kinetic energy of the electron. This energy may be stored in compressed charges (literature refers to a coulomb barrier since protons resist bringing more positive charge into the nucleus). Retained kinetic energy becomes the barrier energy (BE) for fusion.

Addition for isotope number

Without a second addition, the difference between the published and predicted value cycles slightly within one atomic number for the several isotopes of that atom. The section below entitled "Prediction of excess neutrons" below is the source of the correction for the isotopes. Neutrons release slightly more energy than protons and the isotopes either have an excess or deficit of neutrons. The following equation gives the addition:

Addition for isotope number= 1.293*(exp(excess neutrons/220)-1) MeV. Excess neutrons equal the predicted number of neutrons minus actual number. Predicted neutrons=(protons+neutrons)/(exp(1.293/(Eretained)). Of course 1.293 MeV is the difference in energy between the neutron and proton.

Binding energy results

The following data is a combination of NIST [27] data for published binding energy compared against the author's binding energy model. Two additions (the additions are usually negative numbers) were made to the fundamental release. To summarize, binding energy =weighted fundamental energy release+retained energy+isotope number energy.

There was another correction sometimes required that the author believes can be easily identified. Some of the predicted values are multiples of 0.111 MeV higher or lower (this is the energy associated with the electron kinetic energy that initiates fusion). This correction only appears in the steeply rising portion of the curve. In addition, there were two atoms that were obviously different. The fundamental release from Helium (2,2) was exactly doubled. Secondly, it appears that Carbon (6,6) retains an extra 0.622 MeV.

			-0.00067	electrostatic retention	
			0.017409	isotope n correction	
			Pub BE-pr	Binding Energy	
	prot	neut	mev	Published	prediction
H	1	0	0	0	0
D	1	1	-0.03714	1.115051	1.152194
T	1	2	0.000224	2.914766	2.914543
He3	2	1	-0.02023	2.489848	2.510077
He4	2	2	-0.04539	7.075042	7.120429
Li	3	3	0.006003	5.334028	5.328025
Li7	3	4	-0.02211	5.64441	5.666515
Be	4	5	-0.0108	6.492464	6.503259
B	5	5	-0.00188	6.476361	6.478242
0	5	6	0.028574	6.952107	6.923533
C	6	6	0.039666	7.681103	7.641437
	6	7	-0.0071	7.490528	7.49763
	6	8	-0.00632	7.557838	7.564159
N	7	7	0.03027	7.47663	7.446361
	7	8	0.0314	7.717454	7.686054
O	8	8	-0.01434	7.977084	7.991424
	8	9	-0.0435	7.766718	7.81022
	8	10	-0.0175	7.796393	7.813894
F	8	11	-0.04432	7.861472	7.90579
Ne	9	11	0.029683	8.09777	8.068087
	10	11	-0.04443	7.984761	8.029189
	10	12	0.007449	8.104534	8.097086
Na	11	12	-0.02063	8.123431	8.144058
Mg	12	12	-0.02294	8.261501	8.284439
220	12	13	-0.00394	8.234534	8.23847
	12	14	-0.02984	8.354309	8.384146
Al	13	14	0.025146	8.341799	8.316652
Si	14	14	0.006674	8.448492	8.441818
	14	15	-0.02128	8.458196	8.479474
	14	16	0.023813	8.53842	8.514607
P	15	16	-0.04372	8.490166	8.53389

Figure 5:4 Partial list of Binding Energy Comparison

				average
				stand dev
				Energy
	prot	neutrons		retention
H	1	0		0
D	1	1		-0.02534
T	1	2		-0.02534
He3	2	1		-0.05069
He4	2	2		-0.05069
Li	3	3		-0.07603
Li7	3	4		-0.07603
Be	4	5		-0.10137
B	5	5		-0.12672
0	5	6		-0.12672
C	6	6		-0.15206
	6	7		-0.15206
	6	8		-0.15206
N	7	7		-0.1774
	7	8		-0.1774
O	8	8		-0.20275
	8	9		-0.20275
	8	10		-0.20275
F	8	11		-0.20275
Ne	9	11		-0.22809
	10	11		-0.25344
	10	12		-0.25344
Na	11	12		-0.27878
Mg	12	12		-0.30412
220	12	13		-0.30412
	12	14		-0.30412
Al	13	14		-0.32947
Si	14	14		-0.35481
	14	15		-0.35481
	14	16		-0.35481
P	15	16		-0.38015

Figure 5:5 Retained energy (Barrier energy)

Figure 5:4 contains the difference between the latest NIST [27] binding energy data minus the binding energy predictions. The predicted binding energy contains an extra retention of 0.111 MeV for a few atoms. The remainder of the atoms were calculated but not presented here for brevity. For all 351 atoms (includes most isotopes), the standard deviation was 0.017 and the average from zero was -0.0006 MeV. Since the predicted values are very close to the published binding energy, the points overlie each other and there was no need to present the predicted curve. Retained energy for binding energy becomes the barrier energy for fusion since the lost energy must be returned. This value will be used extensively in topic 5.2.

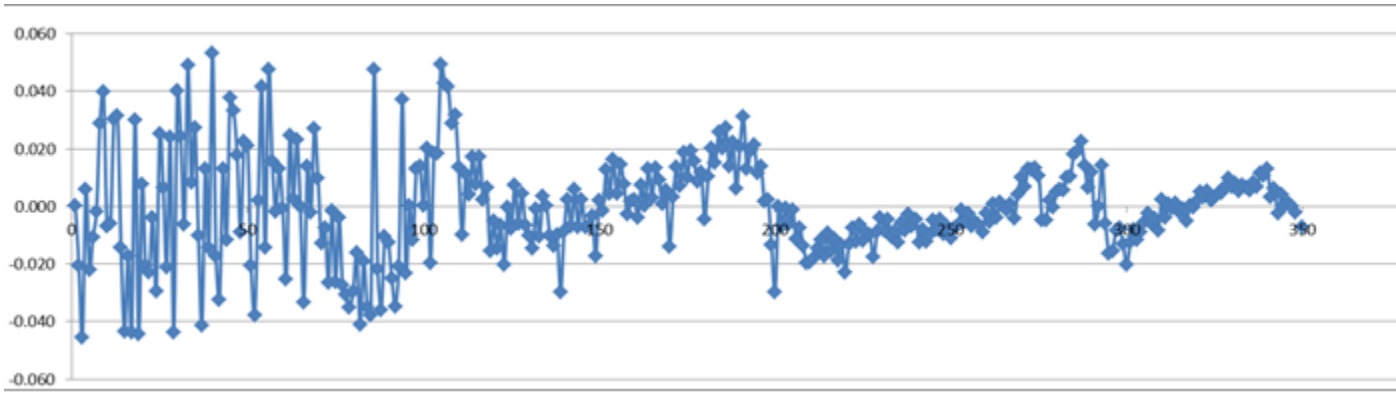


Figure 5:6 Binding Energy Accuracy (MeV)

The more meaningful graph is the above deviation for the 351 atoms. The vertical axis is published binding energy minus predicted binding energy in MeV.

It is instructive to show the binding energy for the proton and neutron separately since it shows that the neutrons give up almost all of their kinetic energy. The proton release is less since energy is retained as described above.

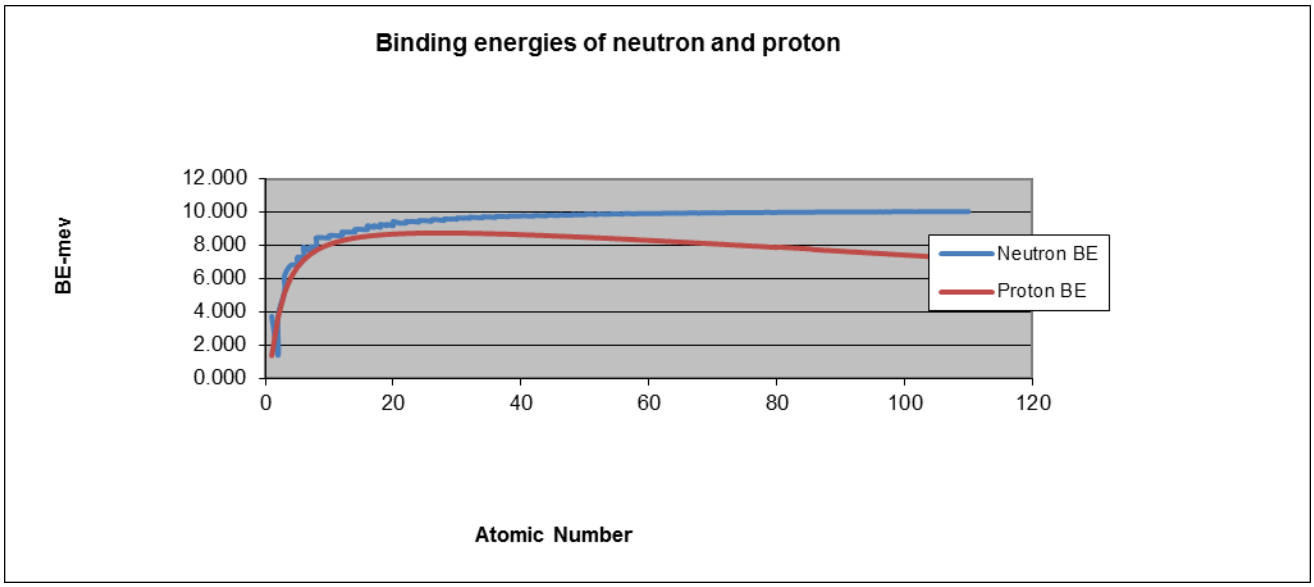


Figure 5:7 Binding Energy Curves for the Proton and Neutron

Prediction of excess neutrons over protons with increasing atomic number

Excess neutrons are produced because they can give up more energy. Prediction of excess neutrons is simply a function of the energy that protons retain. Based solely on this parameter, the number of neutrons can be predicted from the number of protons.

Predicted neutrons=protons+protons/(exp(1.293/(Eretained))

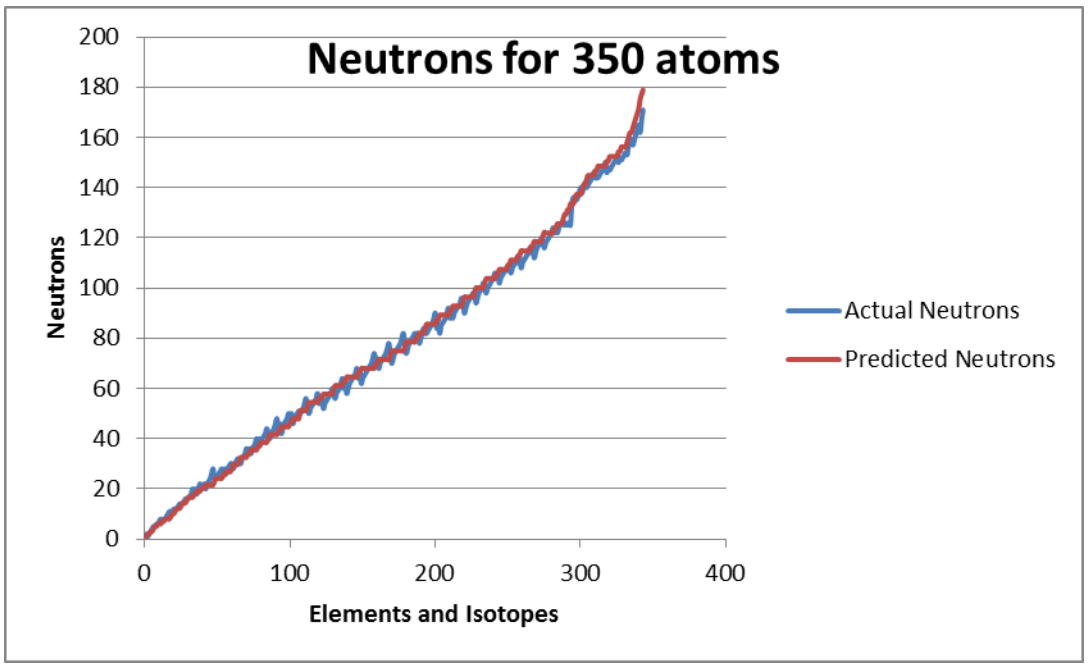


Figure 5:8 Prediction of Excess Neutrons

Note the ripple in the actual number of neutrons. This was the basis for the isotope number correction described above under the heading "Addition for isotope number".

Summary

A proposal regarding how nature releases binding energy is offered as verification of the proton kinetic energy value 10.15 MeV and the energy 0.111 MeV associated with the electron. This value originates in the Proton Mass model. A simple probabilistic model agrees with NIST data to within 0.017 MeV standard deviations when the two additions are applied.

5.2 ABUNDANCE OF THE ELEMENTS

Fusion is an important process in nature. It the abundance of elements measured throughout the universe. Fusion powers the sun and is important in aging of the stars and other high density, high temperature processes. A binding energy model for atoms is extended in this section to abundance of the elements produced in stellar burning phases. Of particular interest was a model that was largely independent of measured parameters and based on probabilities.

Section 4 presented a temperature history for expansion that was similar to other cosmologies. A short time later (on the order of seconds) the author's R1+R3 model produces temperatures in the range of 1e9K from the initial kinetic energy 9.7 MeV cited in Section 4. Plasma exists until the temperature drops enough to allow electrons to form orbits around protons. Eventually acoustic and gravitational forces become dominant and accumulation of mass into clusters, galaxies and clusters begins. The concentration process later allows stars to "light up" with fusion when they become dense and hot. This is known in the literature as re-ionization. Stars burn up their hydrogen and follow a well-documented aging cycle that depends on the kinetics of progressive fusion reactions. Literature cites measurements regarding the abundance of the heavy elements [26][27] that are produced by these reactions.

Fusion fundamentals

Fusion is based on a proton and electron with kinetic energy from its environment colliding with an existing proton or atom. Since the proton and the existing atom are positively charged they repel one another creating a barrier for fusion. Section 5 discusses fusion, binding energy fundamentals and accurately models data from reference 27. To match the barrier energy (BE), the proton and its associated electron must gain energy from the temperature of the environment but they also must be at high density. This prompts the properties exchange and nil release (0.511+0.111-0.622) that characterizes the re-conversion process to neutrons for about half of the protons. The barrier energy (BE) is simply the retained energy for the protons (topic 5.1.5 above).
If he temperature is low only some atoms will achieve the barrier and fuse. Boltzmann's approach to equilibrium kinetics characterizes the process even though it may involve several reaction paths. This probability can be characterized by the expression Pbarrier=exp(-BE/Environment energy)=exp(-BE/(1/5B*T).

Barrier Energy

The author's binding energy model [Section 5 topic 5.1] results in barrier energy (BE) values for all of the elements.
BE (MeV)=-0.101/4*number of protons
Barrier energy is the retained energy column 6 of figure 5:5. The results are reproduced below. Since the barrier energy becomes increasing restrictive there are very few large atoms found in nature and gold is scarce.

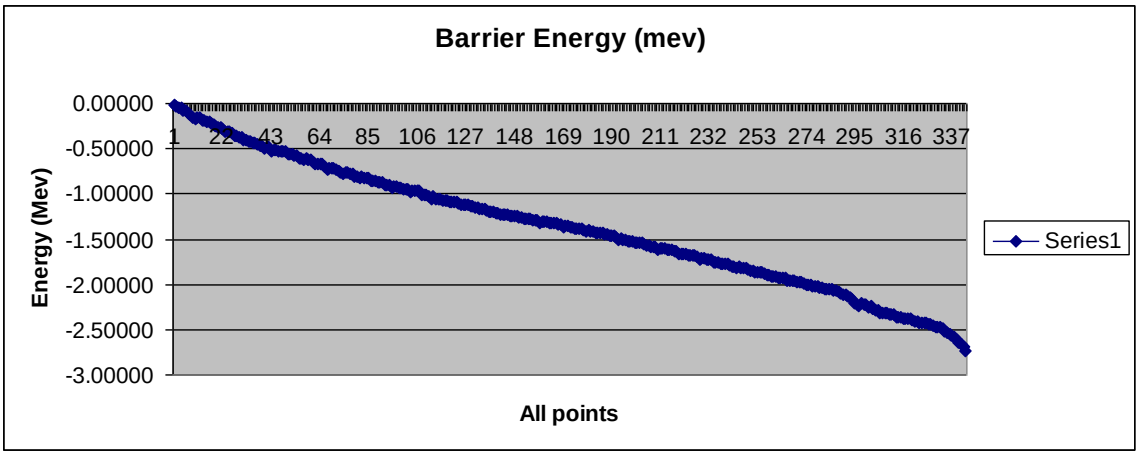


Figure 5:9 Barrier Energy of Atoms

All points means all atomic numbers for elements and their isotopes.

Fusion probabilities

Specifically energy of the environment is the MeV of the electron that it gets from temperature. Reactions that have lower barrier energies are more frequent and this is the basis for the cosmic abundance of the elements. The proposal is as follows:

Probability of fusing/sec=P barrier * P density ratio *reaction rate

Number of protons fused= probability of fusing/sec * number of protons* delta time

Pbarrier= exp(-.011/(1.5*B*T)

Where -0.011 MeV is the barrier energy for the reaction that converts hydrogen to helium/deuterium but each atom has a unique BE.

Boltzmann's constant=8.62e-11 MeV/K

Probability related to density:

At higher density (density ratio) more atoms are present to undergo the reaction. The density ratio is formed from (density/max density). (Maximum density is the initial density associated with time zero radius 7.35e-14 meters and the mass of a proton. For 50% hot matter:

Max Density=(0.5*1.67e-27/(4/3*pi*7.35e-14)=5.02e-11 kg/m^3).

Probability of reaction/second:

The number of reactions is also dependent on how fast each reaction can occur (number of reactions per second). The reaction speeds up if an electron can cross a barrier radius and reach the nucleus more quickly. The radius is the degenerate radius 5.29e-11/degeneracy where degeneracy is (density/2699)^.33. The value 2699 is the density for protons just separated by the electron orbit 5.29e-11 meters. The velocity is v=C*(1-(0.511/(0.511+ke))^2)^.5.

This makes the probability of a reaction in rate/sec:

Reaction Rate=velocity/(2*pi*degenerate radius)/exp(60)

The value exp(60) is the delay "entropy".

Mesons and baryons also have delay "entropies" based on N for their fundamental components [22].

Solar Example

In the following example, the proposed fusion model is applied to the sun. The core density in the sun is about 1.3e5 kg/m^3 [31] and the temperature is about 1.6e7 K.

Solar example			
Temp	deg K	1.59E+07	
Density	kg/m^3	1.28E+05	
Dmax kg/m^3		5.02037E+11	
KE temp	1.5*B*T	0.002055756	
degeneracy		3.62	
Degenerate radius		1.46171E-11	
v/c		0.089429948	
Barrier		-0.011	
Example calculation for above conditions			
rate		Pbarrier	
Probability/sec		exp(-.0139/.005)=.0047	
		Pd=(dens/max)	
		(1.2e5/5e11)^2=2.55e-7	
		Reaction rate R/sec	
		v/(2pi*r)/exp(60)=2.56e-9	
Pb*Pd*Rate/sec		2.67E-18	
Burn time seconds		1/above	
burn time (Byrs)		11.90	
sun N		1.1976E+57	
fract burning		0.1	
burn rate N/sec*me		3.70593E+38	
power mev/sec		2.47371E+39	

Burn time=1/(Pbarrier*Pdensity*Reaction rate)

Figure 5:10 Example calculations for Solar Fusion

Elemental abundance calculations using the probabilistic approach are continued in Appendix 6 (Section 13).

5.3 SUMMARY

Studying the atom deepened our understanding of how probabilities shape nature. In addition, it proves that the kinetic energy value 10.15 MeV from the Proton Model model is accurate. Atomic energy is energy released when protons come back together and fall into each other's strong residual (weak) energy (20.3 MeV). The shape of the binding energy curve follows the fundamentals of Section 2.

The author studied mesons, baryons and baryon resonance's, their decay times and properties. An attempt to fit the data into the fundamental particle values (topic 2.4) gave a tentative understanding of what these transient particles are (Section 11). They are simply combinations of particles and kinetic energy that decay rapidly into simple particles found in the pattern.

1. A probabilistic fusion model was developed that relies on barrier energies from Section 5 to characterize fusion rates of stars, temperatures, densities and element abundances. The model determines which elements are formed from each of the solar burning phases and determines temperature from the slope of the abundance line. The model is dependent on observed burn times of supernovae and abundance data. It uses many fundamentals but, in the end, is semi-fundamental since the fraction of mass exposed to high temperature is highly complex.
2. Supernovae are the source of heavy elements. This means that the sum of the measured abundances for elements heavier than helium is the fraction that was at some point in the core of stars.

6 SECTION 6 LIFE FROM INFORMATION

6.1 INTRODUCTION

One doesn't have to accept the language of nature to understand that nature is adept at building systems [9]. However it allows one to understand that physics and the life sciences are both based on probabilities and information. Sections 1 and 2 explain how nature differentiates the information value 180 into components that fit back together like a picture puzzle. We now focus on life as an extension of information based systems. A popular thought in some books is that there is a deep connection between life and quantum mechanics. Feynman's quantum mechanical equation for absorption of light [2] leads to a sharp response as wavelength matching occurs. It appears that our sensory system utilizes this equation. A model of color vision is presented that agrees well with the measured color sensitivity in humans. The manner in which color responses add together into meaningful perception supports the author's view that perception is based on probabilities and a new concept called "linked probabilities" will be introduced and related to DNA. It is speculated that life is an emergent property of chemicals that absorb energy and use information. Furthermore, it appears that the language of nature applies to our physical and mental structure. The author presents a theory that explains perception, some aspects of functional genomics [7] (how DNA does what it does) and explains the connection between our brain and the "illusive" mind within it. We explore what life is and seek answers to some of the most basic mysteries of science, which in the author's view are:

1. What is the organizing principal of life?
2. Why is nature built on the basic equation of quantum mechanics?
3. What is the physics behind information structures like DNA that manipulate and store information?

6.2 LIGHT

Light is the energy absorbed/released when an electron "jumps" from a lower energy to a higher energy orbit. Quantum mechanics describes the allowable orbits. Absorbed light is characterized by a discrete wavelength. We will focus on the shift in energy associated with the electron jumping from the second orbital to the third orbital (quantum number 2 to quantum number 3). This particular delta energy (1.89e-6 MEV) is special because nature uses it as the "standard" energy for perception. It is converted to a wavelength in nanometers by WL=hC/delta E*1e9=4.14e-21*3e8/1.89e-6*1e9=656 nanometers.

N	Binding Energy	Quantum no	Quantum no	Delta Energy
		2	3	
0.296	1.361E-05	3.402E-06	1.512E-06	1.890E-06
		1.36e-5/2^2=3.4e-6		
			1.36e-5/4^2=1.51e-6	

Figure 6:1 Quantum Shifts that Produce 656 Nanometer Light

6.3 INFORMATION THEORY PROBABILITIES

C. Shannon [30] used S=-ln P to represent information and thermodynamics incorporates similar concepts except it is the statistics of many particles. The author's N identifies particles such as an electron and components of the electric field and E=e0*exp(N). In this system, dimensionless energy ratio e0/E=P probability. Since wavelength is propotional to 1/E=1/hv (h is Heisenberg's constant and v is frequency), the probability and a dimensionless wavelength are equivalent.

P=e0/E=(h v0)/(h v)=v0/v=wl/wlo.

The equation of interest for light absorption is a wave function for a system that has an internal freedom that varies back and forth between two frequency (f) values.

Psi=mu e0/h (1-exp i (f-F) t/ (f-F))

The solution to this quantum mechanical equation is found in The Feynman Lectures on Physics, Volume III page 9-13 [2]. The basic equation for a probability pf is divided by pF to form a ratio normalized to make the peak response equal to one at the peak frequency, F. This equation will be called the absorption equation.

pf/pF=(sin((f-F)t/2))^2/((f-F)t/2))^2
Where f=frequency and t=time interval.

The absorption equation can also be written in terms of distance (D=C t), instead of time. With MC=f-F=C (1/wl-1/WL) and t/2=2D/C=1/(1/dwl-1/wl) where dwl is the width of the response curve, wl is the incoming wavelength and WL is the peak wavelength. The same equation in terms of D and M follows with (f-F) t/2= M*C/C *(2D) = 2DM. (C, the speed of light, cancels).

pf/pF= (SIN (2MD)) ^2/ ((2MD) ^2

Example calculations for red light at wavelength (wl) 400 nanometers (nanometers are meters with decimal place moved 9 places to the right):
M=1/400-1/594.3=8.17e5 meters^-1 and D= 1e-9/ (1/55.8-1/594.3)=5.73e-6 meters (573 nanometers) when the peak wavelength (WL) for red light is 594.3 nanometers and the width of the curve (dwl) is 55.81 nanometers.

Example color calculation for pf/pF				
55.8116	dwl			
594.334	WL			
	pf/pF=(SIN(2*D*M))^2/(2D*M)^2			
	D=1e-9/(1/(WL-dwl)-1/WL)=5.73e-6			
	M=1e9*(1/wl-1/WL)			
wl	M	D	2*D*M	pf/pF
400	817445	5.7347E-06	9.376	2.74968E-05
405	786581	5.7347E-06	9.022	1.89E-03

Figure 6:2 Example Color Calculations

The calculations above are continued from 400 through 600 pf/pF peaks and then decreases. As wavelength increases to the peak, the quantity (1/wl-1/WL) becomes zero for an instant and probability builds to one. On both sides of WL, the absorption equation gives the response of the eye to that color. pf/pF peaks at one through the sin^2 function.

6.4 COLOR VISION

Data for the following diagram was downloaded from the Color Vision Research Laboratory at the University of California [28][29]. It is the Stiles and Burch, red and blue, 10-degree target color matching functions used to characterize cone spectral sensitivity.

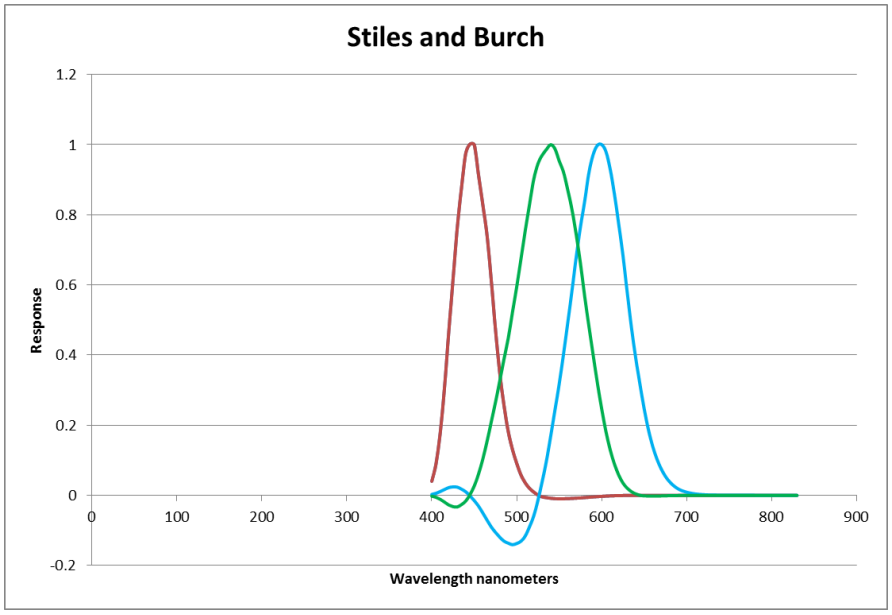


Figure 6:3 Stiles and Burch Data for Human Vision

Color vision appears to be a clue to understanding perception and life. Namely, the wavelengths the eye sees as red, green and blue are exactly separated by N=0.0986. In addition, the width of eye's sensitivity to a particular color is specified in another way by N=0.0986.

Series	Energy MeV	Denergy MeV	width (nm)	peak (nm)
-0.099	1.83E-05			
0.000	2.02E-05	1.90E-06	61.23	652.05
0.099	2.23E-05	2.10E-06	55.48	590.82
0.197	2.47E-05	2.32E-06	50.27	535.34
0.296	2.72E-05	2.56E-06	45.55	485.07
0.394	3.00E-05	2.82E-06	41.27	439.52
		Delta energy from Fig 6:1		
	width (nm)=4.1e-21*3e8/(Energy)*1e9			
	peak (nm)=4.1e-21*3e8/Denergy*1e9			

Figure 6:4 The N Value 0.0986 Series Produces Peak Color Responses

Trying to understand this led to the concept that information associated with the code is used by the mind to interpret signals from our sensory apparatus. Application of the N value 0.0986 allows us to the model color vision is three colors plus a scotopic (black and white) response. Rhodopsin (the main dye in the human eye) and perhaps isomers of rhodopsin (isodopsin) aid absorption, but processing of signals is carried out within the brain and presented to the "mind" as color vision. Note the use of N=0.0986 in the table above with E=e0*exp(N)=2.02e-5*exp(3*0.0986)=27.2e-6 MeV. The value 0.0986= ln(3)-1 is associated with charge including fractional charge of quarks. Of course 27.2e-6 MeV is just the electromagnetic potential (twice the binding energy). With the value e0=2.02e-5, wl0 equals 655.93 nanometers (1.89e-6 MeV).

The rods in our eyes have a response curve between the blue and green peaks and its peak is included above. The table below shows that the wavelengths the eye sees as red, green, rod and blue are separated by N=0.0986. For example information N=0.0986, P=1/exp(.098)= 0.906 and wl/wl0=594.3/655.9=0.906. It specifies the shift in wavelength from wlo=655.9 nm to the other wavelengths by the series 1,2,3,4x0.0986. Each meaning is associated with a wavelength and pf/pF probability response.

The width of eye's sensitivity to a particular color is specified in another way by N=0.0986. Note in the table above that difference in energy between each level can be converted to the delta wavelength series 61, 51, 50, 45, etc. These give the width of the pf/pF response curves.

The eyes measured response to light from Stiles and Burch compare favorably with the Feynman equation for absorption of light using the N series 0.0986. The graph below plots the Feynman equation pf/pF for the three color peaks 594, 538 and 442 nanometers. The associated width series was 61, 55 and 41 respectively for red, green and blue responses. These are tentatively called fundamental since they appear to follow the information series.

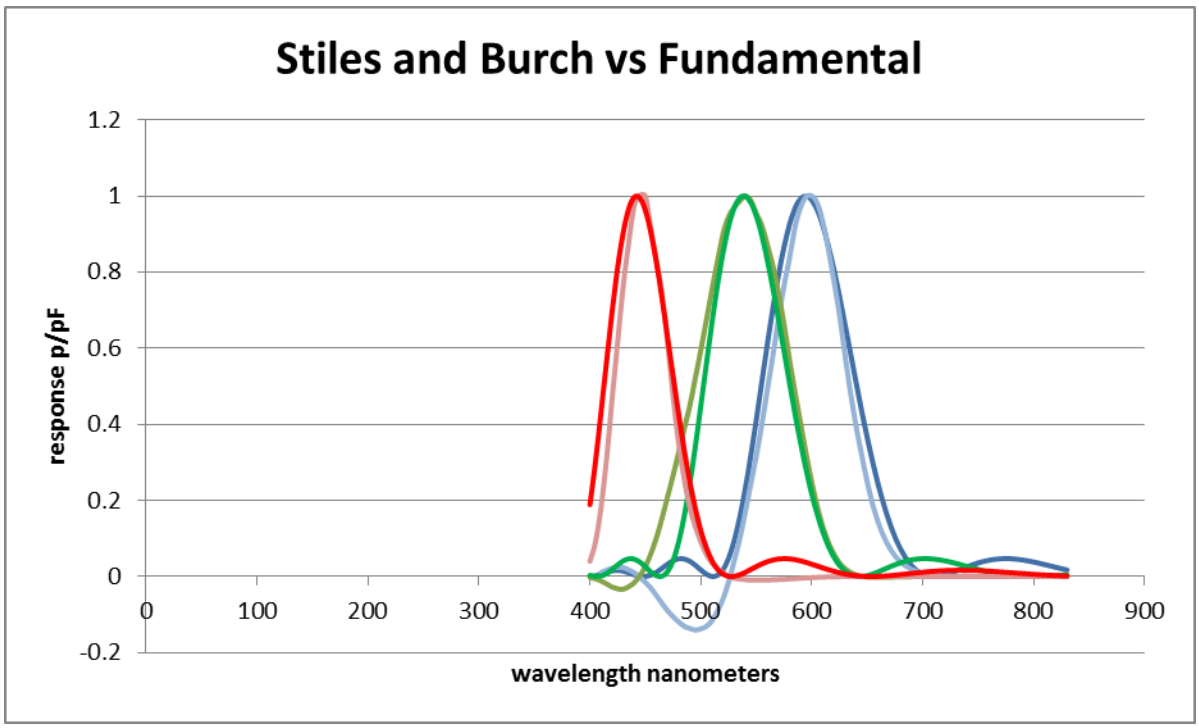


Figure 6:5 Comparison of Measured Color Response with Calculated Color Response

The fundamental calculations are the lighter colors and the dark colors are Stiles and Burch.

The explanation for color vision being sensitivities to different wavelengths based on N=0.0986 is surprising and new. The author followed up on this finding. Rather than four full distinct pf/pF responses, we see white light and this indicates that our human color vision system is operational and stringing together meanings. The other hues are comprised of combinations of these colors without full spectrums and it clear that the brain is adept at creating meanings from these curves. Other senses have different multi-wavelength responses (the ear for example).

6.5 LINKED PROBABILITIES

The wave function is again shown for any system that has an internal freedom that varies back and forth between two values.

Psi=muE0/h(1-exp(i(f-f0)T/(f-f0))

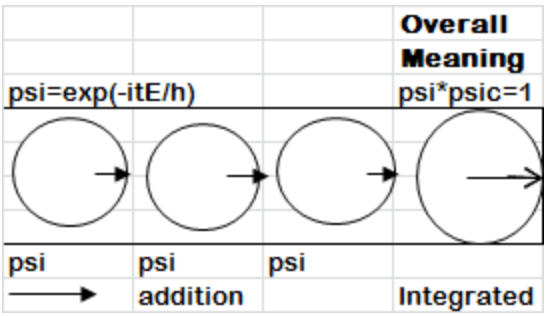


Figure 6:6 Linked Probabilities

The above diagram theorizes that the wave functions called psi above are linked together before the final perception occurs. This would explain why we perceive the result of all four colors together as colored light, not the individual results. We will call this concept "**linked probabilities**". The author believes it is fundamental to our senses and may be fundamental to life itself. Specifically, the probabilities linked together can be identified in the following graph. The brain interprets the probabilities as the four colors but they are linked to form white light, a concept the author calls **integrating**.

Information Operations >Energy interaction >Neutrons, Protons and Electrons >Physical Universe >Linked Probabilities

Series N	P 1/exp(N)	Meaning	Color
0	1	→	652.05
0.099	0.906	→	590.82
0.197	0.821	→	535.34
0.296	0.744	→	485.07
0.394	0.674	→	439.52

Figure 6:7 A "Rosetta Stone" Relating Probability to Color Perception

Overall, the dye (or dyes) absorbs throughout the approximate range 400 to 700 nanometers. There are four signals that come from the pf/pF functions associated with the dyes that aid absorption [29]. Partially processed signals from the retina go into the brain where a great deal of processing takes place. The nerve connections leading from the eyes to the brain are well characterized in the literature. It is known that the nerves convey ions and it is clear from the connections that signals are added and subtracted. Focus of how our brain uses and interprets (perceives) these signals. Based on the above, the signals to be processed are probabilities. The following table shows a few pf/pF intensities for short wavelengths. For example, the probability associated with 400 nm is 0.609 when it is normalized by the divisor 655.9 nm and the red intensity is 0.003). The author believes the brain uses information (N=-ln(P)) based on these probabilities.

Recall that our eye responds in a logarithmic manner to brightness. Also, it is known that the amount of neurotransmitter decreases with increasing light intensity. Note what happens to the value T=-ln(P) as P increases.

P	T
	neg LN(P)
0.1	2.3025851
0.2	1.6094379
0.3	1.2039728
0.4	0.9162907

According to Stanislaus Dehaene [33], it is thought that the brain operates on Bayesian probabilities. The equations of interest are of this type: p(H/E)=p(E/H)/p(E)*p(H). Wiki defines the terms as p(H/E) as the posterior belief and p(E/H) as the probability of the evidence given a prior belief, p(H) as the probability of the prior belief and p(E) as the marginal likelihood. When the eye receives light, ions leave the eye and are transported along the axon taking the value of the normalized wavelength (probability) and its intensity to the brain. There are different nerves associated with the three colors and the rod response so there are four intensity values for each normalized wavelength. The brain receives the intensity (height of the p/pF function for each wavelength) and does not have to recreate the p/pF function to interpret the above data (think of the eye as a sensor that has already translated light into signals). The brains task is to assign meanings to new data signals based on stored information within existing brain cells in the visual cortex. The information stored in the brain is p(H) (the prior belief and expected signal value) and p(E/H) is the new evidence probability (signal) coming from the eye. In this model, p(E) is a probability that normalizes the data as the signal is updated and the brain gains believable evidence.

The goal of the calculation is to find the value p(H/E), the probability of the evidence updating the stored prior belief. Our brain perceives the sum of p(H/E) values over four signals across the wavelength range.

The mind expects white light (the full pf/PF curve for four signals) and p(H) is the prior belief color intensity for each signal at a particular wavelength. For example in the first line of the above table, the pf/pF function gives a p(H) value of 0.003 for red light, -0.0002 for green, 0.04 for rod response and 0.04 for blue. If the evidence intensity signals p(E/H) reaching the brain are the expected values, p(E/H) will be 1. This means that each of the p(H) values is multiplied by 1 and p(E/H) for the sum of the four values at 395 nm will be 0.086. This same process occurs for each wavelength and if each color is full spectrum, the following curve will be produced. Our brain will interpret this as white light. This is made possible because the four color probability values are spaced N= 0.0986 apart.

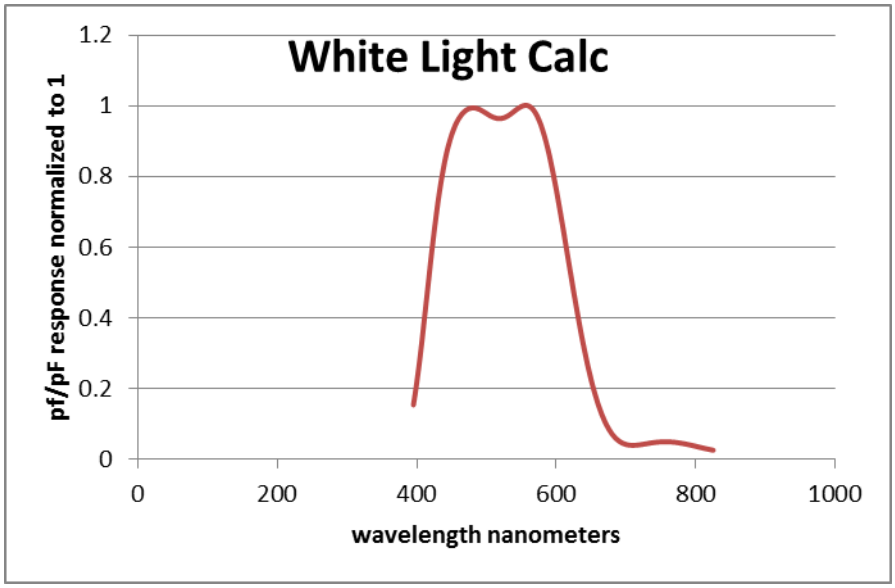


Figure 6:8 Adding Equal Color Responses Produce White Light

The above calculation requires a multiplication and a division, p(H/E)=p(H) x p(E/H)/p(E). The calculation is probably aided by the basis of the author's work that probabilities are fundamentally information represented by the value N=-ln P. Based on logarithmic math, when nerve signals are added, probabilities are being multiplied and when nerve signals are subtracted, probabilities are being divided. When colored light is received (incomplete spectrums for the four components), the evidence p(E/H) is not equal to the expectation value p(H) and the probability updated for evidence p(H/E) will not be 1. This skews the results into the various hues and colors our brain actually sees.

The eye is actually transmitting color images and the visual cortex is a wired to receive the images. Shape recognition is reported extensively in the literature [8]. As an example, assume that a moving yellow spherical object is being observed by the eye. The brain has already used stored information regarding the circular edge and color to identify it as a tennis ball (the P(H/E) probability for this attribute is near 1). As the object comes closer to the observer, nerve signals are sent to the eye and muscles to track the ball. This integration occurs rapidly because the brain has already assigned high attention to these signals and is experienced at tracking tennis balls.

6.6 STARTING LIFE

Primitive sensing is the absorption of light associated with the movement of an electron in the second shell of carbon. Is it possible that the beginning of life is simply a molecule gaining energy from the absorption and seeking to enhance the absorption by searching for light? Simple plants do this and our eyes do this with the maximum sensitivity in the green wavelength (535 nanometers). Carbon, with its four second shell electrons is well suited for absorbing energy and aligning electrons through its chemical structure. Its chemical structure makes it well suited for development of life. Once energy is absorbed,

the energy can be used to build better searching tools. This consists of organizing molecules into cells that use energy to power the developing structure. Nature's animal and plant kingdoms represent different ways of optimizing absorption of energy. Some say that the beginning of complex physical life forms on earth was the point where simple cells, like the cells that became a sponge, began to work together to gather resources. Cell cooperation and specialization develops to optimize the behavior and improve its chance of surviving. Thought arises when the organism uses perceptions to improve the search.

We know that thermodynamic entropy is increasing overall but life absorbs energy and uses information to exploit thermodynamic entropy locally. Viewed from the outside the organism is becoming more improbable. This leads to a primitive identity because the components are part of an overall unity. Evolution of the identity across deep time leads to the thriving and replicating chemical system that we call life. This is fundamental in the author's view because the language of nature allows atoms to build organisms that function as information systems.

There is a connection between nature's language and evolution. The more environmental pressure on the primitive plant or animal, the more improbable the survivors become. Winning against increasing competition leads to improved perception and survival behaviors. Others [9] believe that evolution is enhanced through inherent "friendliness" toward organization. This could be enabled by the integrating property of linked probabilities. When the linked probabilities represent absorption of light wholeness means color vision. When the linked probabilities specify where to place cells, wholeness means the organism.

The author believes that the overall goal is not just the development of physical things, but physical things that incorporate thought. Below the author will further develop the theme that linked probabilities underlie the mind.

Information Operations >Energy interaction >Neutrons and Protons >Physical Universe >Linked Probabilities >Life and Thought

6.1 LEARNING AND REALITY

Information is defined as the N=- ln P. Just remember that when something is improbable it contains more information. In nature, thermodynamics is the study of particles free to combine into lower energy arrangements, taking away the number of possibilities and causing things to be more similar. For groups of particles in contact, energy moves from high temperature to low temperature. This increases thermodynamic entropy and less information becomes available. This leaves us with the challenge of finding more energy or maintaining ourselves against changes in our environment. Just like thermodynamic entropy degrades energy, time causes us to feel that everything is becoming similar or dull and our mind faces new challenges.

Our minds cope with its needs with several tools including intelligence. The definition I like is "seeing differences" because seeing differences is the process of separating, similar to nature's original information operations. Learning helps because storing and using information increases the number of possibilities.

There appears to be several cycles at work. When things become bland or uninteresting we are at the bottom of a cycle for one of our sub-personalities. The opposing "up cycle" starts with a search mode. Interest follows that allows us to focus attention and motivates us to act. Using this cycle, people grow in their ability to see situations experienced before and respond to challenges.

It appears to the author that learning actually changes reality. If you learned something the things you see in the next cycle will be different. Like evolution, the ideas that are more productive are re-used and the quality of thought increases.

Science progresses because people accept other's observation and start to see reality in a new way. See reference 5 for more on how Scientific Revolutions unfold.

6.2 **WHY QUANTUM MECHANICS?**

Some have a difficult time with the idea that we can only define the probability of something existing at a certain point and that wave functions (with interference) are fundamental. This work shows that the wave function represents perception through the ratio (Pf/Pf0). We start to understand when we admit that probabilities are a powerful way of defining reality.

We appear to perceive color based on the electron shift in a potential energy field. Our minds may be based on assigning meanings to the energy received. For the eye, probabilities associated with the number 0.0986 shift our sensitivity to wavelength. A critical energy is established which determines whether incoming light will be "absorbed" by the underlying structure. Absorption is a matching process between incoming energy and a peak wavelength. Other sensitivities may be similar in that they use stored probabilities to establish matching criteria. Think about how natural to say "he is not on my wavelength". We think of criteria matching as the condition for a response. For light the basis of perception is the ability to understand frequencies that drive the probability function to 1. It is not a stretch to see that the brain can link other probabilistic wave functions into meaningful thought. The concept of linked probability segments helps understand mental processes. When electrons align in living structures psi, the symbol for the wave function in quantum mechanics, is assigned a meaning. Integration is represented by taking the sum of several components. Multiplying by the complex conjugate psic at the end of each "thought cycle" allows the system to retain its whole status. Time is the "freedom" that enables our probability-based bodies and minds to develop but time works against permanence because it allows information to change. Quantum mechanics operating in our minds is the math of and incorporating new information into the present.

7 SECTION 7 INFORMATION BASED REALITY

The universe appears to be goal oriented. Ultimately, its goal appears to be development and support of thought. Nature is information based. Information operations create fundamental particles and establish conservation laws leading to development of the physical universe. Energy interactions are assembled into neutrons, protons and electrons inside a hierarchy of field spaces we call the universe. Subsequent gravitational processes (expansion followed by star formation) create conditions where fusion can occur. This subsequently creates atoms that are complex enough to support chemical/electronic activity, which is the basis of perceptive life. DNA is a plan (linked probabilities?) for the physical body and brain. Life uses this information structure to manipulate, organize, and create three dimensional forms.

7.1 MOTIVATION

Science appears to be on the verge of finding that the universe is teaming with life. This is great news but as we realize how inaccessible dialog will be perhaps we will still feel alone. Scientific information should help make good choices that steer our thinking and actions, not just provide an understanding of physical phenomenon. Sociology, law, literature, etc. of course share responsibility for optimizing life on our planet island but historically philosophy was the primary source of deep understanding. Modern philosophy generally follows science and appears to use the scientific method, i.e. posing questions, gathering data and considering possible answers. Good data in this area is difficult and the process of agreeing on meaning is open to dialog and interpretation of data. Often the more powerful argument or people win temporarily until more data can be gathered and society is left waiting for the contribution. By default, the status quo of the culture we are imbedded in decide questions for us and we continue thinking and acting like others. The path forward is consolidating ideas, exposing them to refutation and integrating the result. If there is resonance, the ideas survive and contribute.

7.2 BASIC QUESTIONS

We still have childlike questions like what are things made out of? Where do the laws of nature come from? Why is life possible? What connects mind and matter?

Perhaps we need to rethink our basic assumptions regarding reality. There is developing literature [1] regarding information being a real building block that can help us understand nature. Could what looks like creation have been information based? By information, we mean the thoughts our minds are manipulating but there is a formal approach attributed to Claude Shannon [2] (Information (N) =natural logarithm of probability (P) or N= -ln P).

The FQXi Physics of Information grants, 2014 conference on the subject and the author's 2012 FQXi essay [23] explore the possibility that information is fundamental to physical reality. Based on Section 2, we postulate that things are made out of information. Since

we see information created all of the time we can imagine that creation of information underlies creation of energy.

Where do the laws of nature come from? Considered as information, laws correlate repeating observations and we can state with language augmented by mathematics what the relationships are. No one knows the origin of some laws.

Why is life possible? The author explored information operations responsible for differentiation of information into units able to combine at different levels similar to the way an alphabet forms words, words form sentences, etc. Information operations can be associated with the laws of nature, and information units (actual numerical values) can be associated with particles and fields. Thinking along this line, Section 6 attempted to show that a specific information value and known quantum mechanics leads to color vision and perhaps other senses.

7.3 LANGUAGE AND LINKED PROBABILITIES

Since language is information, an analogy can be drawn between information structures found in nature and language. Language is based on symbols that we learn to form into concepts and eventually complex meanings. One important aspect of information is it can be taken as parts or as a whole. Small defined units can be added together (integrated) into larger and larger structures. The analogy below proposes a relationship between language, information and observed physical reality. The concepts DNA words and DNA sentences represent molecules held in place by electrons. Their meaning is coded but are read and expressed as specific functions that support life. The author calls these structures linked probabilities.

Analogy between language, information structure and physical reality

Language	Information Structu	Physical Reality
Symbol	Information operati	Laws of Nature
Concept		Time, Space
Alphabet	N for particles	Particles
	Proton Mass model	Atoms
Words	DNA Words	Electrons
Sentence	DNA Sentences	Molecules
		Senses, Brain
Paragrap	Genome	Body
Experien	Mental Reality	
History		
	Information Based Reality	

Figure 7:1 Analogy between Information and Language

Our vantage point is from within an existing information structure. Perhaps the reality we observe is a subset of an overall larger reality. One definition of intelligence is seeing differences and we appear to have mental freedom to use information and expand reality. This is enhanced by language that increases our ability to see differences and think about complex issues. Our evolving mental reality suggests that our mind participates in an overall information based reality. When we create new thoughts from old ones, we are advancing our reality.

Is it possible that information operates on a different level then our brains and bodies? It appears that information based laws predated our physical reality. The diagram below shows a relationship between two sides of reality but suggests that they are separate. The physical side of reality (right side of diagram) began as information (left side of diagram) and now appears to fix the laws of nature. Quantum mechanics and information form the senses that evolve to the brain and these are part of physical reality. The left side of the diagram underlies physical reality and our mental reality is an extension of this information side. As a whole, the left side can be called Information Based Realty.

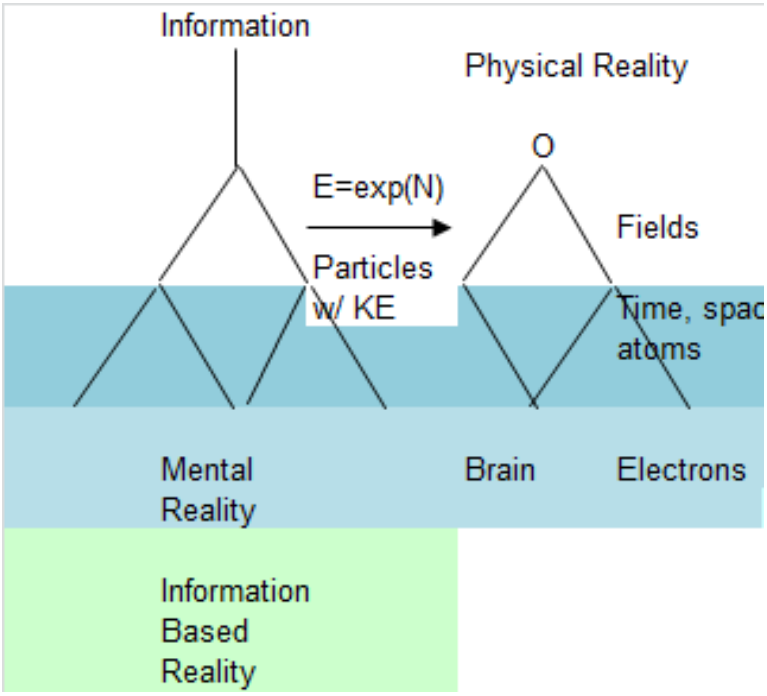


Figure 7:2 Information Based Reality

7.4 INTEGRATION

When information is integrated it represents the product of its components. A computer program works because instructions written in a standard language can be processed by a machine into an output. Lego ® blocks make things because they fit together. Integration of the body information structures makes a complete human not just the

components. This is similar to language telling a story; i.e. we focus on the story not the components. We see alphabetic symbols but automatically read them as words. There are repetitive patterns throughout nature that suggest many levels of information structure and integration. Higher level DNA structures integrate sense components into the body. Our senses evolve with our body and extend basic information to mental structure. As the brain evolves, freedom for each individual to be different emerges because the information is not "hardwired". The brain can process information and does not have to exactly follow a set of instructions. Complex living beings are made possible by integration.

7.5 EVOLUTION OF INFORMATION STRUCTURES

DNA sentences form the body and survival promulgates DNA. In similar fashion, as our brain develops useful concepts that survive, our reality evolves. More specifically, we participate in creating nature.

7.6 REALITY

Reality is at the same time divided into many but also united as one. For physical reality, many duplicate protons form one universe. For mental reality, consciousness is divided into many experiences but its information based structure can be integrated at a high level. It is possible to occasionally experience feelings of wholeness because we are part of the picture puzzle. The basic thesis of the language of nature is that organized information, similar to DNA, underlies everything. Linked probabilities are a dynamic information structure—a design plan. Like any good design plan, it allows the physical form to have features and qualities that function properly. Nature is simple, uniform, diverse and full of possibilities all at the same time.

Think about your body and mind being a small portion of a whole universe. The universe "peoples" and people "think". View yourself as inclusive with other people and their experiences rather than choosing to view yourself as separate. Viewed in this way, we are connected and want to be a productive part of a creative universe. We are all observers in the same physical universe and we are very similar. Each mind is separated from every other mind but the thoughts are easily connected by communication and mental choices. We do not have perfect memories, instead we have the ability to focus and pick the important few out of the many. Hope that what we learn is remembered and integrated with the wisdom of others. We respect that we are not alone separate and unplanned; instead we are part of a perceptive universe that gains experience through all experiences. With the right choices, our collective efforts become dynamic and cooperative. If we are short sighted it may not be possible to sustain high quality life far into the future. We must deepen our understanding because it leads to a more meaningful life and helps mankind continue its ascent. Part of that understanding is the language of nature.

Information Based Reality >Information Operations >Energy interaction >Neutrons and Protons >Physical Universe >Linked Probabilities >Life and Thought

7.7 CONCLUSION

Nature is a dynamic information and energy pattern making up a whole of which we are an integral part. Nature appears to be goal oriented and that goal toward achievement of life, diversity and thought. The basis of both physical life and mental life appears to be nature's uncanny ability to develop complexity from simplicity. On the mental side, complexity increases because of networking and learning.

We live in an observer centric universe at a juncture that is both physical and mental. The basis of the eye's absorption of light is a key to understanding perception. Our eyes gather light energy but our mind gathers information perhaps because it understands and uses the language of nature. Our physical bodies and our minds may be linked probabilities constructed by evolution to interact in and ultimately perceive a very elegant universe. The universe could be a dynamic information structure that may involve connections we do not fully perceive and could be capable of storing information and transcending barriers that we can only dream of.

Nature may have been divided into exp(180) pieces but when re-assembled in the right way it is a beautiful picture.

7.8 LANGUAGE OF NATURE SUMMARY

The author bases his belief that the language of nature is a unified theory on the fact that data from several different scientific fields fit the theory and that the theory extends our understanding of nature. The theory adds value to science in the following ways:

1. The series of numbers, N, that correlate fundamental neutron, proton, electron and quark energies by the equation E=E0*exp(N). Conservation laws appear to support zero as an origination point for information being reality.
2. Information operations provide a recipe for basic components and energy interactions imbed the components in fields similar to quantum mechanics. Models that give the masses of the neutron, proton and electron.
3. Information from the proton mass model that unites the four fundamental forces through the quantum mechanical "R equation". This includes quantum gravity.
4. The cosmology that results from constants found in the proton mass model including an understanding of inflation, the current size of the universe and its major features. An understanding of primordial nucleosynthesis.
5. The binding energy curve that underlies nuclear energy and uses the probabilistic fundamentals described in Section 2 and the values 10.15 MeV and 0.111 Mev from the Proton Mass model.
6. Probabilistic fusion kinetics that model the abundance of elements and power the sun based on the barrier energy from 0.111 MeV.
7. Use of a quantum mechanics absorption equation that underlies perception.

8. The concept of linked probabilities that allows organized code to represent complex structures and meanings. Examples of linked probabilities include color vision, DNA and the mind (mental construct).

Overall: Basic interactions (represented in the text by an arrow, i.e. >):

- Information Operations >Energy Interaction >Neutrons and other particles in the physical universe
- Electrons and atoms > Linked probabilities> Perception
- The physical body/DNA > Mental construct
- Information based reality

ANALOGY BETWEEN THE UNIVERSE, PHYSICAL REALITY AND INFORMATION BASED REALITY

UNIVERSE: Nature is built on the idea of making something out of nothing by the process of unbalancing and then balancing back to zero. Initial N=90-90=zero and Emass-Efields=zero. Nature uses the idea of replication extensively. Even replicating protons exp(180) times appears to be a way of maintaining probability =1 (wholeness). We can "reverse engineer" the operations but where do the ideas come from?

PHYSICAL REALITY: Cells in cosmology are like cells in the body. Each cosmology cell contains information I call the Proton Mass model and each cell in the body contains DNA. For the body DNA replicates itself in each cell as it divides. Constructing the body and brain involves positioning cells according to probability instruction, forming a whole.

INFORMATION BASED REALITY: Development of the mind could be another example of individual parts forming a whole. Linked probabilities may be "words" integrated to psi0*psi0c=one. We identify N= 0.0986 as information and see how it is used in color vision and perception.

Could linked probabilities govern development of the physical universe much the way DNA in each cell governs the development of the physical body? Maybe the information operation and energy interaction are linked probabilities for the universe. We can think of DNA as having two forms, information coded in the molecule and the physical body. Do we exist as linked probabilities or do we exist as a spacial representation? Time and distance are a spacial representation of replicated information. Any one of the N=1.4e78 centers are perfectly equivalent for perceiving our universe.

Our mind is not known to live on because a supporting information structure has not been discovered but could information based reality be deeper than we *can* observe? Consider for a moment that there may be two fundamental forms in nature 1) a compact information form and 2) an expanded form we recognize as the body and the universe around us. We do not ask where physical laws are stored because they are built into the fabric of nature. Our language and experience trains us to locate things but perhaps we need to think deeper. Information may not have a location. We could be linked probabilities that don't always have a physical form. We need to consider this possibility carefully since it could open a window to our future. Of course this is speculation but we

can confidently say that we exist in a universe that is whole and we are part of that wholeness.

8 APPENDIX 1 FUNDAMENTALS

This appendix contains some fundamentals. The only quantum mechanics important to this book are contained in about three equations. The author draws on a very reputable source; "The Feynman Lectures on Physics" [2].

8.1 Units

This document uses the MKS system (Meters, Kilograms, and Seconds). Here are a few important constants.

Constants	MKS	Units
Heisenberg's	4.1357E-21	mev sec
h=H/(2pi)	6.5821E-22	mev sec
Light Speed	2.9979E+08	c-meters/sec
	6.6261E-34	newtons m sec
Charge	1.6022E-19	q-coloumbs
FR/27.2	1.6022E-19	
Conversion	1.7827E-30	Kg/mev
Proton mass	1.6726E-27	Kg
Proton mass	9.3827E+02	MeV
F=E/R	Mev/m*1.602e-13	newtons
Conversion	6.2415E+12	mev/(newt-m)

Figure 8:1 Units

8.2 The argand Diagram

The following review is nomenclature and fundamentals that come from the field of quantum mechanics. Psi is the Greek symbol for wave amplitude. Psi is a complex number meaning it is the addition of a real number and an imaginary number. An imaginary number is the square root of negative one. Even though the symbol psi will be used several times below, we will deal with concepts and not the actual complex numbers. The basic energy equation is E=h/t (usually stated as E=hv where v=1/t is a frequency that counts revolutions in a time interval). The full equation for psi can be very complex and a simple form is psi=exp(ivt) with E/h=v. Quantum mechanics deals with the multiple, psi*psic, where psic is the complex conjugate. A complex conjugate simply reverses the sign on vt, so psic=exp(-ivt). The multiple psi*psic =cos(vt). Cos(vt)=1, when vt=0, 2pi, etc. This occurs at the collapse point marked 1 below.

The Argand diagram is a plot of real numbers on a horizontal (x) axis and imaginary numbers on a vertical (y) axis. Quantities we want to know about, like energy, are real only at the collapse point. As time moves forward, the collapse point occurs repetitively

at cos(vt) =1 as shown below on the Argand diagram. Higher energy represents moving around the diagram faster. The Argand diagram moves through the sequence, 1, imaginary number, -1, negative imaginary number and back to 1. As time moves forward, rotation around an Argand diagram plots a cosine wave since psi*psic=cos(vt). The wave function psi can be added linearly to other wave functions. Probability is fundamental in quantum mechanics and the standard interpretation is that it gives the probability that something exists over a certain interval.

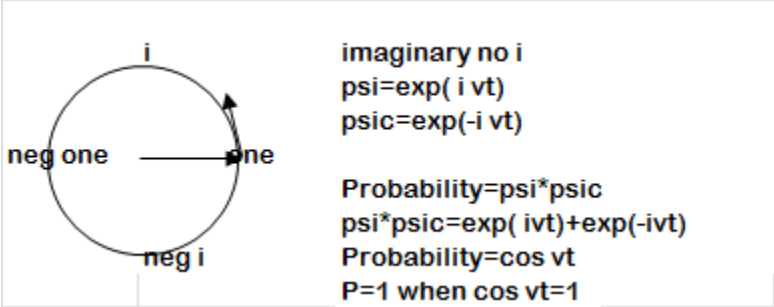


Figure 8:2 Wave function collapse shown on the Argand Diagram

8.3 Light speed

We live in a four dimensional universe, with time being the fourth dimension.

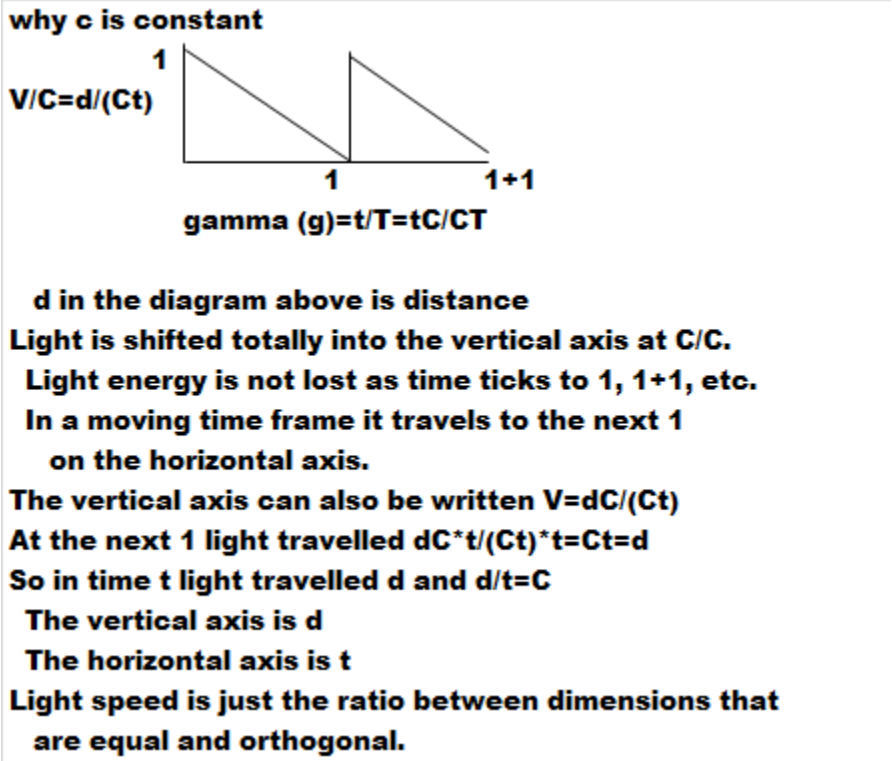


Figure 8:3 Why Light Speed is Constant

The concept of gamma leads to the famous equation E^2=(mc^2)^2+p^2c^2.

gamma represents a shift in time dimension	
V/C represents a shift in the distance dimension	
Defined orthagonally:	
(V/C)^2+(g)^2=1	
(sides make a right triangle)	
g=(1-(v/c)^2)^.5	
1=1/g*((1-(v/c)^2)^.5	
(1/g)^2(1-(v/c)^2)=1	
(1/g)^2-(1/g)^2(v/c)^2=1	
(1/g)^2=1+(1/g)^2(v/c)^2	
(m/g)^2=(m)^2+(m/g)^2(v/c)^2	
(m/g)^2c^4=m^2c^4+(m/g)^2v^2c^2	
(mc^2/g)^2=(mc^2)^2+(m/g)^2v^2c^2	
With p=momentum, E=m'c^2 and m'c=p below	
E^2=(mc^2)^2+p^2c^2	

Figure 8:4 The famous Einstein Momentum Equation

Example of how the above equation is used:

m	13.797	mev	
pc	101.00893	mev	
		4.13567E-21	h
		1.78266E-30	kg/mev
		6.24151E+12	mev/nt-m
	101.00893	pc in mev	
(13.8/.135)	10393.161	(mc^2/g)^2	mev^2
13.8^2	190.357	(mc^2)^2	mev^2
101.009^2	10202.804	p^2c^2	mev^2
E^2 (total)	10393.161	mev^2	

8.4 Electron Orbits

One of the features of quantum mechanics is that the "orbit" of an electron is probabilistic[2] in nature. We cannot say exactly where an electron is, although we know the most probable radius (a value) is 5.29e-11 meters. Quantum mechanics can write the probability distribution in terms of x, y and z coordinates but there is only one electron in this representation and it can't be everywhere at once. Here is one example of how an electron is located:

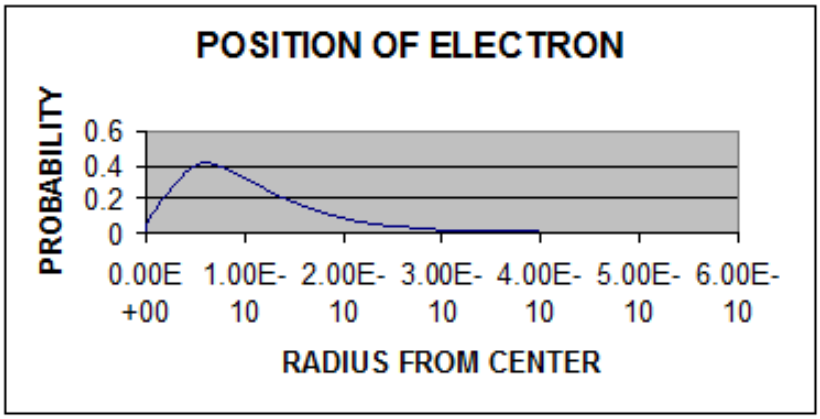


Figure 8:5 Position of Electron

8.5 Derivation of R equation

[2] Condon, E.U., Morse, P.M., *Quantum Mechanics*, McGraw Book Company, Inc., New York, 1929.

Derivation of R equation				
	similar to pg 2-7 Feynman			
kinetic energy=.5 mV^2=p^2/(2m)=(h/(2pi))^2/(2mr^2) ←				
Energy of particle=h^2/(4 pi^2 mr^2)-e^2/r				
	where h is Planck's constant			
	e^2/r is the energy of the field at r			1.36E-05
	r is the radius of the orbit			
	to find orbital radius and energy			
	dE/dr=-h^2/(4 pi^2 mr^3)+e^2/r^2			
	dE/dr=0 since orbit is at minimum energy			
	h^2/(4 pi^2 mr^2)=e^2/r			
	r=h^2/(8 pi^2 m e^2)			
	E0 is the kinetic energy of the orbit			
	(examples are electron's orbit)			
	m=.511 mev. Relativistic m is m/g			
	E0=e^2/r=4 pi^2 me^4/h^2=13.6e-6			
E0=8*PI()^2*0.511*(2.68e-8)^4/(1*4.13e-21^2)/(3e8)^2				
check	1.4E-05	mev		
	r=h^2/(2 pi mE)^.5			
	E is the central field energy			
	E is 2E0=27.2e-6			
	r=hC/(4*PI()^2*0.511/g*E)^.5			
r=4.12e-21*3e8/(4*pi^2*.511/1*27.2e-6)^.5				
check	5.3E-11	meters		1.109E-18
E=h^2/(4*PI()^2*0.511/300000000^2*r^2)				
check	2.7E-05	mev		

Figure 8:6 Feynman R Equation Derivation

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8.6 Spin

The net angular momentum of the universe is zero. Quantum physics quantitizes angular momentum and calls angular momentum/h "spin". They assign quanta in units of ½ to this property. The conservation rule is that quantitized spin must be conserved and balance to zero overall. Two neutron quarks have positive spin balanced to zero by one negative spin quark and loss of one neutrino half spin. Two proton quarks have positive spin balanced to zero by one negative spin quark and one lost neutrino. The electron is also balanced to zero by loss of one neutrino.

8.7 Number of Particles in Universe

Question about number of particles in universe				
Critical Density Predictions (kg/M^3)				
Density	8.93E-27	pg 337 isHughes		
Density	3.73E-26	rho zero pg 103 Peebles at H=.71		
Density rh	9.5E-27	WMAP basic results Table 3		
R	6.30E+25	meters		
N protons	1.61E+78	N=rho*0.27*(4/3)*PI()*R^3/1.67e-27		
ln (N)	180.0759			

Figure 8:7 WMAP Data Used to Estimate the Total Number of Protons

9 APPENDIX 2

9.1 Examples using the value 1/exp(90) to scale cell values to large size observations

Example 1: The earth's gravitation

Large space			
R is the earth size geodesic			
		quantum space	
		r=cell size geodesic	
RV^2/M	G=G	rv^2/m*1/exp(90)	
r=cell size geodesic		0.554	m
cell v meters/sec		15.7	m/sec
cell proton mass		1.67E-27	kg
rv^2/m*1/exp(90)		6.67E-11	nt m^2/kg^2
Velocity of orbit		7897.7	m/sec
Mass earth		5.98E+24	kg
R=r(v/V)^2*(M/m)*1/exp(90)			G=G
R geodesic		6.40E+06	meters
RV^2/M		6.674E-11	nt m^2/kg^2

Figure 9:1 Earth's Gravitation

The table above indicates that the surface of the earth must be moving at 7898 m/sec to be on the geodesic; however rotation only gives the surface 464 m/sec. Since the velocity is low we experience acceleration of 9.8 m/sec^2.

	Mass kg (earth	5.98E+24	
	earth R (m)	6378100	
a=gm/r^2	m/sec^2	9.80	

Of course, to reach a force balance one would increase velocity to the geodesic value.

9.2 Example 2: The geodesic is universe size when expanded proton positions regain kinetic energy by falling into deep orbits.

First review how orbits are formed. The diagram below shows that there was about 20 MeV of potential energy (Section 2 Proton Mass model) available (a) and the proposed model for expansion is based on an orbiting proton with approximately 10 MeV of kinetic energy (b). Since the proton is attracted to and separated from the center of the field, there was also 10 MeV of potential energy when the orbit is established. As expansion occurred (process (b) >(c) below), 10 MeV of kinetic energy was converted to 10 additional MeV of potential energy. At a much later point in expansion (c), although

there is motion (temperature) of the proton on the surface of the expanding cell, there is no motion between cells (protons) except for expansion. With the proton velocity nil between cells geodesics will be extremely flat (on the order of 5e38m) compared to 6.3e25m. This causes acceleration of particles toward one another (process 2 below) and external kinetic energy (between protons) increases as protons fall back toward the geodesic (d) >(c). On average the expanded cells do not change their radius. Theoretically, 10 MeV of external potential energy could be reconverted to10 MeV of kinetic energy as particles fall toward one another. Overall, process (b) >(c) >(d) >(e) converts cellular surface kinetic energy to external potential energy between cells.

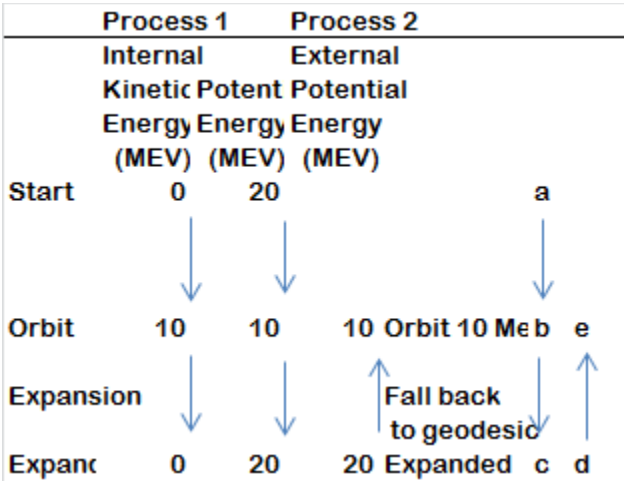

Figure 9:2 History of Proton Mass Model Expansion Energy

What actually happened during expansion was a transition occurred and acoustic waves broke the total mass into about 27000 clusters. After equality of photon density and mass density, process (d) >(e) occurred, protons accumulated and eventually fell into orbits that we observe as clusters of galaxies, galaxies, etc.

During expansion, the kinetic energy of the proton on the cell surface decreased by KE/ratio =9.8/ 7.4e12=1.3e-12 MeV and the current velocity on the surface of each cell fell to15.8 m/sec.

The protons could theoretically regain 4.3e7 m/sec by falling but particles usually fall less than this where orbits are established. The scaling procedure using 1/exp(90) yields R=9e25 meter.

As an engineer one cannot help but be impressed with the approximate energy conservation of combined processes 1 and 2. These processes represent the largest construction project in nature and almost no energy is consumed. The “neat trick” seems to be cells that expand, on average don’t re-contract and are able to move and fall relative to each other after they are far apart.

Large space			
R is the universe size geodesic			
		quantum space	
		r=cell size geodesic	
RV^2/M	G=G	rv^2/m*1/exp(90)	
r=cells size geodesic		0.554	
v cell surface		15.7	m/sec
m cell		1.67E-27	kg
rv^2/m*1/exp(90)		6.67E-11	nt m^2/kg^2
V from ke=9.7 MeV		4.30E+07	m/sec
M=m*exp(180)		2.49E+51	kg
R=r(v/V)^2*(M/m)*1/exp(90)			G=G
R=universe size geoc		9.00E+25	meters
RV^2/M		6.67E-11	nt m^2/kg^2

Figure 9:3 Scaling Space to Universe Size

The radius 9e25 meters is larger than R1+R3=6.3e25 meters. The equations for expansion cause this difference.

9.3 Time dilation

Time dilation is the slowing of time associated with velocity. An expanded cell with a surface velocity of 15.8 m/sec gives a special relativistic time shift of 1.33e-15 seconds (calculated from velocity, KE=1.3e-12 MeV, gamma=(938/(938+KE), time shift =1-gamma, but since KE is low the time shift is approximately KE/(2*938)=1.33e-15 seconds.

The Schwarzschild time shift is a key general relativity prediction. The time shift calculated below is for one cell undergoing expansion at a radius of 0.55 meters. Agreement (the factor of 2 is Schwarzschild 2 in 2GM/(C^2*R)) indicates that special relativity and general relativity make the same prediction when the large factor exp(90) is included.

dt=1/(1-2GM/(C^2*R)^.5				
dt=1/((1-EXP(90)*2*6.67e-11*1.67e-27/(3e8^2*0.55)))^0.5				
		dt=(expression above-1)/2		
1.00000000000000133		1.332E-15	sec	

Figure 9:4 Example Time Dilation Calculation

Calculations show that time dilation dt for general relativity and special relativity are equal throughout expansion. Time dilation for a cell starts at 0.01 sec and decreases to the present value of 1.33e-15 seconds.

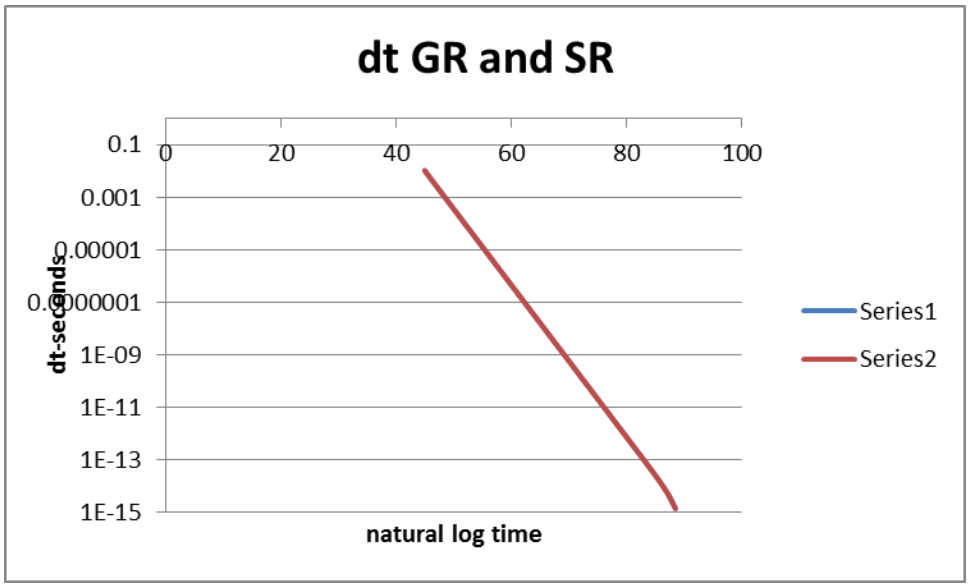

Figure 9:5 Comparison of Time Dilation for General and Special Relativity

9.4 Example 3: Agreement with the Schwarzschild radius.

It is demonstrated below that scaling with 1/exp(90) exactly matches the Schwarzschild radius (S) calculation. Proton mass is used in the equation below. The equation for S is:

1=1/(2*(Metric)-r) term in solution
2*(Metric)-r=1
r=2*(Metric)
Metric=G M/C^2 M is mass
S=2G M/C^2 singularity radius

This equation is twice the Compton wavelength r=G M/C^2. With G=r C^2/M this is the same equation in the box below G=RV^2/M when V=C.

Note that in this case, the velocity at the surface is the speed of light.

Large space			
R is the universe size geodesic			
		quantum space	
		r=cell size geodesic	
RV^2/M	G=G	rv^2/m*1/exp(90)	
r=cells size geodesic		0.554	
v cell surface		15.7	m/sec
m cell		1.67E-27	kg
rv^2/m*1/exp(90)		6.67E-11	nt m^2/kg^2
C light speed		3.00E+08	m/sec
m=proton mass		1.67E-27	kg
R=r(v/V)^2*(M/m)*1/exp(90)			G=G
R black hole geodesi		1.24E-54	m
RV^2/M		6.67E-11	nt m^2/kg^2

Figure 9:6 The Schwarzschild Radius with 1/exp(90)

R above equals 1.24e-54 meters. And below, the same calculation from Schwarzschild S=GM/C^2=2.48e-54 meters. This equation is central to prediction of black holes.

m	1.67e-27 kg
S=GM/C^2	2.48E-54
S/2	1.24E-54

In the following calculations, big V=C and the result is the Schwarzschild radius (S) for the solar mass (2e30kg). The result is S=1.48e3 meters. The G=G scaling procedure with 1/exp(90) used as a multiplier for the expanded cell matches the accepted Schwarzschild result (1.5e3 meters).

S=2GM/C^2=2.96E+03 m
My Geodesic at C and High M=1.50E+03 m
S=2Geodesic=3.00E+03 m

10 APPENDIX 3 PERCEPTION THEORY

In this appendix, the following topics will be discussed:

1. Nature uses a fundamental information unit N=0.0986 extensively, especially in the life sciences. It is fundamentally related to the electromagnetic field.
2. Integrating, a property of linked probabilities helps explain how complex perceptions evolve.
3. DNA probably contains linked probabilities that store information for future generations of life. It is a write/read information system. In other words, it not only stores the information but also expands it into the body by specifying where to place cells.
4. Perceptions are organized into a linked probabilities the author calls a "mental construct"? (Same concept as DNA except for the mind)

10.1 Linked Probabilities and their Properties

It is conceivable that the "whole" originally existed at a point shown schematically as the point labeled "1" on the Argand diagram. Information operations occurred that divided the logarithm 90 into components. Each components has an energy and a probability (P) based on E/e0=exp(N) and P=e0/E. Each P is equal to psi*psic but like a language, values of psi can be added together (linked) to form meanings.

Define linked probabilities as an organized set of probabilities (psi) that integrates information at a higher level.

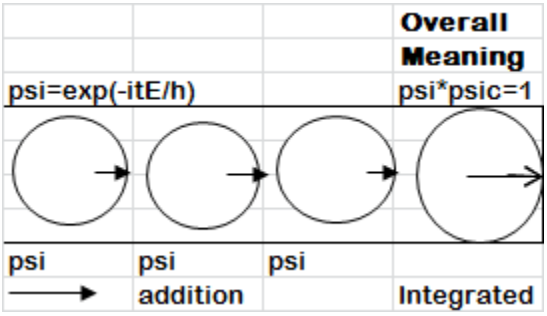

Figure 10:1 Repeat of Linked Probability Proposal

In the diagram above, sub-information segments are added together similar to an alphabet that forms a word. These information segments use the complex quantum mechanical probability psi that represents a wave function. Full perception requires collapse of a wave function, psi*psic=1. The left circle represents the original condition. Circles in the center represent sub-perception. This series of circles can be quite long. The circle

on the right represents the integrating process. It represents unification because it brings the linked probabilities circles back together.

The author will use diagrams similar to the one above as a theme throughout the work on perception and life**.** Meanings defined separately will be additive and give the linked probabilities an integrated meaning. This property allows information to represent diversity and complexity, yet be part of whole. The concept is that when nature divides something, a complementary process can occur which puts it back together. Nature uses uniform code (language) because it can be added together easily. Read the words linked probabilities as a concept that adds information segments and displays the meaning when psi*psic collapses the wave function.

Linked Electrons as Linked Probabilities

Electrons can be associated with each psi segment of the linked probabilities. Each electron has an associated proton that locks electrons into a structure but the electron appears to be the particle that can have information associated with it. Chemicals, especially carbon containing chemicals with 4 second shell electrons, are suitable for alignment. The electrons become a "linked probabilities" which takes on information (and meaning) through perception. When linked probabilities segments take on meanings, they are not simple repeats of each other. Each electron in the structure creates a new potential meaning. When the wavelength reaching the electron exactly matches the peak wavelength, the sensor responds with Pf/Pf0=one. During the integrating step, the peaks realign so they are observed simultaneously. The following figure shows the calculated and surprising result again. A simple addition of the four responses, red, green and blue light means white light to our mind.

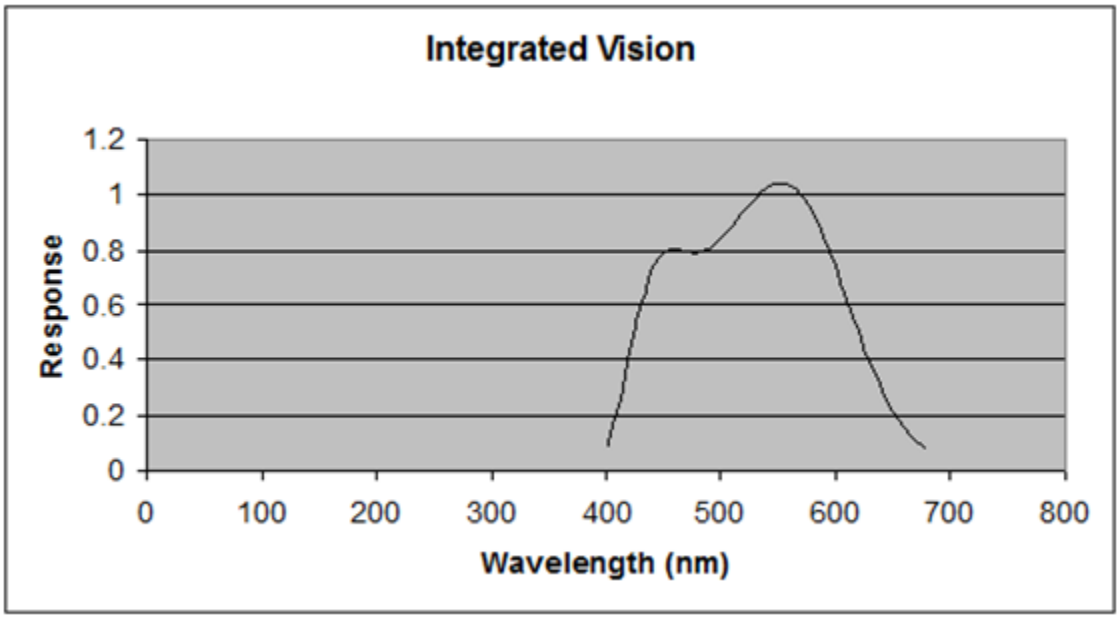

Figure 10:2 Calculated and Integrated Color Vision

More Complex Linked Probabilities

As an organism, complex perception is based on synapses connecting brain cells. Vision is considered an array of cellular sensors connected by nerves. Science has not fully understood how all this apparatus becomes our "mind" with its enormous capabilities. We can even "remember" views and associated events from the past as if they were captured by a vast memory.

To help understand the above capability, the author defines the "mental construct" as linked probabilities connecting sensory "apparatus" of the brain allowing it to function as a mind. Our color vision may not be the only sensor and it may be possible that linked probabilities, consisting of many electrons, can be brought into alignment. This would suggest that mind stores the whole "Pf/Pf0" associated with vision and the thoughts that go with it. This structure may allow complex meanings to develop and may underlie our ability to integrate many sub-perceptions into a single unified perception.

A mental construct is to the mind what DNA is to the body. The concept of a mental construct is that linked probabilities integrate our senses and create complex perception. The work is done in cells, but atoms and especially electrons make up the cells. The author is intentionally suggesting that the level of information interpretation may be deeper than the synaptic level. Nerve impulses fire in an all or nothing fashion. Information exchange between molecules is electrochemical but whatever the individual responses are, we know that the brain assembles the information. In this model, the integrating property underlies the overall "thought" that we experience.

Each segment of the mental construct is capable of contributing to a response. The response is Pf/Pf0 over interval dt and we experience this as perception. All the individual psi parts add to the integrating point psi0*psi0c=one, giving one combined response.

What proof do we have that the response Pf/Pf0 from the absorption equation represents perception?

a. The linked peaks for red light, green light and blue light give us color vision. Color vision is a single experience, not three. The peak at 591 nanometers in the eye is associated with black and white vision. It also smoothly adds to the perception of light, especially in low light.
b. Receptors in the eye are connected to optic nerves that lead to the brain. The associated neural networks connect to cells in the brain. However, we perceive one image, not three of what our eye sees. This is a good example of how individual cells combine their functions. Measurement of signals from red, green and blue receptors in the eye are known to add similar to the way the absorption functions add in this work.
c. Damage to individual cells in the brain shows us that there is a great deal of distributed storage and functionality. In this work, we would view this as integrated perception made up individual cell contributions allowing the

brain to function as a whole. It is clear however that most cells must function properly and some of our senses are easily destroyed.

10.2 **PERCEPTION SUMMARY**

1) "Perception of light" is the mind's capability to interpret absorption of light energy as **information**. The specific electronic shift involved is the second shell electron of carbon shifting from 3.4 electron volts to 1.5 electron volts and back.
2) The number N=0.0986 from the pattern shifts our interpretation of energy so that we see red, green, blue, and scotopic frequencies. According to this theory, this gives our minds the ability to perceive color. Use of the value 0.0986 to represent a probability seems to be nature's way of specializing segments in linked probabilities so that complex perception occurs made of many sub-perceptions.
3) The brain "stores" previous measurements through connecting synapses in the brain. Electrochemical messages pass across synapses, allowing a computer like network to operate. These networks allow our mind to make complex observations against complex expectations because our mind stores and operates a mental construct. Perceptions are based on comparing differences between new input and complex memories of previous relationships. Our mental capabilities are temporal, based on our experiences and neural networks but we store and process expectations. It is possible that the operational capability of our basic senses is built into DNA and passed down to us via evolutionary changes

The implications of having the pattern and quantum mechanical equations built into nature are far reaching. It means the following:

1. Perception (the observer) is central to nature.
2. Nature seems to facilitate development of higher complexity by creating sub-structures that fit together and function as a whole.

We have learned in this work that the things within our senses are perceptions and meanings that are transitory at best. Nature comes from a void, but it is a creative void. We are made of transitory energy, structured over time but in reality we are part of a collective, dynamic information structure that co-develops with our senses and the physical universe. We approach an understanding of the universe when we focus on perception as the platform from which we view the universe. Our thoughts are information and they change as we receive more information.

11 APPENDIX 4 BARYON AND MESON MASS ESTIMATES

Experiments at high energy labs have resulted in a large volume of data regarding the several hundred unstable baryon and meson particles. Experimenters gather this information with the goal of understanding the basic principles that give these particles their masses, properties, and decay times. Their masses are thought to be related to a Higgs particle that remains undiscovered.

The proton and neutron are classified as baryons. This appendix extends a theory that predicts the neutron and proton mass from a new theory involving energy interactions. Please be advised that this is somewhat tentative. It is shown that the remainder of the baryons and mesons are composed of quarks and kinetic energy components derived from energy interactions, similar to the proton and neutron. According to a zero energy principle, a quark mass and its kinetic energy are balanced against an equal and opposite field energy. An energy associated with a natural frequency is excited by collisions. Three quarks express themselves as a baryon while one quarks and one anti-quark express themselves as mesons. Reference 22 derives the natural frequencies involved and gives estimates for mesons and baryon masses. The goals are to:

- Explain the basic energies that form mesons and baryons.
- Show diagrams of the baryons and mesons.
- Explain the process that allows decay to new combinations of mesons and baryons and ultimately to electrons.
- Show that baryons and mesons belong to the same energy hierarchy. Baryons are classified as baryons since they decay to either a proton or neutron and carry an extra spin of 0.5, like the neutron or proton.
- Show the basic series that result in hundreds of particles. Does the series explain why most of the particles in the accessible energy range have been found?
- Explain the mechanism for decay and correlate all the particle decay times. Identify the quarks in the mesons and baryons.
- Suggest a mechanism for decay modes and correlate branching ratios for the decay products.
- Show the energy components for the Mu and Tao.

11.1 Excel® Spreadsheet Entitled mesonbaryon.xls

The above spreadsheet contains calculations for all the mesons and baryons (including the muon and tao). Each line of the spreadsheet contains the PDG data for the particle plus proposed calculations that show its origin, properties (mass, charge), decay time and calculated decay time. Data and calculations for many of the decay products and their branching ratios are also included. There was too much information to explain in a word document and even Reference 22 contains abbreviated information.

11.2 Component natural frequencies

Section 2 topic 2.6 describes four N values (referred to as a quad) that are involved in a zero entropy, zero energy interaction. The interaction results in a particle with kinetic energy attracted to central fields. The table below reviews two natural frequencies that form the neutron and proton.

Quads that cause natural frequency			
N	energy	N	energy
11.43	1.87	13.43	13.80
12.43	5.08	10.43	0.69
13.43	13.80	15.43	101.95
12.43	5.08	10.43	0.69
15.43	101.95	17.43	753.29
12.43	5.08	10.43	0.69
17.43	753.29	19.43	5566.11
12.43	5.08	10.43	0.69
19.43	5566.11	21.43	41128.30
12.43	5.08	10.43	0.69

Figure 11:1 Quads that cause natural frequencies in mesons and baryons

Four energy (E) values result from the four N values by the equation: E=e0*exp(N). An energy interaction involves exchanging the value N=2 in a way that the entering N total (13+12=15+10) shifts to (15+10=13+12) while the total 25.86 remains constant. The energy for this interaction also remains constant and a quark of mass E=e0*exp(13.43)=13.8 MeV is created and receives kinetic energy that balances the energy before and after the interaction. Specifically, the kinetic energy for the above quad is 83.8 MeV=101.95+0.69-13.8-5.08. The mass plus kinetic energy value for the first quad totals 102.63 MeV (101.95 + 0.69). Overall energy for all interactions is zero. This means that the two balancing field energies emerge that are negative and also total 102.63 MeV (101.95+0.69). This total energy is called a natural frequency and is a basic component of all mesons and baryons. The top portion of the table above indicates that the 13.8 MeV quark orbits in its strong field (-101.95 MeV). Its orbital velocity is determined by the transition (N=2) and is exactly gamma =0.135 (natural log of 1/exp(2). The quark is also attracted to the second, lower field (-0.69 MeV) and orbits with kinetic energy related to interactions that occur during its decay, not important for mesons.

The question related to baryon and meson masses is: “why do we see a response in particle detectors as the accelerator energy is increased through a specific level?” This paper proposes that there is a natural frequency match at the energy where the particle energy, including its fields is balanced at zero. For the quark of mass 13.8 MeV, this balance is represented by the value 102.63 MeV. For the second quad shown above, the higher energy is balanced (zero overall) at 754.0 MeV. Each of these frequencies contains a quark and other components from the quad. A 101.95 MeV quark is contained in a 754 MeV natural frequency. When the natural frequency is matched by the experiment, there is a potential that quarks can be expressed as a meson or baryon at that frequency. The quark itself is imbedded in the natural frequency but for a brief time,

experimenters are able to infer its spin and charge. Decay times are measured by velocities and length of tracks in particle detectors.

Mesons are classified by the quarks that they may be composed of. According to the standard model for particles [20] mesons contain pairs of quarks and anti-quarks that are labeled up, down, strange, charm, and bottom quarks. Also according to this classification, baryons contain combinations of three quarks.

N Quad pair	Natural frequency (MeV)	Quark
11.43	13.80	1.87
12.43		
13.43	101.95	13.80
12.43		
15.43	753.29	101.95
12.43		
17.43	5566.11	753.29
12.43		double?
19.43	41128.30	5566.11
12.43		

Figure 11:2 Natural Frequencies for Baryon and Meson Components

Particle Data group quark listings

Quark charges, spins and tentative masses are listed at the PDG website [22]. The convention for spin and charge used in this proposal are identical to the PDG listings:

Particle Data Group designation	PDG mass MeV	propertie (I,J)	charge
up	2.4	.5 .5+	0.667
down	4.9	.5 .5+	-0.333
strange -1	100	0 .5+	-0.333
charm +1	1290	0 .5+	0.667
bottom=-1	4190	0 .5+	-0.333

Figure 11:3 Particle Data Group Quark Data

The measurement method accepted by the PDG involves chirality (spin along its axis of travel) and may include some kinetic energy since single quarks have not been observed independently. Based on the above proposal, each quad contains components that can be particles or anti-particles. For example, the 11+12=13+10 quad has components at energy 1.87 and 13.8 MeV. Mesons can hold charge but the way they may get their charge is by charge separation as pairs are produced. Recall that the above quad represents an equal energy, equal entropy interaction and may be able to go either direction. The referenced quad could have an opposite (associated with an anti-particle) such that 0=.333-.333.

The following diagram describes the proposal for protons (typical for baryons). In the diagram below, the small circles represents the "bundles" of quarks with their kinetic energy orbiting in their strong field. The larger circle is a second orbit. The quark bundle orbits in a weak field with kinetic energy 10.15 MeV. The weak field is related to 4 12's of energy 5.08 MeV leaving the nucleon leaving an energy deficit. As the bundle falls into the 20.3 MeV field, it achieves 10.15 MeV of kinetic energy by "falling into the field".

Reference 16, *Application of the proton model to cosmology*, contains a re-analysis of the WMAP data. WMAP [11] concluded that dark matter was a significant component of our universe. The author explored the possibility that the light matter and dark matter were approximately equal. This means for the diagram below that there is another 939 MeV of "dark" matter and that the total energy for these three natural frequencies would be about double the neutron energy. The author suspects that an experimenter might produce a neutron and a dark neutron in a high energy collider at about 1878 to 1918 MeV. However these may be "out of phase" and the other possiblity is that the neutron and "dark" neutron only come from separation of zero into two parts. This does not happen with mesons and artificially produced baryons since they require energy from the accelerator.

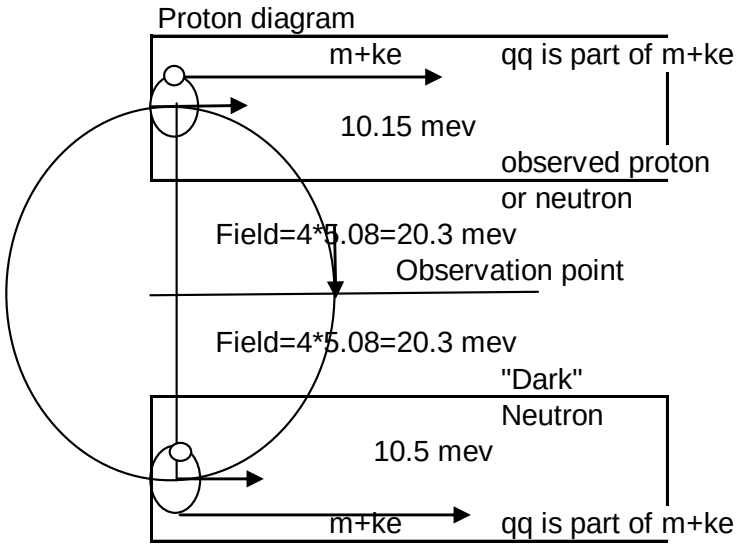

Figure 11:4 Proposed Diagram for Light and Dark Proton

It is clear from cosmology that the light and dark matter separate (dark matter has been inferred from gravitational lensing, anomalous velocity profiles of galaxies and WMAP analysis). This is reminiscent of the neutrino that is inferred by energy and property transitions that are "absent" but required for energy balances and property (spin, iso-spin, etc.) conservation. Quantum mechanics and the acceptance of anti-particles also provide a conceptual basis for energy that exists but is not observable in the same way as commonly accepted observations. It further indicates that there is a symmetry regarding angular momentum and that both the quark orbits in their strong fields and the quark bundle (see reference 1) orbits in their weak fields are opposite in direction. This relationship would be required to in fact create these particles from "zero" [Section 1].

Series for the total energy of mesons and baryons

A model for the masses of the neutron and proton was presented in Section 2. The model for these masses can be used to extend the theory to the other baryons and mesons. The proposal involves adding natural frequencies to arrive at the energy of a particle. They appear to form a limited base 10 number sequence. Refer to the number positions as 1's, 10's and 100's. The 1's position is 14.5 MeV, the 10's position is 102 MeV and the 100's position is 754 MeV. There are 183 mesons and baryons in the series that starts with 011 and ends with 723.

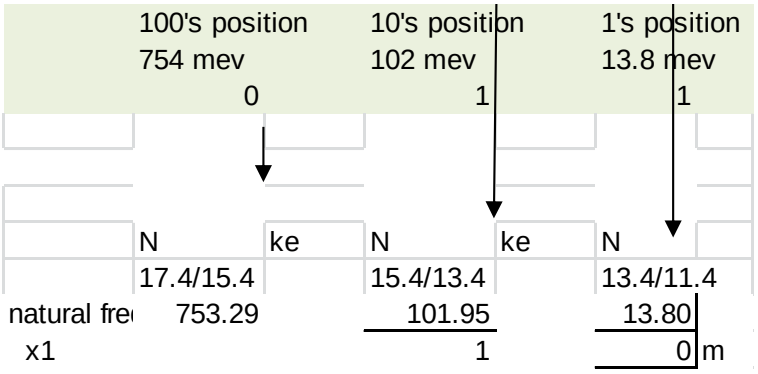

Figure 11:5 Meson and Baryon Series

The lower end of the number series is not fully filled in and the higher end of the number series uses primarily the 100's and 10's position (it doesn't count from 1→10 for each of the 10's position).

The proton and neutron mass is represented by the number 120 using the above series.
A few of the predicted and measured neutron and proton masses from reference 1 are shown as natural frequency components in the table below. All of the remaining baryons and mesons get their base energy by the totaling the natural frequencies involved.

Data	Predicted	Natural Frequencies		
Mass	Mass	13.8	101.947	753.291
(MeV)	(MeV)	(MeV)	(MeV)	(MeV)
1382.8	1384.63		7	1
1750	1749.371	1	1	3
1670	1692.646		8	7
1775	1787.004	1	1	5
1915	1925.67	1	2	2
1940	1944.487	1	2	3
2030	2038.57	1	2	8
2452.9	2466.435	1	4	10
1660	1655.013		8	5
2517.5	2529.836	1	5	3
2518	2529.836	1	5	3
2518.4	2529.836	1	5	3
5807.8	5814.644	3	6	8
5815.2	5833.461	3	6	9
5829	5852.277	3	6	10
5829	5852.277	3	6	10
5836.4	5852.277	3	6	10
1383.7	1384.63		7	1
1387.2	1384.63		7	1
2453.76	2466.435	1	4	10
2454.03	2466.435	1	4	10

Figure 11:6 Example of the Meson and Baryon Number Series

12 APPENDIX 5 MORPHOLOGY

Data from Genome Project

1e15	Number of cells/human
	3000 genes/cell
1e9	Number of bases/chromosome
	23 pairs of chromosome/cell
4.6e25	Number of bases/human
2.3e10	Number of bases/cell
4.0e12	Number of electrons per cell

Figure 12:1 Genomics Data

Fundamental Cell Size?

The absorption equation below was used extensively in the section regarding color vision.

Pf/Pf0=sin^2((f-f0)T/2)/(f-f0)T/2)

The absorption equation can also be written in terms of distance (D), instead of time (T). CT=D in the work that follows, where C is the speed of light and f is frequency. This is feasible since f*T=f/C*CT are both dimensionless. The same equation in terms of D follows with (f-f0) T/2= (1/wl-1/wlo) (2/ (1/dwl-1/wl)) = (1/wl-1/wl0)*2D0

Pf/Pf0= (SIN ((1/wl-1/wl0)*2D0)) ^2/ ((1/wl-1/wl0)*2D0) ^2

Where: Do=1/ (1/dwl-1/wl0) gives the width of the response curve.

Where: wl0=Peak wavelength standard i.e. 594 nanometers

Where: dwl=delta wavelength =response wavelength shift i.e. 55 nanometers

Example D0= 1e-9/ (1/55-1/594)=5.2e-6 meters

The human body has about 1e15 cells and knowing the density and size of the body, the average cell size can be calculated. Based on a circular cell, the radius on average would be 5.1e-6 meters (5.1 microns). This agrees with the speculative D0 above, although it is known that cells come in many shapes and sizes.

Please understand this is speculative.

1) Linked probabilities [Topic 10.1.1] may represent a whole body similar to the way three frequency peaks mean color vision. Probabilities may be stored within the DNA molecules. Although it is replicated in each cell and consists of many segments, it may represent “one” through the integrating property discussed above.

2) It is possible that cells are allocated to various parts of the body through probabilities. Because it is three dimensional it grows as Ncell^0.33.
3) It is the author's hypothesis that mind/body aliveness is the combined and varying Pf/Pf0 and D0 "cell placement" associated with integrated linked probabilities. It is plausible that electromagnetic energy is the basis of communication within and between cells. The "Pf/Pf0"perception function perceives this energy just as our eyes perceive energy coming from our surroundings. The "probabilistic map" in the DNA of each cell forms an "image" of itself in relation to the cellular structure around it. The process of cell division is special since it makes each electron in the gene map part of a "set". The concept of integrating is a way for linked probabilities with many "psi segments" to work together to create a whole. The "wholeness" achieved represents a image just as the components of 90 represent the proton.

13 APPENDIX 6 ELEMENTAL ABUNDANCE

This appendix is a continuation of Section 5.2.

The role of the electron in fusion

Section 2 indicated that the electron comes from energy interactions of the "electron quad". As with the other energy interactions there is a difference kinetic energy resulting from the requirement that the energy entering the interaction has to equal the exiting energy. In this case the difference energy specifies the initial kinetic energy of the electron. (0.622+27.2E-6-2.47E-5-0.511=0.1114 MeV).

As the neutron decays and releases the electron, the Proton Mass model indicates that the electron has the maximum initial kinetic energy above. The 0.1114 MeVenergy is released and the electron is in its base state of about 13.6e-6 MeV. As density changes the electron is either in its base state or degenerate if compression reduces the electron to less than 5.29e-11 meters. The equation is:

A requirement for fusion is that the electron must gain energy before it can be accepted into the atom. This kinetic energy barrier is quite high. For example, the sun's temperature produces only 0.002 MeV. This alone makes fusion low probability.

Late stage fusion in stars

Mass accumulation results in a first generation of stars that light the skies at about 500 million years. As stars over a threshold mass age, processes are put into motion that burn hydrogen to helium, helium to carbon, carbon to neon, neon to neon, oxygen to silicon and silicon to iron. There are several sets of data regarding the temperature and density during the life cycle of stars (burns) [4][26][31]. Based on the proposed fusion kinetics model, heavy elements found in nature are produced. The main empirical factor is the amount of material subjected to the high temperature conditions.

Burn time, temperature and density information [26] is shown below including the author's barrier energies and fusion calculations for burn time. Each column contains information for a specific burn. The fusion model gives the probability of reactions/second and burn times are calculated from 1/(probability of reactions/sec). This produces time for the burn that is converted to years. Densities are listed for comparison.

Comparison of lbl.gov burn times with				
	calculated burn times			
	protons–>He	He–>Carbon	C–>Ne	Ne–>O2
Chap10 density				
(kg/M^3)	5.00E+06	7.00E+08	2E+11	4E+12
Density**	1.52E+06	1.85E+09	1.2E+11	7.8E+11
Chap10 k	5	20	80	150
(mev)	0.00187	0.00892	0.03345	0.09915
Chap10 te	3.87E+07	1.55E+08	6.2E+08	1.2E+09
	1.45e7*	1.55E+08	6.2E+08	1.2E+09
V/C elect	0.09	0.18	0.35	0.55
degenera	8.26	88.17	352.68	661.28
Barrier	-0.01360	-0.08	-0.27	-0.49
Energy (mev)				
degen R	6.4E-12	6.0E-13	1.5E-13	8.0E-14
react rate	5.6E-09	1.3E-07	9.6E-07	2.9E-06
years	7.00E+09	5.00E+05	600	1
	1.20E-17	burn rate (n/sec)		
	2.65E+09	predicted burn (yrs)		
	7.00E+09	Chap10 burn (yrs)		
		He–>Carbon		
	(n/sec)	6.0401E-14	burn rate (n/sec)	
		5.25E+05	predicted burn (yrs)	
		5.00E+05	Chap10 burn (yrs)	
			C–>Ne	
burn rate (n/sec)			7.1E-11	
predicted burn (yrs)			447	
Chap10 burn (yrs)			600	
				Ne–>Oxyg
	burn rate (n/sec)			3.2E-08
	predicted burn (yrs)			1.0
	Chap10 burn (yrs)			1
* alternate source for solar temperature				
** density formula 5e-16*T^3 kg/m^3				
http://www.lbl.gov/abc/wallchart/chapters/10/0.html				

Figure 13:1 Burn Times part 1

Comparison of lbl.gov burn times with calculated burn times			
	O–>Si	Si–>	fe–>
Chap10 density			
(kg/M^3)	1E+13	3E+13	5.00E+15
Density*	1.9E+12	9.9E+12	6.25E+15
Chap10 k	200	350	3000.0
(mev)	0.10249	0.3115	3.00E+00
Chap10 t	1.5E+09	2.7E+09	2.32E+10
	1.5E+09	2.7E+09	2.32E+10
V/C elect	0.55	0.78	0.99
degenera	881.707	1542.99	1.32E+04
Barrier	-0.55	-0.9	-1.00
Energy (mev)			
degen R	6E-14	3.4E-14	4.00E-15
react rat	3.9E-06	9.6E-06	1.03E-04
years	0.5		
	6.6E-08	burn rate (n/sec)	
	0.48	predicted burn (yrs)	
	0.5	Chap10 burn (yrs)	
		Si–>	
burn rate (n/sec)		1E-05	
predicted burn (yrs		0.0030	
Chap10 burn (yrs)		0.00274	
	burn rate (n/sec)		9.22E-01
	predicted burn (yrs)		3.44E-08
	Chap10 burn (yrs)		3.17E-08

Figure 13:2 Burn time comparison part 2

Fusion kinetics during star evolution

The example for solar fusion presented in topic 5.2.4 was used for the remainder of the elements with temperatures from figure 13:1 and figure 13:2 for each of the supernova "burns".

Using barrier energy from the binding energy model, the fusion model and temperature from 5-9, an abundance can be calculated for each elements. Using abundance data from reference 27 it is fairly easy to determine the burn that formed each element. Once the source is determined the elements can be plotted and the slope determined. The slope is unique for each burn because the denominator in the following equation (MeV) is determined by temperature alone.

Pbarrier= exp(BE/(1.5*B*T)).

Density was calculated as follows and compare favorably (Figure 13:1).

Density (kg/m^3)=(T^3)/3.14e16 where T is degrees K

Abundance calculatons

Equation for abundance calculations:
Abundance fraction=Pbarrier*Pdensity*Reaction rate*fraction*burn time

Where:

Pbarrier=exp(-BE/ke) barrier energy from binding energy model
Reaction rate=V/(2*pi* rdegenerate)/exp(60)
Pdensity=density/5.03e11
Fraction=fraction available in the core to burn
Time=burn time in seconds

Burn time= 1/(Pbarrier*Pdensity*Reaction rate)

The table below contains the constants for each burn in the vertical column. The only unique thing about each element is its barrier energy.

Carbon Abundance Example		
Temp	deg K	1.55E+08
Density	kg/m^3	1.20E+08
Dmax kg/m^3		5.02E+11
KE temp	1.5*B*T	0.020
degeneracy		35.43
Degenerate radius (DR)		1.49E-12
v/c		0.27
Barrier		-0.15
Example calculation for above conditions		
	Pbarrier	
	exp(-.152/.02)=5e-4	
	P density	
	(dens/crit)=2.3e-4	
	P rate/sec	
	v/(2pi*r)/exp(60)=7.6e-8	
fract at temp		8.00E-03
Pb*Pd*Rate/sec		7.25E-17
time (seconds)		1.58E+13
calculated carbon abundar		0.0011
	data	0.005

Figure 13:3 Carbon abundance example

The calculation above was carrier out for each element. The resulting abundance data was grouped by burn (this required selecting which atoms were produced in the burn but a pattern was fairly clear because each burn has a unique slope) and plotted on a semi-log plot for all points (atomic numbers including isotopes). A statistical fit was determined (the line below) from the abundance groupings. The burn lines were produced from the barrier energies, densities and fusion kinetics. One example is shown below.

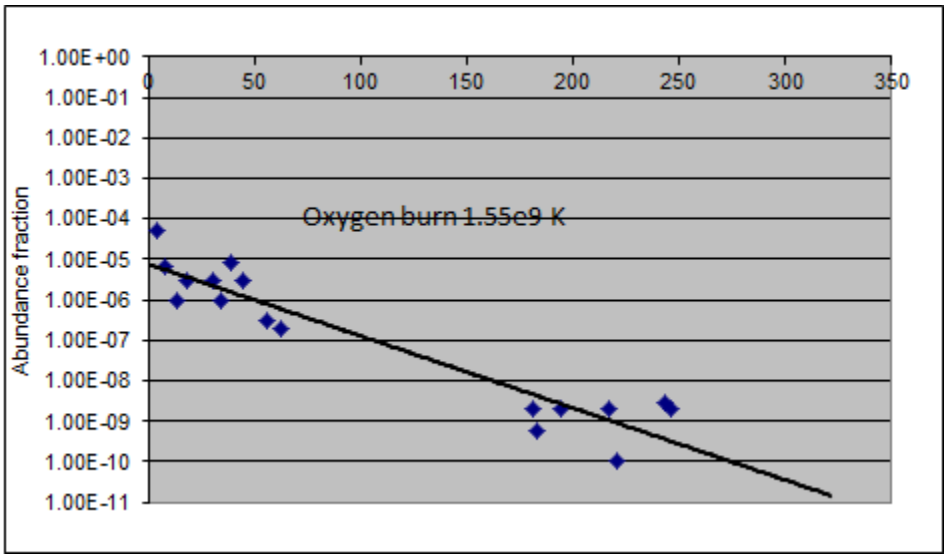

Figure 13:4 Oxygen burn slope

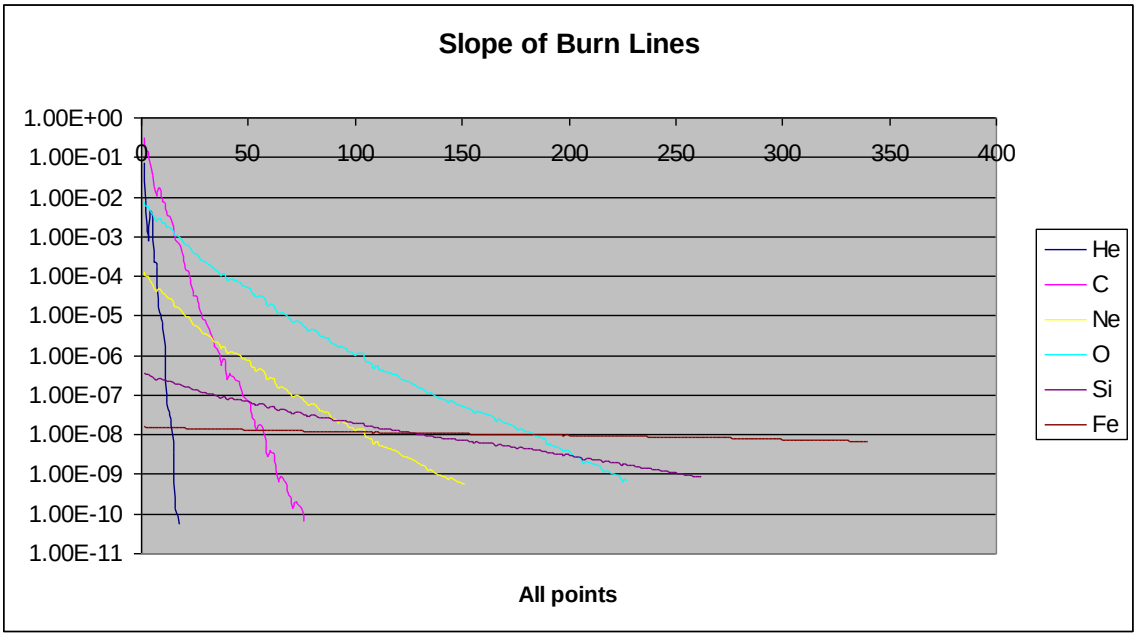

Figure 13:5 Slope of Burn Lines

Abundance of the elements

Abundance data [27] is presented below on the vertical axis of a semi-log plot. The horizontal axis is all the atomic numbers and their isotopes.

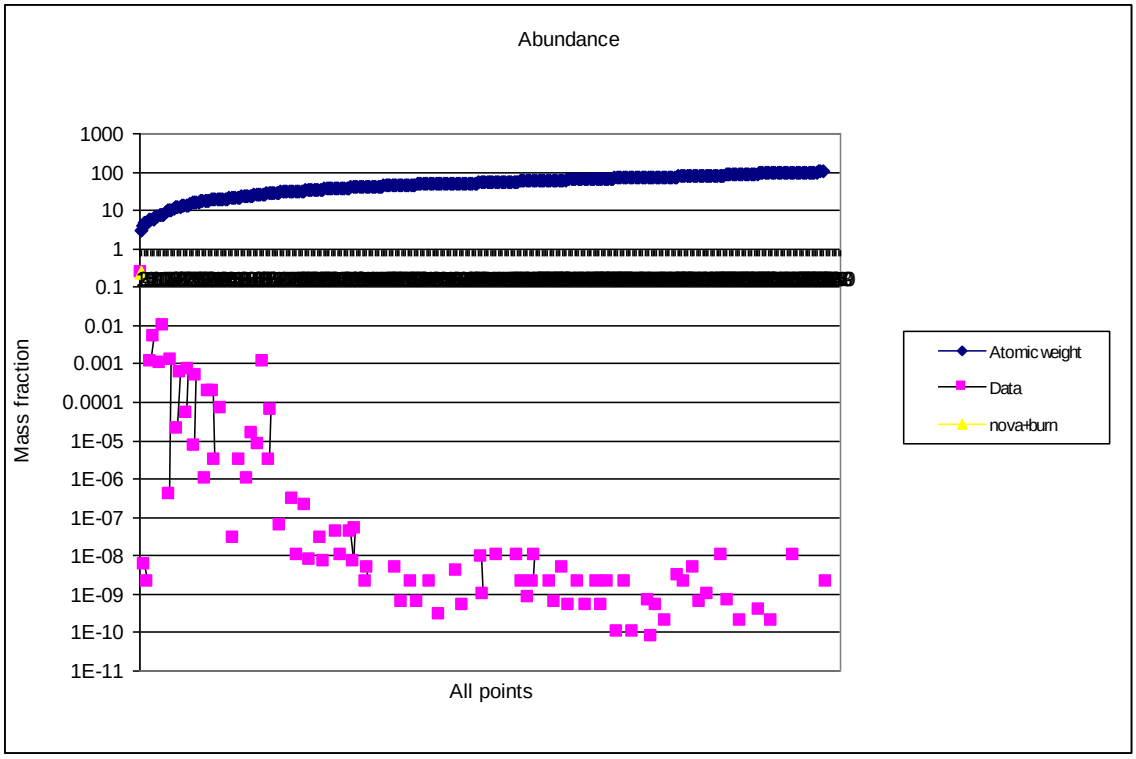

Figure 13:6 Abundance Data

The burn lines (the points marked in yellow that determine the burn line) above are superimposed on the raw data below to produce a comparison of data and calculated abundances. The ratios for each data set below compared with its temperature line are on the order of 1 or 2 standard deviations.

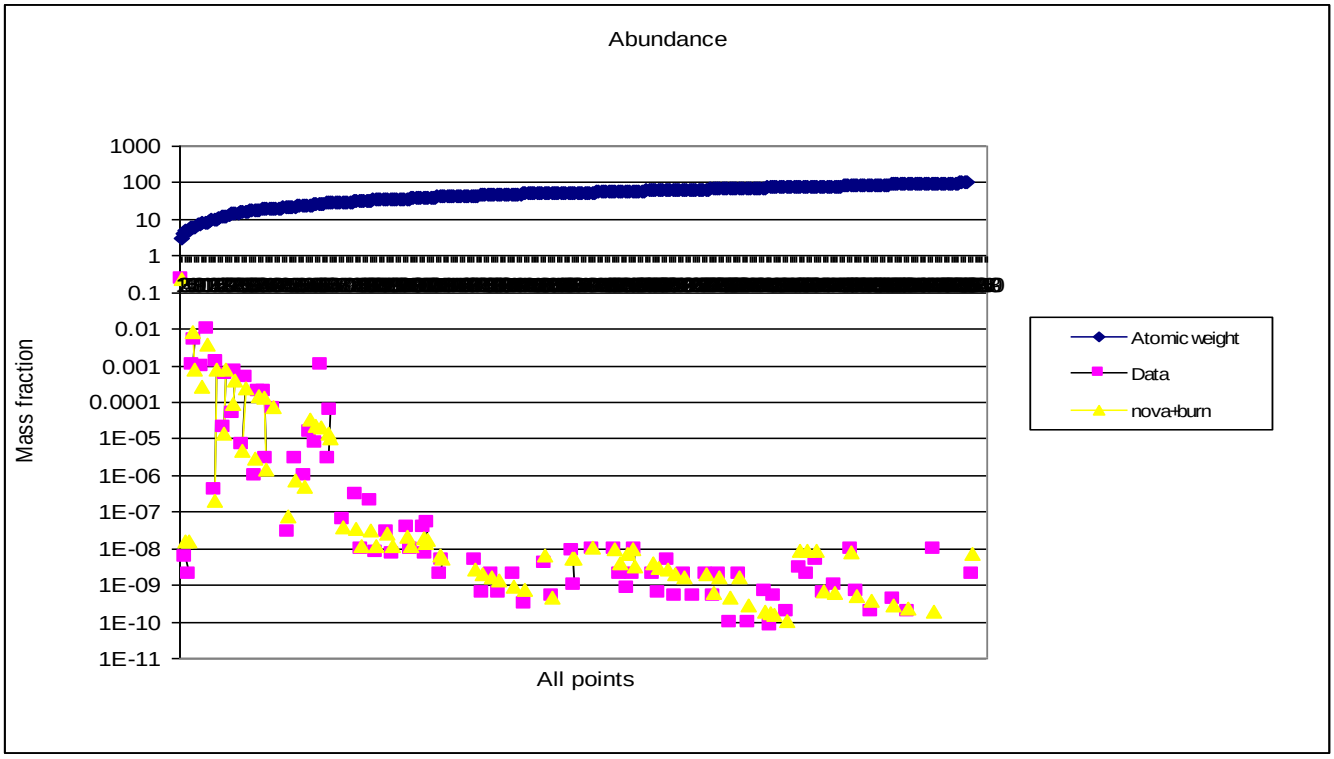

Figure 13:7 Comparison of Abundance Data with Abundance Calculations

As indicated above, the model is semi-empirical since the vertical position of the line is also dependent on the fraction of the burning element that is subjected to high temperature. This will remain empirical because the history of all supernovae cannot be known.

This completes the author's goal of demonstrating the power of a probabilistic moel for fusion based on 10.15 MeV for a probabilistic binding energy curve.

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