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Research Article

Gravitational Energy and Expansion Models

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Abstract

Cosmology expansion models require accurate space and time models. Two models are analyzed for proper use of gravitational, energy conservation and thermodynamic principles. One model is the conventional Lambda Cold Dark Matter (LCDM) model. The other model is called a straight-line expansion model. The LCDM model utilizes a cosmological constant to simulate late-stage expansion. The straight-line model expands at C and allows the current radius R to be determined from Hubble's constant. This eliminates uncertainties associated with CMB based determination of the current radius with the LCDM model. Both models are based on exchanging kinetic energy for potential energy, but the critical density equation obscures kinetic energy values. The straight-line model's attributes do not depend on values from a companion proton model but with its initial kinetic energy 10.15 MeV leads to a specific energy history. The end point in the history is 28 times less than CMB temperature 2.73 K indicating that another energy source may overwrite the CMB. The cosmic web is an alternative source of CMB variations. Preliminary work indicates that observation of early galaxy formation, flat galaxy rotation curves, dark matter, dark energy and Hubble tension can be resolved using straight-line expansion. The author is an amateur seeking help from the scientific community.

Keywords: Expansion Model, LCDM, CMB, Critical Density, Dark Matter, Dark Energy

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Comparison of Expansion Models

This section discusses the LCDM model's adherence to proportionality between time and distance. Hubble's constant (H0) has been reported for various methods (WMAP, PLANCK, Cepheid variables [1-4].

H0 1/sec	km/mpc/sec	Source
2.187E-18	67.50	HST
2.375E-18	73.30	Cephids

Table 1 Hubble's Constant

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Cephid variable data is the basis of the LCDM expansion curve below in red. It can be compared with the blue line that has slope C (lightspeed). WMAP reported methodology for constructing the expansion curve [3].

R expands as R'=R*(time'/time)^(2/3) (prime for the next value as time advances) (1)

Current time in the graph below is 1/H0=4.21e17 seconds (2)

Current R in the graph below =1.262e26 meters (3)

Early expansion velocity is greater than C. At about 2e17 seconds, the slope falls below C, and a cosmological constant becomes significant. This simulates data that shows accelerated expansion [2,5]. The slope is about velocity C at the present time= 1/H0.

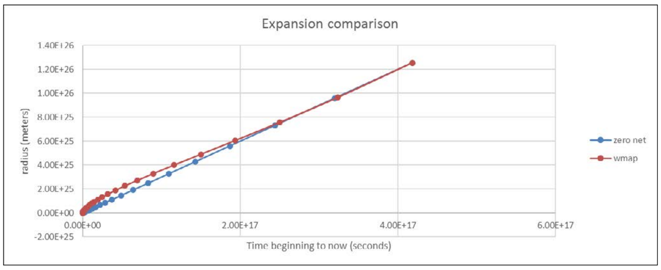

Figure 1 Comparison of Expansion Models

The diagram below shows the difference between the LCDM model and a model that defines space as a small circle with radius r that can be scaled to large R.

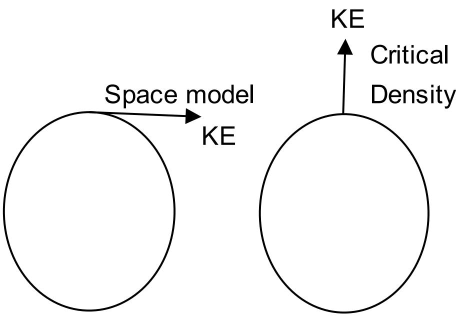

Figure 2 Velocity Vector Difference

The LCDM model is based on density projected upward (opposing gravitational force). Kinetic energy is exchanged for potential energy based on the critical density equation for Rho [3]. The equation obscures the value of kinetic energy (KE).

KE=1/2*M*V^2 = PE = F*R= (G*M^2/R^2)*R (4)

Rho=(V/R)^2/(8/3*pi*6.67e-11) (5)

Expansion in the small circle model is based on a vast number of expanding circles that collectively represent large R. Large R expands at velocity C [6,7]. Gravitation, energy conservation and thermodynamic principles define the small circles. The critical density equation does not apply because R's in the derivation above cannot be combined (velocity is a different direction).

Space Model for Straight-Line Expansion

This section will present a definition of space based on a circle that ebeys Et/H=1 and Schrodinger equation P=1. Small space r is scaled to large R expansion over multiples of time t.

Slope C at large scale R defines small scale r'=(time'/time)^1, not exponent (2/3). (6)

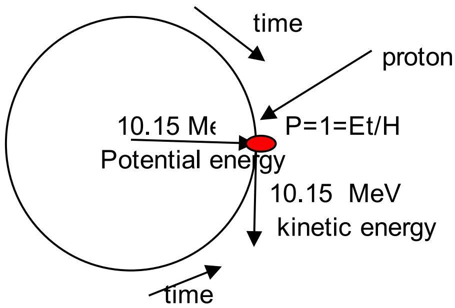

Figure 3 Space Model

Energy E=hv is written Et/H=1

Planck's reduced constant h=H/(2pi)=6.582e-22 MeV-sec. (7)

Energy E is the frequency associated with time moving around the circle. The radius of the circle

r= hC/E where E= gravitational field energy (8)

E=0.687+ 0.687+ 0.687+ 0.740 = 2.801 MeV gravitational energy from Table 6 (9)

Initial radius r=hC/E=(6.582e-22*2.998e8)/2.8011=7.0447e-14 meters (10)

Time across large R advances from exp(60)*2.35e-22 to exp(90.384)*2.35e-22 seconds (11)

Radius R=r*exp(60) in three dimensions with number=exp(180)^(1/3) from equation 43 (12)

Small r=7.045e-14 meters expands with r= time*C/exp(60) meters (13)

Expansion of large R vs time across radius R is called straight-line expansion. The current time on expansion curves is 1/H0. With slope C, the current radius is R=C/H0=3e8/3.75e-18=1.26e26 meters (equation 29). The current radius of the LCDM model is also R=1.26e26 meters. The straight-line model determines large R without numerous sources of error analyzed and reported by WMAP. A portion of the model below compares Cephid variable H0= 2.375e-18/sec to Hubble Space Telescope H0=2.180e-18.

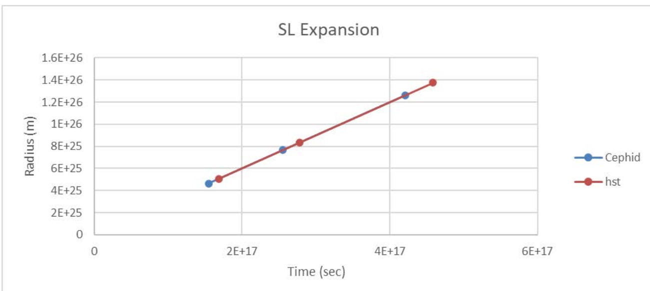

Figure 4 End Portion of Straight-Line Expansion.

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The Hubble constant does not change the expansion slope or the line's position, but it changes the current time=1/H0. Expansion ratio Z=Rfinal/R-1 is dependent on current radius R.

Edwin Hubble's discovery that large R is expanding was based on a graph constructed with data. It is reconstructed below as "Velocity vs Distance away". The column labelled V= dR/dtime= slope= C. When C is divided by R= 1.26e26, it reduces the column values labelled V=H0*distance away. The column labelled H0 =3e8/(1.26e26/3.08e22)) km/sec/parsec is the slope for the reconstructed Hubble graph. From our perspective, the slope is less than C because large R increased.

			R=1.26e26 m	dR=R-R'		H0	V=H0*dR
exp(N)	Time (sec)	r/proton (m)	R'=r*exp(60)	Distance awa	V=dR/dtime	km/sec/mpars	Distant velocit
			(meters)	1.26e26-D'	(km/sec)	V/(R/3e22)	(m/sec)
89.384	1.55E+17	4.07E-01	4.64E+25	7.98E+25	3.00E+08	73.16	1.90E+08
89.884	2.55E+17	6.70E-01	7.66E+25	4.97E+25	3.00E+08	73.16	1.18E+08
90.384	4.21E+17	1.11E+00	1.26E+26	0.00E+00			0.00E+00

Table 2 Simulation of H0.

Comparison of Thermodynamics for Expansion Models

This section examines whether the models obey thermodynamic principles. Adherence to thermodynamics requires tangential velocity in the associated space model. Proof at the measured current temperature T=2.73 K is presented.

In the space model, pressure that expands r is inertial force divided by area. Inertial force is produced by a particle with velocity tangential to the circle radius. For example, at the end of expansion:

r=1.262e26/exp(60)=1.105 meters (14)

Temperature=2.73 K (15)

V =(2*3.528e-10/1.6726e-27*1.6022e-13)^0.5 =259.6 meters/second (16)

Outward inertial F/A equals the pressure of mass moving around radius 1.105 m.

Force= mV^2/R = 1.6726e-27*259.6^2/1.105 = 1.032e-22 N (17)

Area = 4*pi*(1.105^2)= 15.35 meter^2 (18)

Pressure1= Force/Area= 6.7e-24 N/meter^2 (19)

density=1.6726e-27/(4/3*pi()*1.105^3)=2.96e-28 kg/m^3 (20)

Pressure2 =rho R T=2.96e-28*8257*2.73=6.7e-24 N/meter^2 (24)

Pressure1=Pressure2 completes the proof (21)

Velocity in the direction of the expanding surface in the LCDM model represents escape velocity. Some believe that pressure expands large R and if so there are two kinetic energy sources because kinetic energy in the direction of expansion is not thermodynamic pressure. There is expansion in both models, but the cause is different. WMAP projected temperature 2.73K back to earlier expansion with (time/time)^(2/3). This temperature defined conditions called equality and de-coupling. These key values were used to determine the percentages of dark energy and dark matter. A CMB peak angle=0.0104 radians was scaled to the current radius of the universe. Large R was credible but there were several sources of error and questions about critical density components.

Energy Conservation

This section evalutes adherance to energy conservation for the alternate cosmologies. The LCDM model is intended to be based on KE to PE conversion, but values are obscured by critical density. The straight-line model is based on kinetic energy conversion to potential energy and the values are below.

Initial KE=10.15 MeV/proton based on Table 7 (22)

Velocity for this kinetic energy = 0.1459*C=4.375e7 m/sec (V is tangential) (23)

(gamma=(938.27/(938.27+10.15))=0.9893 and V/C=(1-g^2)^0.5= 0.1459) (24)

Inertial force F =1.6726e-27/0.9893*4.375e7^2/7.0447e-14=45.937 N (25)

Initial PE =45.937/0.995*7.0445e-14/1.6022e-13/2=10.15 MeV (26)

A proton on the surface of the space circle has initial energy =10.15+10.15=20.3 MeV (27)

In the equations below, maintaining G throughout expansion is the basis of ke/proton as radius increases. The proton on the space circle obeys a Newtonian orbit throughout expansion.

G=RV^2/M= rv^2/M also written as (v/V)^2= (r/R) or KE/KE'= r'/r (28)

KE initial= 10.15 MeV and R initial= 7.045e-14 meters (29)

r= 10.15*7.045e-14/KE also written as KE=10.15*7.045e-14/r (30)

The equalities below conserve energy.

20.3=KE+PE MeV beginning (31)

20.3=10.15-dKE+10.15+dPE MeV (32)

20.3=3.5e-10+almost 20.3 MeV (33)

Potential energy at the end should be related to the gravitational energy 2.801 MeV because gravitational force resists positive but decreasing inertial force throughout expansion. Curvature of small r can be decreased but it consumes kinetic energy. Gravitation energy 2.801 MeV is curving small r with the equation r=hC/E but its effect is hidden in the gravitational constant G. The multiple 2.801*7.045e-14 is proportional to G in the equation below. Mass 2.1764e-8 kg is the Compton mass, derived at the Planck scale.

G=2.8011*7.0447e-14/(2.1764e-8)*1.6022e-13=6.674e-11 N m^2/kg^2 (34)

Unit check: 2.8 MeV is 1.78e-13 N-m in the KMS system.

A reconstructed Hubble graph (Velocity vs Distance away) is compared below for two H0 values. When redshift measurements are made for velocity, different slopes introduce well known distance errors.

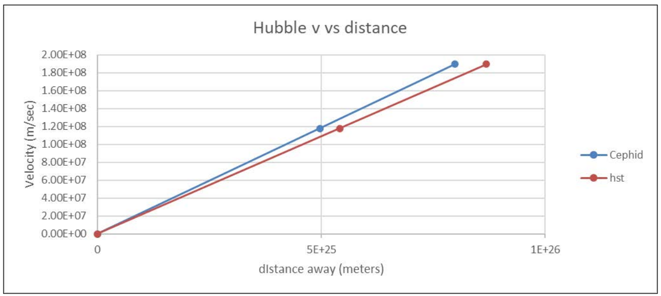

Figure 5 Reconstructed Hubble Graph

Gravitational Energy for Large Scale R

This section provides a cross-check for gravitational energy 2.801. The gravitational energy E is calculated below using exp (180) particles from equation 43 at the "center" of large R orbited by a proton. Small scale properties are the same everywhere and there is no real large-scale center. Equation 35 yields E=F*R.

6.674e-11*exp(180)*2.3206e-28*1.67e-27/
(7.0447e-14*exp(90)/1.6022e-13=2.801 MeV (35)

The value 1.6726e-27 kg is the proton mass but the particle with mass 2.32e-28 kg is interesting. It is found in Table 7.

101.947		
13.797		
13.797		
0.6224		
130.163	1.7827E-30	2.3204E-28
MeV	kg/MeV	kg

Table 4 Mass of Quarks Without KE from Table 7

A mass without kinetic energy cannot resist accumulation according to the Jeans criteria. A mass cloud will collapse when its pressure is less than gravitational pressure and the crossing time criteria is met. This particle could quickly form observed black holes.

Energy History

This section is the energy history for straight-line expansion. It will be compared with LCDM CMB temperature measurement 2.73K. A potentially important assumption is revealed. Initial KE=10.15 MeV/proton. Expansion reduces kinetic energy triggering primordial nucleosynthesis at KE=0.11 MeV adding 7.07*0.29=2.03 MeV/proton.

exp(N)	Time (sec)	r (m)	dKE/proton (MeV)	Velocity (m/sec)	Inertial F N	dPE (MeV)
60	2.68E+04	7.05E-14	10.15	4.410E+07	4.610E+01	0.00
64.52	2.46E+06	6.47E-12	1.11E-01	4.602E+06	5.467E-03	10.04
64.52	2.46E+06	6.47E-12	2.14	2.025E+07	1.058E-01	8.01
90.384	4.21E+17	1.11E+00	1.26E-11	4.911E+01	3.644E-24	10.15

Table 5 Energy History Throughout Expansion

The LCDM measured temperature is 2.73K (3.53e-10 MeV).

Ratio = LCDM KE/(straight line KE)=3.53e-10/1.26e-11= 28.

Both temperatures= 2.73K. This means there must be another energy source for straight-line expansion. If it is energy from star fusion, the "first light" CMB may have been overwritten.

Justification for the Straight-Line Expansion Model

Some will question why values from Tables 6 and 7 should be used. Two cases are examined, with and without these tables.

1) Without Table 6 and 7 values, the straight-line model is justified by its adherence to velocity C, gravitational and thermodynamic principles. Space is modeled as a circle that obeys Schrodinger P=1=Et/H. Time and space are properly proportional. Thermodynamics is obeyed when modeled as inertial force divided by the surface area of the small sphere. Slope=C provides a straightforward simulation of large R, the same value reported by WMAP but without dependence on a cosmological constant that has been problematic for fundamental physics. The model is energy based.

The LCDM is based on R'=R*(time'/time)^(2/3). Time and space are not proportional. Early expansion is greater than C in Figure 1. Expansion is based on critical density (1.0e-26 kg/m^2 for H0 3.75e-18/sec) opposing gravity with fractional components 0.714, 0.24 and 0.046. To date the first two components, dark energy and dark matter have not been experimentally verified. The LCDM model is not based on energy, and it is difficult to analyze fundamentals/particle.

2) With the values in Tables 6 and 7 the straight-line model's capability is enhanced. Energy=2.801 MeV defines initial radius r= 7.045e-14 and time across the circle 2.3e-22 sec. Expansion is based on initial kinetic energy 10.15 MeV being converted to potential energy. The proton number exp(180) leads to a cosmology expansion model with slope C that scales r to R=r*exp(60) in three dimensions. The density is determined by exp(180) proton masses divided by the volume of large R. Protons with velocity tangential to the circle produce inertial force that is balanced by gravitational forces into small orbits. Gravitational energy curves small r according to r=hC/E. It was shown that gravitational energy =2.801 MeV and the Newtonian constant are related.

Possibility that the Models Reviewed will Resolve Current Concerns

The section below addresses the future of cosmology. Current cosmology concerns require further study, but the models reviewed contain clues.

1. Early mass accumulation is promoted by comparatively high early density in the straight-line model [8].
2. A particle without kinetic energy appears in the model that aids black holes formation according to the Jeans criteria [9].
3. The straight-line model is energy based. The history of energy vs time suggests that the CMB may be over-written. CMB and the LCDM model lead to unsubstantuated percentages of normal matter, dark matter and dark energy. Star densities in the cosmic web may be the source of CMB variations [10].
4. Space associated with each proton can both expand and contract. Small r=const/KE. KE decreases during expansion and increases during mass accumulation. This may help explain dark matter and Hubble tension [11,12].
5. The Friedmann equation dates to 1922. Einstein's cosmology constant was added later. The relationship R'=R(time'/time)^(2/3) needs to be re-examined.
6. Progress toward a unified theory [13].

Neutron and Proton Models

Neutron and proton models are based on data in Table 8. Table 6 shows the energy values associated with N and describes the pattern they form. Table 7 shows the neutron and proton mass components that simulate the mass of the neutron, proton and electron. These tables provide values for gravitational energy, quark masses, weak field energy, kinetic energy and potential energy.

Neutron				Proton					
N values for mass	E=e0*exp(N)	N values for fields	E=e0*exp(N)	N values for mass	E=e0*exp(N)	N values for fields	E=e0*exp(N)		
12.432	5.076	10.432	0.687	12.432	5.076	10.432	0.687	X	
15.432	101.947	17.432	753.291	15.432	101.947	17.432	753.291		
12.432	5.076	10.432	0.687	12.432	5.076	10.432	0.687	Y	
13.432	13.797	15.432	101.947	13.432	13.797	15.432	101.947		
12.432	5.076	10.432	0.687	12.432	5.076	10.432	0.687	Z	
13.432	13.797	15.432	101.947	13.432	13.797	15.432	101.947		
Z components	E=e0*exp(N)	N value for Z Field	E=e0*exp(N)	W components	E=e0*exp(N)	N values for W fiel	E=e0*exp(N)		
-10.432		-10.432		-10.432		-10.432			
10.507	0.740	10.507	0.740	**10.408**	0.671	10.5069	0.740		2.80113
10.333	0.622	10.333	0.6224	10.136	0.511	10.333	0.622		
				0.2958	2.72E-05				
90.000		90.000		90.0000		90.000			

Table 6 Neutron and Proton Information N and Energy E Models

Information values N for energy components is in the left column of the neutron diagram on the left. Energy correlation with N.

E= 2.0247e-5*exp(N) based on correlation of E and N in table 8. (36)

N is information [ref 1] with N= neg ln(p) written as p=1/exp (N).

Combining the correlation with the definition yields E=2.0247e-5*exp(N) (37)

The value of N correlated with energy in Table 8 data is placed next to its respective E=2.02e-5*exp(N) value in Table 6. The N values form a pattern. For the first six rows of the models, N is a whole base 10 number plus a decimal.

The decimal following the whole number is 1/3+.0986=0.4319 (the value 0.0986 = ln(3/e)). (38)

The N values are different by =/-2 within sets of four N values. The set below defines one quark with kinetic energy in energy fields.

There are six rows of N values in sets of 4 in table 6 that represent P=1 multiplication and division of probabilities.

(1/exp(12.432)*1/exp(15.432))/(1/exp(10.432)*1/exp(17.432)=1 (39)

The neutron energy in the left-side diagram decays to a proton, electron, and anti-electron neutrino in the right-side diagram based on p=1 and energy=0 transitions in the bottom three rows. Energy values from Table 6 are arranged into columns for clarity in Table 7. Energy components add down through the table leading to a simulation of neutron and proton mass in red. Particle Data Group data is compared to neutron and proton mass simulations [14]. The protons and neutrons themselves have initial expansion kinetic energy and potential energy.

KE+ potential energy =4*(2.0247e-5*exp(12.4319))=10.15 MeV KE+ 10.15 MeV PE (40)

Expansion is based on exchanging kinetic energy for gravitational potential energy. There is also 10.15 MeV of kinetic energy inside the neutron that is the asymptote for energy lost during fusion [8].

	MeV		MeV		MeV		MeV
	Neutron Mass Components		Neutron Field Components		Proton Mass Components		Proton Fields
	101.947	Mass	753.291	Strong Field E	101.947	Mass	753.291
	13.797	Mass	101.947	Strong Field E	13.797	Mass	101.947
	13.797	Mass	101.947	Strong Field E	13.797	Mass	101.947
	5.076	Ke	2.801	Gravitational Field	5.076	Ke	2.801
	646.955	Difference KE			646.955	Difference KE	
	83.761	Difference KE			83.761	Difference KE	
	83.761	Difference KE			83.761	Difference KE	
	10.151	Fusion KE			10.151	Fusion KE	
	-20.303	Weak Field E			-20.303	Weak Field E	
					-0.622	minus quark mass	
accuracy vs PDG	0.622	adds to quark mass		accuracy vs PDG	-0.048	ae neutrino	
-7.18546E-09			-0.118	-0.0000096	-5.44E-05	Em Field +2	-0.118
939.5654133	939.565413	Neutron mass		**938.2720814**	938.27209		
PDG				PDG	2.72E-05	EM Field -1	
					0.511	Electron	
					0.671	.622+.048	
					0.11141	Kinetic E	
	10.15127081	KE Expansion			10.15	KE Expansion	
	10.15127081	PE Expansion			10.151	PE Expansion	
	959.8680		959.8680		959.8679		959.8680

Table 7 Neutron and Proton Mass Model

Probability =1 recovery with improbable components.

This section provides a probablistic argument for the number of neutrons in nature that decay to protons, electrons and anti-electron neutrinos. Information N values of the left-hand side neutron components total 90 [Table 6]. Written as a probability [4]

The equal and opposite left-hand side components are both p=1/exp(90) (41)

They occur at the same time, multiplying the probability p=1/exp(90)*1/exp(90) (42)

To recover P=1 there must be a vast number.

P= 1= probability of each neutron* number of neutrons= 1/exp(180)*exp(180) (43)

After neutron decay, the electromagnetic field separates into equal opposite charges for the proton and electron.

Energy Data Correlation with Information

The author found an information correlation in the data below for fundamental particles. It led to a math model of neutron and proton components. Data is from the Particle Data Group [14].

		Particle Data	Energy Es	N details
Identifier		Group energy	Es=e0*exp(N)	
v means neutrino	N=ln(E/e0)	E (MeV)	(MeV)	e0=2.025e-5 MeV
taon v		<15.5		
electron v		2.20E-06	0.048	
N component	0.0986			ln(3)-1
N component	0.16667			.5/3
muon v		< 0.17	0.0695	
E/M Field E	0.296	2.720E-05	2.72E-05	3*.0986=.296
ELECTRON	10.136	0.51099891	0.511	10.136=10.432-3*.0986
N component for qua	10.333		0.6224	10+1/3
N component for W	10.408		0.671	90-remainder
Grav field compc	10.432		0.687	10.432=10+1/3+.0986
Grav field compc	10.507		0.740	10.408+.0986
Energy difference Neutron-Prc		1.293		0.622+0.671=1.293
Graviton	10.432 & 10.507	6.00E-26	2.801	3*0.687+.74
Up quark Mass	13.432	2.16	2.490	4*0.622 MeV
Kinetic Energy fc	12.432		5.076	10.432+2
Down quark Mas	13.432	4.67	4.357	7*0.622 MeV
Down quark KE	15.432	93	92.507	101.947-9.44 (quarks)
Down Strong Fie	15.432		101.947	
Charmed Quark	17.432	1275	1273.37	15.432+2
Strange Strong f	17.432		753.291	
Bottom Quark M	19.432	4175	4175.27	17.432+2
Top Quark Mass	21.432	17276	17261.00	19.432+2
W+,w- Boson	22.106	80445	80668.71	22.5-4*.0986
Z Boson	22.234	91188	91757.6	22.5-.0985-.167
HIGGS Boson	22.530	125300	123340.7	22.5+2*.0986-.167

Table 8 Particle Data Comparisons with Model N Values

The values of N (column 2) and E form a series. There is an exponential relationship between particle and boson energy E (MeV). The up and down quark data masses do not fit the series, but their masses move to lower values while conserving energy in their path to decay in short lived mesons and baryons [15,16]. Column 3 is data from accepted sources and column 4 uses the relationship E=2.02e-5*exp(N) from equation 36 to correlate E with N data. The pre-exponential, e0= 2.0247e-5 MeV is evaluated from the electron.

N=10.4319-0.296=10.1362. This N is identified as the electron information value Table 6 (44)

e0=0.511/exp(10.1362)=2.0247e-5 MeV (45)

The top 7 lines in Table 6 contain the fractional value xx.432= 1/3+0.0986

N= 0.0986 = ln(3/e), where e is the natural number 2.718 (46)

Model Probabilities

Energy= 0 constraint

Time moves around circle P=1 in opposite directions, one direction for mass+ kinetic energy and the other for field energy [17]. Likewise, the entire proton model is based on probability= 1 and energy separations from zero. Energy is overall zero for the four N values in Figure 6.

Radius r for this quark r=hC/(m*field E)^0.5=1.973e-13/(753.98)=2.62e-16 meters (47)

	MeV			MeV	
	E=e0*exp(N)			E=e0*exp(N)	
N1=12.43	5.076	E1 ke	N3=10.43	0.687	E3 field
N2=15.43	101.947	E2 mass	N4=17.43	753.291	E4 field
	E3+E4-E3-E4=646.96				
	E2 mass		E1 ke	E3 field	E4 field
	MeV	MeV	MeV	MeV	MeV
	101.95	646.96	5.08	753.29	0.69
	E2+Difference KE+E1 →		753.98	E3+E4	753.98
	Energy is conserved since 753.98=753.98				

Figure 6 E=0 constraint details.

Probability=1 constraint

Definitions:

p=e0/E=1/exp(N) and p=1/exp(N). Combining these definitions yields E=e0*exp(N) (48)

Probability=1 constraint

The set of four sub-components a,b,c and d in Table 9 multiply and divide to p= a*b/(c*d)=1. There are five sets like Figure 6 in Table 6. Probability=1 for each set and all five multiply to P=p*p*p*p*p=1 for the neutron. Valuable information is in the sub-components of each p=1= a*b/(c*d). Probabilities in the model are low but there were a vast number of initial neutrons. Probability =1 and net zero energy may be initial conditions suggesting that components were formed simultaneously.

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