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Progress toward a Unified Theory

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Abstract

Progress toward a unified theory occurred when scientists discovered that fundamental particles occur in families. Physicists developed a Standard Model [1] that includes the Higgs, Z, W+, and W− bosons but there is still much to learn [2]. Some are wondering if a unified theory will converge using ideas of the 20th century. Scientists use quantum mechanics but say it is incomplete. Physicists use general relativity but are frustrated with attempts to reconcile large scale gravity with Quantum Field Theory. Astronomers and astrophysicists continue to gather data with missions like WMAP, PLANCK, James Webb, and the Vera C. Rubin Observatory. But there are unresolved problems related to early observation of fully formed galaxies and Hubble measurements. This document proposes requirements for a unified theory to highlight remaining questions. It also describes an information pattern that connects Standard Model components. The document (1) describes the pattern and (2) applies energy and mass values found in the pattern to force unification, cosmology, and atomic binding energy. A gravitational field energy may help resolve the long-standing quantum gravity issue. The reason gravity is weak is that field energy E shifts to a lower value E/exp(90). An expansion model was developed based on kinetic energy in neutron and proton mass models. It provides expansion with an energy history/proton. Equations for gravity suggest that a mass without kinetic energy exists. This mass would resist accumulation and support early development of black holes. Research papers were reviewed that represent progress toward understanding early galaxy formation and flat galaxy rotation curves.

Keywords

Unified Theory, Quantum Gravity, Cosmology, Information

1. List of Unification Goals

A unified theory will gain acceptance if it satisfies these goals:

Explains the origin of time, space, and energy.

Agrees with data reported by the Particle Data Group [3], maintained by University of California at Berkeley and National Institute of Standards and Testing [4];

Explains the particles we observe, the neutron and its decay to a proton, electron, and anti-electron neutrino;

Provides a source of constants for the four forces;

Explains the Standard Model of particle physics;

Provides the number of neutrons in nature;

Unites quantum mechanics and Newtonian gravity;

Presents principles behind atomic binding energy data;

Describes measured abundances of the elements;

Understands short lived baryons and mesons mass and their decay times;

Agrees with quantum mechanics observations;

Presents the correct cosmology expansion curve.

Explains observation of early black holes;

Describes accumulation of mass into clusters, galaxies, and stars;

Explains the cosmic web, dark matter, and dark energy;

Explains the origin of the Cosmic Microwave Background (CMB);

Provides a basis for research regarding biology and life.

Science is a potential source of answers regarding difficult long-standing questions. We need a plausible creation "story" that includes life and consciousness even if we do not know its origin.

2. Energy Data and the Proton Model

Features of nature have been measured for centuries. High energy experiments at labs throughout the world gather data that is detailed and voluminous [3]. After studying short lived mesons and baryons [5] [6] the author found a value labelled N that allows the mass of the neutron, proton, electron, and other fundamental particles to be simulated. Shannon [Bell labs circa 1920] [7] [8] defined information as $S = 1/\ln(P)$. Probabilities are basic to thermodynamics, information theory and the simulation value N is similar to entropy value S. In the work that follows, probability $P = e_0/E = 1/\exp(N)$. This yields the relationship Energy $E = e_0{*}\exp(N)$.

Values of N (**Table 1**, column 2) form a series. The up and down quark data do not fit the N series, but their masses move to lower values while conserving kinetic energy (ke) in their path to decay in short lived mesons and baryons [5]. Column 3 is data from accepted sources and column 4 uses the relationship $E = e_0{*}\exp(N)$ to correlate N with the data. It supports an exponential relationship. The pre-exponential e0 is evaluated from the electron mass 0.511 MeV that is correlated to $N = 10.1362$.

$$N = 10.4319 - 0.296 = 10.1362 \quad \left(e_0 = \frac{0.511}{\exp(10.1362)} = 2.0247\mathrm{e}-5\ \text{MeV} \right) \qquad (1)$$

Table 1. Particle energy correlation with N values.

Identifier	N = ln(E/e0)	Particle Data	E = e0*exp(N)	
		Group energy	e0 = 2.025e−5 MeV	
		E (MeV)	(MeV)	notes
taon neutrino		<15.5		
electron neutrino		2.20E−06	0.048	
N component	0.0986			ln(3) − 1
N component	0.16667			0.5/3
muon neutrino		<0.17	0.0695	
E/M Field E	0.296	2.720E−05	2.72E−05	3*0.0986 = 0.296
ELECTRON	10.136	0.51099891	0.511	
N component for quark	**10.333**		**0.6224**	
N component for W	10.408		0.671	
Grav field component	10.432		0.687	
Grav field component	**10.507**		**0.740**	
Energy difference Neutron-Proton		1.293		
Graviton	10.432 & 10.507	6.00E−26	2.801	3*0.687 + 0.740
Up quark Mass	13.432	2.16	2.490	4*0.622
Kinetic Energy for quad	12.432		5.076	2*5.076 = 10.151
Down quark Mass	13.432	4.67	4.357	7*0.622
Down quark KE	15.432	93	92.507	101.947 − 9.44
Down Strong Field E	15.432		101.947	
Charmed Quark M	17.432	1275	1273.37	15.432 + 2
Strange Strong field E	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*0.0986
Z Boson	22.234	91188	91757.6	22.5 − 0.0985 − 0.167
HIGGS Boson	22.530	125300	123340.7	22.5 + 2*0.0986 − 0.167

N values are integers with the fractional value xx.432 = 1/3 + 0.0986. The value $0.0986 = \ln(3/e)$, where e is the natural number 2.718.

$$N \text{ for the electromagnetic field energy} = 3 * 0.0986 = 0.296$$
$$\text{and } E = 2.0247\text{e}-5 * \exp(0.296) = 27.2\text{e}-6 \text{ MeV} \quad (2)$$

Information values *N* from Table 1 were used to construct math models that match nucleon (neutron and proton) mass within 1e−6 MeV. The model supports the Standard model Higgs, W and Z bosons and helps understand their relationship to quarks and gluons. The left column of Table 2 below indicates that *N* = 90 was divided into four parts, two Higgs of $E = 2.02\text{e}-5 * \exp(22.53)$, a Z with

$E = 2.02\text{e}-5*\exp(22.235)$ MeV and W with $E = 2.02\text{e}-5*\exp(22.106)$ MeV (energies reported by the Particle Data Group [3]). The sums of N for the columns of **Table 2** are N = 90. The three quark Standard Model is supported. The quarks have mass $E = 2.02\text{e}-5*\exp(\text{N})$ where N = 15.432, 13.432 and 13.432 and their associated gluons are $E = 2.02\text{e}-5*\exp(\text{N})$, where N = 17.432, 15.432 and 15.432. Each quark has 5.076 MeV of kinetic energy (N = 12.432). In addition, each quark carries a component of the gravitational field. The energy values for the gravitational field are 0.687 MeV (N = 10.432). Feynman diagrams [9] [10] show W and Z bosons involved in neutron decay. Near the bottom of **Table 2**, Z = 22.235 components provide the N values for mass decay.

Table 2. The Higgs, W and Z bosons energy values and neutron energy values.

					Neutron			
	Split 90/4	**Z components**			N values for mass	E = e0*exp(N)	N values	E = e0*exp(N)
			W components		mass&ke	(MeV)	fields	(MeV)
Higgs = 22.53	22.500	22.530		0.197	12.432	5.076	10.432	0.687
		−0.1972		5.167	15.432	101.947	17.432	753.291
		0.167						
Higgs = 22.53	22.500	22.530		0.197	12.432	5.076	10.432	0.687
		−0.1972		3.167	13.432	13.797	15.432	101.947
		0.167						
Z = 22.235	22.500	22.235	−10.4316	0.197	12.432	5.076	10.432	0.687
		0.0986	10.507	3.167	13.432	13.797	15.432	101.947
		0.167	10.333					
					Z components	E = e0*exp(N)	Z compon	E = e0*exp(N)
W = 22.106	22.500	22.106	−10.4316		−10.432		−10.432	
		0.3944	10.408		10.507	0.740	10.507	0.740
			10.432		10.333	0.622	10.333	0.6224
	90.000	90.00	22.50	12.092	90.000		90.000	

The neutron decay to a proton, an electron with mass 0.511 MeV, its E/M field, and an anti-electron neutrino is shown in **Table 3**.

Table 3. The W boson and proton energy values.

Proton			
N values	E = e0*exp(N)	N values	E = e0*exp(N)
mass & ke	(MeV)	fields	(MeV)
12.432	5.076	10.432	0.687
15.432	101.947	17.432	753.291
12.432	5.076	10.432	0.687

Continued

13.432	13.797	15.432	101.947
12.432	5.076	10.432	0.687
13.432	13.797	15.432	101.947
W components	E = e0*exp(N)	W components	E = e0*exp(N)
−10.432		−10.432	
10.408	0.671	10.5069	0.740
10.136	0.511	10.333	0.622
0.2958	2.72E−05		
90.0000		90.000	

Neutron and Proton Mass Simulations

Energy values for neutron and proton components from Table 2 and Table 3 are arranged into columns in Table 4. The simulated mass of the neutron and proton are marked in red below (Table 5 compares simulated mass with PDG and NIST data). The models include initial neutron expansion kinetic energy 10.15 MeV and potential energy 10.15 MeV. The energy 10.15 MeV/nucleon is also fundamental to atomic fusion. The neutron decays to a proton, electron, and anti-electron neutrino and its mass and fields are listed along with the decay products toward the bottom right side of Table 4.

Table 4. Neutron and proton mass simulations.

MeV	MEV		MEV		**MeV**		**MeV**
m w/o ke	Neutron Mass Components		Neutron Fields		Proton Mass Components		Proton Fields
m	101.947	Mass	753.291	Strong Field E	101.947	Mass	753.291
m	13.797	Mass	101.947	Strong Field E	13.797	Mass	101.947
m	13.797	Mass	101.947	Strong Field E	13.797	Mass	101.947
	5.076	Ke	2.801	Gravitational Field	5.076	Ke	2.8011
	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	
m	0.622	(1.293 = 0.622 + 0.671)			−0.671		
130.163							
			−0.118		−5.44E−05	Em Field +1	−0.118
939.5654133	939.56541	Neutron mass		**938.2720814**	938.27209		

Continued

accuracy vs PDG				accuracy vs PDG	2.72E−05	EM Field −1	
−7.2E−09				−9.59E−06	0.511	Electron	
					0.671	0.622 + 0.048	
					0.11141	Kinetic E	
					0.04850	ae neutrino	
	10.151	KE Expansion			10.103	KE Expansion	
	10.151	PE Expansion			10.151	PE Expansion	
	959.8680		959.8680		959.868		959.8680

Table 5. Comparison of models with PDG [3] and NIST [4] data.

			Simulation	Difference
	Particle Data Group & NIST		result	(MeV)
Neutron	**939.5654133**	MeV PDG	**939.56541329**	**6.4E−09**
Proton	**938.2720814**	MeV PDG	**938.27209094**	**−9.6E−06**
Electron	**0.51099895**	MeV PDG	**0.51100028**	**−1.3E−06**

Model Fundamentals

The models are based on probability one and zero energy.

$$\text{Energy} = 0 \text{ condition} \tag{3}$$

Table 2 and Table 3 information N and energy E values have specific meanings for each of four positions in Table 6. Table 7 shows an energy balance for each quark. (E_1 + E_2 + difference ke) = (E_3 + E_4). This can be considered zero energy based on separation.

Table 6. Meaning of energy positions for one quark.

kinetic energy	E1	field1	E3
mass	E2	field2	E4
Difference kinetic energy = (E3 + E4 − E1 − E2)			

Table 7. Quark mass plus kinetic energy and field energy.

	E = e0*exp(N) MeV			E = e0*exp(N) MeV	
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	Diff KE	E1 ke	E3 field	E4 field
	MeV	MeV	MeV	MeV	MeV
	101.95	646.96	5.08	753.29	0.69
	E1 + E2 + Diff KE		753.98	E3+E4	753.98
	Energy is conserved 753.98 = 753.98				

$$\text{Probability} = 1 \text{ condition} \tag{4}$$

Table 6 positions also represent probability = 1.

$$p = \frac{1}{\exp(12.432)} * \frac{\frac{1}{\exp(15.432)}}{\frac{1}{\exp(10.432)} * \frac{1}{\exp(17.432)}} = 1 \tag{5}$$

Equation (5) is one of the four groups of N values in Table 2 that multiply to p = 1. Overall, $P = p * p * p * p = 1$ indicates that Table 2 and 3 Standard Model quarks components obey probability = 1. Energy components emerge from P = 1 and E = 0 as mass plus kinetic energy and field energy. The neutron and proton are manifestations of information transitions from N = 90 with H, Z and W+/− intermediaries. This satisfies one of the criteria for a unified theory. The N value for the quark strong field is N = 2 higher than quark mass N (for each of 3 quarks). Whole numbers, the fraction $\frac{1}{3} + \ln\left(\frac{3}{e}\right) = \frac{1}{3} + 0.0986 = 0.432$ appear extensively.

3. Application of Proton Model Information

This section explores how sub-component energy values of Table 4 are used throughout nature. The value 10.15 MeV appears throughout the discussion below. It is $E = 2.0247\text{E}-5 * \text{EXP}(12.4349) * 2 = 10.1513\ \text{MeV}$ from Table 2.

This document is a synopsis of details reported in reference [11]. Data based computer modeling of processes is referenced. The topics focus on space and time, force unification, cosmological expansion, and binding energy.

3.1. Time Space and Energy

Time and space are defined by a circle. Energy = h * frequency, also written as Et/H = 1. With $C = r/t$ = 2.998e8 m/sec, it is also written $r = hC/E$ where h = Planck's reduced constant $\frac{H}{2\pi} = 6.582\text{E}-22\ \text{MeV}\cdot\text{sec}$ (Figure 1).

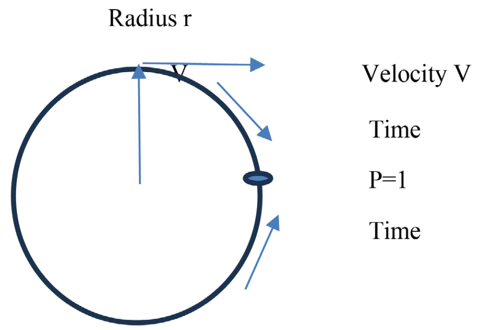

Figure 1. Space model.

E = gravitational field energy components from Table 3 = 0.69 + 0.69 + 0.69 +

0.740 = 2.801 MeV (6)

$$\text{Circle radius } r = \frac{hC}{E} = \frac{1.973e-13}{2.8011} = 7.045e-14 \text{ meters} \quad (7)$$

$$\text{Circle time} = \text{time around circumference} = 7.045e-14 * \frac{2\pi}{3e8} = 1.47e-21 \text{ seconds} \quad (8)$$

3.2. Force Table

Mass and kinetic energy field values in Table 8 are from the proton mass model in Table 4. Published values for comparison are available [12]-[16].

Table 8. Neutron and proton model values for forces.

Force Table		Gravity	Strong (comb)	Weak	Electromagnetic
		MeV	MeV	MeV	MeV
Mass M (kg)					
Field Energy E (MeV)	**E = 2.801/EXP(90)**	**2.8011**	**957.18**	**20.3**	2.7217E−05
R = hC/2.801 meters	hC = 1.973e−13	7.0446E−14			**7.2501E−09**
Particle Mass (MeV)		938.27208	**129.54**	**4.357**	0.511
Mass M (kg)		1.6726E−27	2.31E−28	**7.77E−30**	9.11E−31
Kinetic Energy (MeV)		**10.1500**	**797.34**	**749.62**	1.361E−05
					1.361E−05
Gamma (g)	**m/(m+ke)**	0.9893	0.1398	0.0058	0.99997
Velocity Ratio	**v/C = (1−(g)^2)^0.5**	**0.1459**	**0.9902**	**1.0000**	**7.298E−03**
V = V ratio*C		4.37E+07			
R = hC/(m/g*E)^0.5		**See Figure 9**	**2.095E−16**	**1.595E−15**	**5.291E−11**
Inertial F = M/g*V^2/(r*exp(90)) N		3.7631E−38			
G = 45.93*7.045e−14^2/(exp(90)*1.673e−27^2)		6.6750E−11			
Force = E/r*1.602e−13 N		**3.7631E−38**	**7.320E+05**	**2.039E+03**	**8.242E−08**

3.2.1. Strong Force

Combined Table 8 strong field

$$E = 753.291 + 101.947 * 2 = 957.185 \text{ MeV} \quad (9)$$

$$\text{Combined quark mass } M = 101.947 + 13.797 * 2 = 129.541 \text{ MeV} \quad (10)$$

$$r = \frac{hC}{\sqrt{E \cdot \frac{m}{g}}} = 2.095e-16 \text{ meters and Force } F = 7.3e5 \text{ N} \quad (11)$$

3.2.2. Electromagnetic Force

From Table 4, the electromagnetic force is the result of N = 3* 0.0986 = 0.296 being separated from the N = 10.432 − 0.296 = 10.136. This becomes the electron (N = 10.136 and energy = 0.511 MeV). The electromagnetic energy of the field

$E = e_0 * \exp(0.296) = 27.217\text{e}-6\ \text{MeV}$. This is the published value for the electromagnetic field [3]. During decay, the electromagnetic energy is separated into 0 = 2.72e−5 − 2.72e−5. This is the basis of opposite charges.

The permittivity constant e' (e prime) governs electromagnetism (including charge and the electrical field). Calculation of e' is below but shielding effects from the complicated electron orbitals are not included.

$$F = 1/(4 * \pi * e') * q^2/r^2 \tag{12}$$

$$e' = \left(\frac{1}{4} * \pi * F\right) * q^2/r^2 \tag{13}$$

$$F = 8.2414\text{e}-8 \text{ newtons and } r = 5.2911\text{e}-11 \text{ meters} \tag{14}$$

$$q \text{ in Coulombs} = 1.6022\text{e}-19 = F * \frac{r}{27.217\text{e}-5} / 1\text{e}5 \tag{15}$$

$$e' = \left(\frac{1}{4} * \pi * F\right) * \frac{q^2}{r^2} = 8.853\text{e}-12\ \text{N/m}^2 \tag{16}$$

This compares favorably with PDG [3] published value 8.854e−12 N/m^2.

3.2.3. Residual Strong Interaction (AKA the Weak Force)

Energy with value 2*−10.15 = −20.30 MeV is missing in each proton and neutron simulated in **Table 4**. Three quarks form a bundle with kinetic energy 10.15 MeV orbiting in field energy 20.30 MeV. This embeds the mass 928.12 MeV in a 20.30 MeV field with 10.15 MeV of kinetic energy and determines a radius of 1.43e−15 meters (the radius of the atomic nucleus). This is not new to physics, but the origin of energy 10.15 MEV/nucleon is new.

3.2.4. Gravity

The Planck scale is currently associated with the gravitational constant. Literature reviewed below [16] reviews the Planck scale.

$$\text{Compton mass } M = \frac{hC}{G}$$

$$\begin{aligned} M &= 6.682\text{e}-22 \times \frac{2.998\text{e}8}{6.67428\text{e}} - 11 \times 1.6022\text{e}-13 \\ &= 2.176\text{e}-8\ \text{kg} = 1.221\text{e}22\ \text{MeV} \end{aligned} \tag{17}$$

$$G = 6.582\text{e}-22 \times \frac{2.998\text{e}8}{(2.1765\text{e}-8)^2} \times 1.6022\text{e}-13 = 6.6742\text{e}-11\ \text{N}\cdot\text{m}^2/\text{kg}^2 \tag{18}$$

There is a mass on the left side of **Table 4** related to the Planck scale Compton mass.

$$\text{mass} = 101.947 + 13.797 + 13.797 + 0.622 = 130.16\ \text{MeV}\ (2.3206\text{e}-28\ \text{kg}) \tag{19}$$

$$m = 2.3206\text{e}-28 \times \exp(90) \times 1.6726\text{e}-27 = 2.1764\text{e}-8^2\ \text{kg}^2\ (\text{Compton mass}) \tag{20}$$

But we use G at the scale of protons. With r = 7.01448e−14 = hC/2.8011, the equation 21 hC equality can be be substituted into Equation (18).

$$hC = 6.582\text{e}-22 \times 2.998\text{e}8 = 2.8011 \times 7.0448\text{e}-14\ \text{MeV}\cdot\text{meter} \tag{21}$$

$$G = \frac{2.8011}{\exp(90)} \times \frac{7.0448\text{e}-14}{2.3206\text{e}-28 \times 1.67263\text{e}-27} \times 1.6022\text{e}-13$$
$$= 6.6744\text{e}-11\ \text{N}\cdot\text{m}^2/\text{kg}^2 \quad (22)$$

Equation (22) is equivalent to equation 18 but based on proton scale masses and Table 4 values. The value 2.801/exp(90) weakens the gravitational field and force. More can be learned about the effect of exp(90) on gravity by studying orbits.

The column labelled cell radius is defined by Equation (7) that gives the circle $r = hC/2.801$ This radius varies with kinetic energy (ke). The derivation below is based on G remaining constant.

$$G = \frac{rV^2}{m}$$

$$\frac{Gm}{Gm} = \frac{r*ke}{r*ke}$$

$$r*ke = r*ke = 7.045\text{e}-14*10.15\ \text{MeV}\cdot\text{meter}$$

$$r = 7.045\text{e}-14*\frac{10.15}{ke} \quad (23)$$

The column labelled Orbital R and conventional $R = GM/V^2$ agree down through Table 9. The equation below yields R with cell radius r multiplied by exp(90) and a mass ratio.

Table 9. Effect or exp(90) on orbits.

					R orbit = cell r*exp(90)*(Mcentral/2.49E+51)				
	Central Mass			r cell = 7.045e−14*10.15/ke				Fg = GMm/R^2 (N)	
Orbit	(kg)	Vel m/sec	ke (mev)	r cell (m)	R orbit	R = GM/V^2	Fi = 1.67e−27*V^2/R (N)		Fnew (N)
earth/sat	5.98E+24	7.43E+03	2.902E−07	2.46E−06	7.22E+06	7.22E+06	1.280E−26	1.28E−26	1.28E−26
sun/earth	2.00E+30	2.97E+05	4.635E−04	1.54E−09	1.51E+09	1.51E+09	9.765E−26	9.77E−26	9.77E−26
galaxy/star	2.00E+41	2.26E+05	2.690E−04	2.66E−09	2.60E+20	2.61E+20	3.289E−37	3.29E−37	3.29E−37
cluster/star	2.00E+46	4.36E+05	1.00E−03	7.15E−10	7.01E+24	7.01E+24	4.545E−41	4.55E−41	4.55E−41
Universe/proton	2.49E+51	4.40E+07	10.15	7.05E−14	8.60E+25	8.60E+25	3.760E−38	3.76E−38	3.76E−38
proton/proton	1.67E−27	1.26E−12	8.318E−39	8.60E+25	7.03E−14	7.04E−14	3.766E−38	3.77E−38	3.77E−38

Fnew = (2.801/EXP(90)*ke/r)/(Mcen/2.49E+51)/10.15*938.27/130*1.602e−13.

$$R = r*\exp(90)*(\text{central mass } M/2.491\text{e}51) \quad (24)$$

$$\text{Universe mass} = \exp(180)*1.67\text{e}-27 = 2.491\text{e}51\ \text{kg} \quad (25)$$

The force of gravity is calculated two ways and compared with the inertial force, F_i. The new force equation is on the right. It agrees with $F = GMm/R^2$ for all orbits.

$$F_{new} = \left(2.801/\exp(90)*ke/(10.15*r)\right)/\left(M_{central}/2.491\text{e}51\right)$$
$$*938.27/130.16*1.602\text{e}-13\ \text{N} \quad (26)$$

This equation can be understood as follows. Force is proportional to gravitational field E = 2.801/exp(90) MeV, increases with inertial kinetic energy ke and further increases with small cell radius r. The multiplier (central mass M/mass of universe) is the same multiplier used to determine orbital radius R from cell radius r. E/exp(90) weakens the gravitational field and force.

In topic 3.3 entitled "Expansion models", kinetic energy/proton = 10.15 MeV from Table 4. This is the initial kinetic energy/proton for expansion and the velocity of each proton on radius small r is below lightspeed. There is potential tension between radius r that describes space expanding at C in the straight-line expansion model and r*exp(90) that describes gravity below C.

This is resolved with force equalities based on values that compares orbits for extreme conditions. Table 9 line 5 is for a central mass equal to the universe and line 7 is for a central mass of one proton. In line 5 cell size r = 7.045e−14 m for 10.15 MeV ke but based on exp(180) protons, the orbital radius R = 8.59e25 m. If a proton orbits another proton at radius 7.045e−14 meters, ke/proton = 10.15/exp(90) MeV.

The force on the orbiting proton in line 6 is calculated four ways:

$$F_g = \frac{GMm}{r^2} = 6.674\text{e}-11 * \exp(180) * \frac{(1.6726\text{e}-27)^2}{(8.54\text{e}25)^2} = 3.76\text{e}-38\ \text{N} \tag{27}$$

$$F_{inertial} = \frac{mV^2}{r * \exp(90)} = 1.6724\text{e}-27 * \frac{(4.374\text{e}7)^2}{8.54\text{e}25} = 3.76\text{e}-38\ \text{N} \tag{28}$$

$$\begin{aligned} F_{new} &= \left(2.801/\exp(90) * ke/(10.15 * 8.54\text{e}25)\right)/(2.491\text{e}51/2.491\text{e}51) \\ &\quad * 938.27/130.16 * 1.602\text{e}-13 \\ &= 3.76\text{e}-38\ \text{N} \end{aligned} \tag{29}$$

$$F_g = 6.6742\text{e}-11 \times (1.6726\text{e}-27)^2 / (7.045\text{e}-14)^2 = 3.76\text{e}-38\ \text{N} \tag{30}$$

$$\begin{aligned} &\text{Integral } dE \text{ across expansion} \\ &= Fdr = 9.76\text{e}-38 * \frac{8.59\text{e}25}{2} * 1.602\text{e}-13 = 10.15\ \text{MeV} \end{aligned} \tag{31}$$

The value 10.15 MeV/proton in Line 5 of Table 9 agrees with kinetic energy being converted to potential energy during expansion in Table 10.

3.2.5. Comparison of Gravity with the Other Forces

One of the un-resolved questions in physics [Wiki] is the difference between gravity and the three fields in Quantum Field Theory (QFT). According to Table 3 gravitation field energy = 2.801 MeV. The main difference between gravity and the other forces is that orbital radius R is large and force is low because 2.801/exp(90) MeV/proton. The bottom line of Table 8 shows that field energy causes curvature for all four forces with the equation $r = hC/E$ and $F = E/r$ is universal.

$$F_{gravity} = \frac{E}{r} = \frac{\frac{2.8011}{\exp(90)}}{7.04478\text{e}-14} * 1.6022\text{e}-13 * \frac{938.2708}{130.16} = 3.76\text{e}-38\ \text{N} \tag{32}$$

General relativity is the curvature of space. "Mass tells space how to curve and curvature tells mass how to move". Table 9 equations indicate that a cell of radius small r is curved by

$$R_{large\ orbit} = r \times \frac{M_{central}}{2.49e51} \times \exp(90) \text{ and } r = 7.045e-14 * \exp(90) * 10.15/ke \quad (33)$$

Curvature is **caused** by field energy $r = hC/(2.801/\exp(90))$. It is enlarged by $M_{central}$ and low kinetic energy.

This represents a step toward the goal of uniting gravity with the other forces. Gravity has gravitational field energy like the other three Quantum Field Theory field energies, and it appears that the energy experiences a quantum shift from 2.801 to 2.801/exp(90).

3.3. Cosmology Expansion Models

Physicists say that physics breaks down at a "big bang" singularity. Many believe that there was an early brief period of expansion called inflation. It was proposed to keep different areas uniform that are more than C away from one another. But new maps show huge voids and non-uniformities. The Lambda Cold Dark Matter (LCDM) expansion model was used by WMAP and PLANCK missions [17]-[22]. It is based on the Friedmann equation which expands space as $r' = r(\text{time}'/\text{time})^{2/3}$.

3.3.1. A Probabilistic Argument for the Initial Number of Neutrons in Nature

Overall, the N values of the left-hand side neutron components of Table 2 equal 90. Written as a probability $p = 1/\exp(90)$. The equal but opposite left-hand side components are also $p = 1/\exp(90)$. They occur at the same time, multiplying the probability to 1/exp(180). To re-establish $P = 1$, there must be a vast number of particles. Specifically,

$$\begin{aligned} P &= 1 = \text{probability of each neutron} * \text{number of duplicated neutrons} \\ &= \frac{1}{\exp(180)} * \exp(80) \end{aligned} \quad (34)$$

3.3.2. Straight-Line Expansion Model

In three dimensions, exp(180/3) scales equation 7 small r to large $R = r*\exp(60)$ meters. Each small circle (sphere) is expanding. A neutron with kinetic energy of 10.15 MeV is positioned on small circle radius r and travels around the circle with initial velocity 0.145*C.

$$\begin{aligned} &ke(\text{kinetic energy/proton}) = 10.15 * \frac{7.045e-14}{r} \text{MeV} \\ &(\text{Derivation in equation 23}) \end{aligned} \quad (35)$$

The straight-line model [23] [24] simulates time across the expansion radius in increments of time = 1.47e−21/(2pi)) = 2.35e−22 seconds. Large R expands outward at lightspeed since $C = R/T = 2\text{pi}*R/(2\text{pi}*T)$. After neutron duplication an exponential (exp(N)) relationship is useful with

$$\text{Initial } R_0 = r_0 * \exp(60) = 7.045\text{e}-14 * \exp(60) = 8.05\text{e}12 \text{ meters} \quad (36)$$

$$\text{Small } r = 7.045\text{e}-14 \text{ meters expans with elapsed time and } r = r_0 + \text{elapsed time} * C/\exp(60) \quad (37)$$

Table 10. Straight-line expansion.

Straight-line expansion			beginning	current expansion
N exponent for number of time cycles			60	90.384
Field Energy E (MeV)			2.8011	2.8011
r cell = hC/E = 1.97e−13/2.801 = 7.045e−14 meters			**7.045E-14**	1.106
time across radius = 7.045e−14/C (seconds)			2.350E−22	
E*t/H = 1	2.801*1.476e−21/4.136e−21		1.00E+00	**1.00E+00**
R=7.045e−14*exp(60) meters			8.05E+12	**1.263E+26**
time across radius=time across*exp(60) seconds			2.68E+04	**4.21E+17**
Particle Mass (MeV) (1.6726e−27 kg)			938.27	
Universe mass=1.67e−27*exp(180) kg			2.4912E+51	
Kinetic Energy (MeV)	KE = 7.045e−14*10.15/r		**10.1513**	6.47E−13
conserved E = PE + KE (MeV)			20.300	20.3
Gamma (g)	m/(m+ke)		0.9893	1
Velocity Ratio	v/C=(1−(g)^2)^.5		1.4592E−01	
V = gamma*C			4.375E+07	11.13
F = 6.6742e−11*(1.67e−27^2)/7.045e−14^2 N			3.762E−38	
Inertial F = 1.67e−27*4.4e7^2/(7.045E−14*exp(90) Nt		Figure 9	3.763E−38	1.54E−64
F = 6.6742e−11*(1.67e−27*1.67e−27)/R^2 N			3.763E−38	1.53E−64

The column on the left of Table 10 contains values for the beginning of expansion. The beginning is high temperature and nucleons are primarily neutrons that decay to protons plus 1.293 MeV. The initial gravitation force resisting expansion derived in Table 8 (3.76e−38 N) decreases as expansion occurs and potential energy increases according to integral F*dr. Potential energy increase.

$$PE = 0.5 \times 3.76\text{e}-38 \times (8.54\text{e}25 - 7.045\text{e}-14) \div 1.6022\text{e}-13 = 10.15 \text{ MeV} \quad (38)$$

The column of the right side of Table 10 contains current values. The model is zero net energy with $KE + PE = 20.3$ MeV.

This produces expansion that is compared with the LCDM model in Figure 2.

The current radius is determined by the Cephid variables [20] Hubble constant, H0 = 2.375e−18/sec (equal = 1/4.21e17 sec).

$$\text{At } 2.35\text{e}-22 * \exp(90.384) = 4.21\text{e}17 \text{ seconds} (13.35 \text{ B years}) \quad (39)$$

$$\text{Current small } r = 1.106 \text{ meters and large } R = 1.106 * \exp(60) = 1.26\text{e}25 \text{ meters} \quad (40)$$

WMAP and PLANCK [18] [19] [22] mission analysis was based on the Lambda Cold Dark Matter (LCDM) expansion model. Figure 2 compares the two expansion models (Table 11).

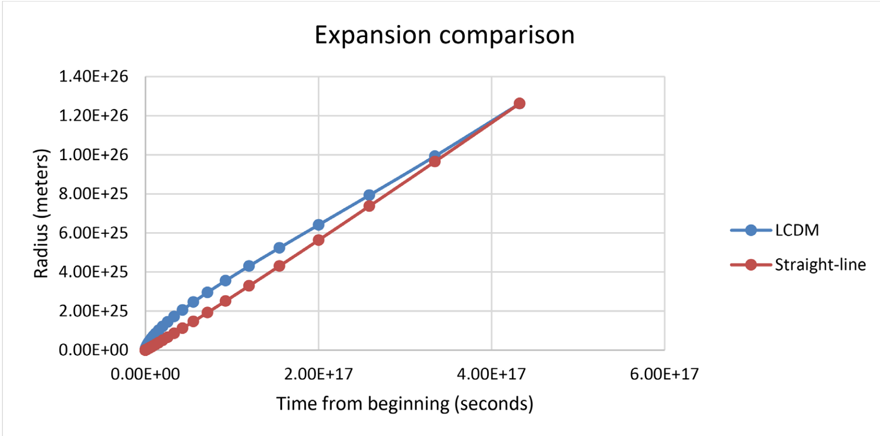

Figure 2. Comparison of expansion models.

Table 11. Energy history/proton.

radius r (m)	ke (MeV)	V = (2ke/m)^0.5	F = mV^2/r N	F*dR (MeV)	10.15−FR (MeV)
7.05E−14	10.150	4.41E+07	46.08	10.145	0.00
1.41E−13	5.075	3.12E+07	11.54	5.083	5.07
2.82E−13	2.538	2.21E+07	2.89	2.541	7.61
7.05E−13	1.015	1.39E+07	0.46	1.017	9.13
0.774	9.24E−13	1.33E+01	3.83E−25	9.26E−13	10.15
1.105	6.47E−13	1.11E+01	1.88E−25	6.48E−13	10.15

1) The straight-line expansion model are close to the WMAP [19] values for age (13.4 billion years) and radius (1.26e26 meters).

2) The concept of critical density is not supported in straight-line expansion. Velocity of a proton on the radius of the small circle model (Figure 1) is tangential to the surface, not perpendicular like LCDM cosmology. Thermodynamic pressure causes expansion in the straight-line model [25].

3) The straight-line expansion model can be applied to troubling observations. James Webb telescope observations shows fully formed galaxies well before they are predicted. Early black holes and red spots have been observed. The author studied and documented details of straight-line expansion [26]-[29]. It is possible that matter is pushed into Zel'dovich pancakes [30] by early perturbations in normal matter and is now observed as the cosmic web. A particle without kinetic energy is shown on the left side of Table 3 that aids black holes formation [28]. It is a neutron without kinetic energy (130.163 MeV) that according to the Jeans criteria cannot resist accumulation. This mass is also found in gravitational theory above in equation 19. Early formation of galaxies is promoted by relatively high

densities [29] in the straight-line model.

4) WMAP documents presented cosmology parameters for their belief that an acoustic wave was responsible for the Cosmic Microwave Background (CMB) spot they measured as 0.0104 radians [18]. This spot in the straight-line model is the size of the galaxy clusters in the cosmic web [30].

5) The straight-line model is energy based. Initial $KE = 10.15$ MeV/proton. Expansion reduces kinetic energy triggering primordial nucleosynthesis at $KE = 0.111$ MeV adding fusion energy 7.07 * 0.29 = 2.03 MeV/proton.

3.4. Binding Energy and Barrier Energy

Table 4 contains values that allow binding energy to be accurately predicted. The familiar $E = \text{const}^*\exp(N)$ equation is applicable with a different pre-exponential. Binding energy was simulated with this probability-based approach [17]. Binding energy release is the weighted contribution from the protons and neutrons.

$$\text{Energy release protons } Ep = 10.15 * \exp\left(-\frac{2}{protons}\right) * protons \text{ MeV} \quad (41)$$

$$\text{Energy release neutrons } En = 10.15 * \exp\left(-\frac{2}{neutrons}\right) * neutrons \text{ MeV} \quad (42)$$

$$\text{Weighter average } BE = (Ep + En)/(protons + neutrons) \quad (43)$$

Li7 has 3 protons and 4 neutrons.

$$BE = \frac{10.15 * \exp\left(-\frac{2}{3}\right) * 3 + 10.15 * \exp\left(-\frac{2}{4}\right) * 4}{7} = 5.75 \text{ MeV}$$ minus retained energy = 0.087 = 5.664 MeV (NIST [4] = 5.664 MeV).

The protons retain energy due to electrostatic repulsion. The binding energy curve for all Atomic numbers is in Figure 3 with the asymptote 10.15 MeV [17].

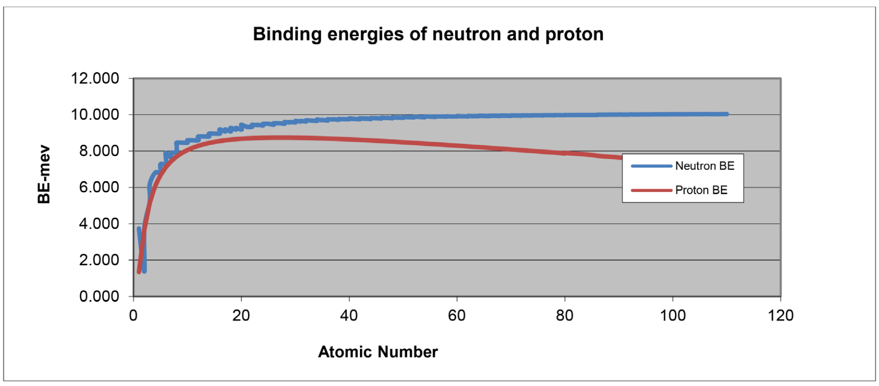

Figure 3. Binding energy for neutron and proton.

The decay of a neutron to a proton is shown in the Table 2 and Table 3 models. The decay energy balance from a neutron to a proton is: 939.465 − 0.740 − 0.622 = 938.272 MeV.

The value 0.622 - 0.111 where 0.511 MeV is the electron and 0.111 is kinetic energy.

$KE = 0.111$ MeV is found in two important processes. During early expansion, kinetic energy/proton decreases from the initial value 10.15 MeV. When it reaches 0.111 MeV, primordial nucleosynthesis [18]-[20] is triggered, and free neutrons readily combine into He4. The second process that involves this value is fusion in stars [21]. Barrier energy 0.111 MeV must be provided before fusion can occur.

3.5. Mesons and Baryon Mass and Decay Times

The author studied mesons, baryons, baryon resonance, their decay times, and properties [5] [6]. Fitting data with fundamental particle values gave a tentative understanding of these transient particles. They are combinations of proton model components and kinetic energy that decay rapidly.

Decay time is related to a particle with kinetic energy circling once and then starting its decay if its wave function is unbalanced (Breit-Wigner theory [Wiki]). Mass m is the mass of the meson or baryon.

$$\text{Radius of circle} = hC/\sqrt{20.3 \cdot m}$$

$$\text{Circle time} = 2\pi r/V$$

$$\text{Circle time} = \frac{\text{half time}}{0.693} = \text{approximately } 2\text{e}-23 \text{ seconds for many short life particles} \quad (44)$$

But there are several exceptions, for example the muon, pion, neutron and proton. Study [6] shows that circle time is modified by N, which slows the decay. Data for the bare neutron lifetime = 879.6 seconds [Wiki] and N = 13.431*3 + 17.431 = 57.73 slows the decay by exp(57.73).

3.6. Information and Life Processes

With the equation E = 2.02e−5*exp(N), the proton model indicates that there are two levels to nature 1) an energy level and 2) a correlated information level. Each particle in our body contains information. Nature is mathematical and one can speculate that life uses the information level [31]. The ratio p/P compares an observation to a known reference. Our brains could have probability-based memory, perceptions, and thoughts like letters in the alphabet that represent learned words.

There is a difference between N for energy and S for thermodynamics. N is a fixed information value (code) and interacts in discrete quantities like quantum mechanics. There is a similarity between N and DNA information codes that keep the body and brain intact even though underlying chemical processes obey thermodynamic S. We know that the DNA code evolved but we do not know the origin of the pattern of N values in Table 2 and Table 3.

4. Summary of Progress toward Unification

Data from high energy experiments was correlated with an information value called N. The pattern of N values discussed provides an understanding of gravity [32] and the relationship between Standard Model energy values. Energy and wave relationships are important [33], but energy cannot explain energy. An information basis for energy invites new concepts into physics [34]. The initial conditions for the proton model, probability = 1 and net energy = 0, support the concept that nature is based on separations. The data correlation between information and energy, $E = 2.02e{-}5*\exp(N)$ indicates that there are two interacting levels in nature and represents progress toward understanding. The information level is lower than Leucippus and Democritus concept's that originated atomistic theory in the fifth century BCE. Understanding the role of information is important. Although the theory described is preliminary, it deserves further attention.

Summary of Energy Values in the Proton Model

The Standard Model Higgs, W and Z bosons are energies related to $N = 90$ being partitioned into components. Groups of N form patterns we observe as the energy of neutrons, protons and electrons and their fields. Standard Model components were combined into simulations that match NIST and Particle Data Group masses of the neutron, proton, and electron to within 1.6e−6 MeV. Component energy values appear throughout nature.

1) Fundamental forces. The **s**trong forces, weak force, electromagnetic force, and gravitational force can be calculated from proton model components. Key values for gravity include the gravitational field energy of 2.801 MeV, which gives fundamental radius of 7.045e−14 m and kinetic energy of 10.15 MeV of a proton orbit that has an inertial force of 3.76e−38 N. The value exp(90) makes gravity weak, but otherwise gravity is like the other forces. The transition to quantum gravity is associated with a proton with velocity below C is positioned on the space model.

2) Atomic binding energy and abundance of the elements. The familiar probability approach leads to equation $E = 10.15*\exp(-2/\text{nucleons})$ as the basis of binding energy. The asymptote for energy released for the neutron is 10.15 MeV. As the neutron decays to a proton, electron and anti-electron neutrino, a proton with kinetic energy is released. It transitions at 0.622 − 0.511 = 0.111 MeV. This KE is the energy that primordial nucleosynthesis begins. It becomes a barrier for stellar processes which require 0.111 MeV to initiate fusion, normally supplied by compression heating.

3) Baryon and meson masses and decay [5] [6]. Proton model components appear as resonances in short-lived mesons and baryons. They lack field energy - 20.3 MeV and are unstable. Circle times correlate with decay times but N for fields delays the decay of muons, pions, and neutrons.

Progress toward Resolving Current Cosmology Issues

1) Table 4 identifies initial expansion radius small scale radius $r = hC/2.8$ and the initial kinetic energy 10.15 MeV/nucleon for expansion.

2) A straight-line expansion model was presented based on velocity C large scale expansion of exp(180) small spheres with protons that maintain orbits and obey thermodynamics. The value exp(180) was based on a probabilistic argument for the number of nucleons in nature.

3) The straight-line model agrees with the WMAP and Lambda CDM large radius *R* and time using values from the proton model.

4) Velocity in the small circle model is tangential to the surface and the critical density concept does not apply [24]. Density is based only on baryons in the proposed cosmology model.

Research that Requires Verification

1) The history of energy vs time suggests that the CMB "first light" may be overwritten. In addition, the straight-line model analysis [30] indicates that energy from stars partitioned into galaxy clusters, voids, walls, long and short filaments and galaxies in the cosmic web interferes with CMB micro-temperature observations. Is this the reason that percentages of normal matter, dark matter and dark energy have not been substantiated?

2) In straight-line cosmology, space associated with each proton can both expand and contract. Small *r* decreases as KE increases locally during mass accumulation. This local effect is probably masking true Newtonian behavior of star orbital velocity [35].

3) Galaxies form with most of their mass and light emission near the center of the galaxy. Analysis shows that the cause of this distribution is the gravitational influence of black holes on galaxy formation [32].

Accretion into massive black holes at the center of galaxies may occur early [32].

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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