The Effect of He4 Fusion on Primordial Deuterium

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Abstract

It is well known that approximately 23% to 25% of nucleons found throughout space are in the form of Helium 4 atoms. The distribution uniformity indicates that these atoms were formed in the very early universe. In addition, trace amounts of Deuterium, Lithium 3 and Beryllium 7 are also uniformly distributed. These elements are evidence of a process known as primordial nucleosynthesis based on historical work by G. Gamow, H. Bethe and A. Sakharov and more recently by N.D. Schramm [10].

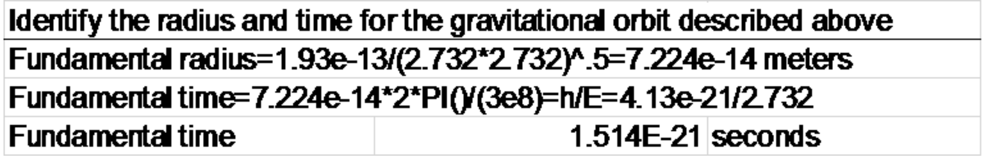
Residual deuterium is a sensitive test for this period and the goal of the work is to determine when residual primordial deuterium originated and re-evaluate limits on cosmological parameters. Specifically, the WMAP [3] and PLANCK [13] missions concluded that baryons could not make up more than 0.046 of current density. The primary variable is the baryon/photon ratio that is a function of expansion temperature and radius. PLANCK concluded that the baryon/photon ratio was 6e-10 and WMAP's value was slightly lower. The author explored an expansion curve called R1+R3 based on values found in a model of the proton [5][7][Appendix 1]. The expansion curve is similar to the concordance model [4][3]. The temperature decreases from big bang values until He4 forms at 8e8K but He4 fusion energy causes the temperature to spike and this affects the baryon/photon ratio. The temperature spike is accompanied by a radius increase. Both of these affect the baryon/photon ratio. The radius increase allows the baryon/photon ratio to be 6e-10 with a baryon fraction of 0.5 of current density. The other half of current density is dark matter. Temperature and radius histories that include He4 fusion energy appear to be missing from the literature.

Discussion

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. In this environment there were still a large fraction of neutrons that had not decayed and when deuterium formed, He4 was quickly formed. It is widely accepted that He4 fusion occurred at a temperature of 8e8K. WMAP results [12] are important to cosmology but the temperature response to He4 fusion appears to be absent from their analysis. WMAP results support the existence of dark matter and are widely quoted for the discovery that most of the expected matter in the universe is missing. WMAP results also claim that cosmologies with more than 0.046 baryon fraction [4][6] are ruled out by the residual deuterium criteria. The view that conventional mass is only 4% of the observed universe, with the remainder "missing" is reluctantly becoming accepted. WMAP and PLANCK reports do not explicitly report the temperature and radius they use to make broad claims regarding the baryon fraction. These values are extremely critical and should have been reported. Literature is reviewed [8][9] that does not account for the fusion energy of He4. In particular the temperature spike and radius increase associated with fusion are missing from the literature.

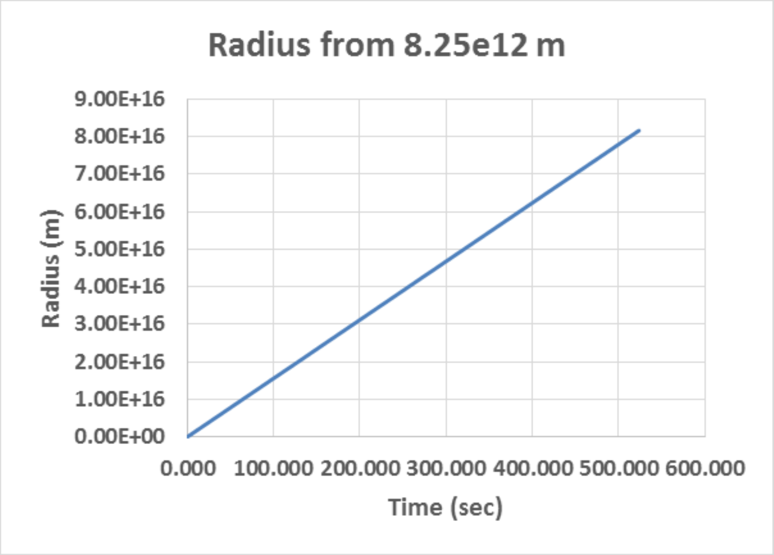
Radius and temperature history from beginning to He4 fusion

We find values in the proton mass model that give the beginning radius. It is related to values from the proton mass model, specifically E=2.732 MeV in the equations below. R0=7.22e-14*exp(60)=8.25e12 meters (the value exp(60) is to scale one cell radius to full radius assuming exp(180) neutrons and three dimensions).

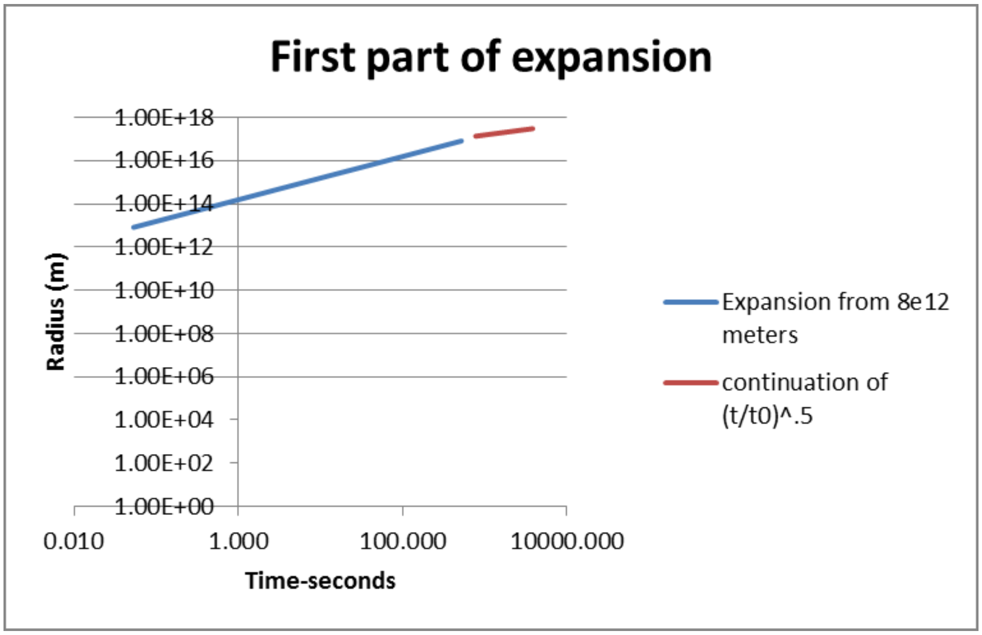


Identify the radius and time for the gravitational orbit described above		
Fundamental radius=1.93e-13/(2.732*2.732)^.5=7.224e-14 meters		
Fundamental time=7.224e-14*2*PI()/(3e8)=h/E=4.13e-21/2.732		
Fundamental time	1.514E-21	seconds

It gives the energy required to expand the radius (10.15 MeV labeled above as expansion kinetic energy (ke). What we don't know is the relationship between time and radius. However direct expansion with time; i.e. R=R0*(time/time0)^1 works perfectly. I use a time scale that starts at the natural log value 45. But we must also know the units. The time I call cosmological time is exactly one time around the circle 7.22e-14 meters at velocity C. Cosmological time equals 2*pi*7.22e-14/3e8=1.51e-21 seconds. Time0=exp(45)*1.51e-21=0.059 seconds. The time scale is constructed by adding small constant increments to 45. This defines the expansion curve from the beginning R0=8.25e12 to Rh=2e17 meters. Here is the relationship between radius and time:



But to be accurate it must match the curve at Rh (helium production) that was constructed backwards from the present time. The curve before and after Rh is shown below:



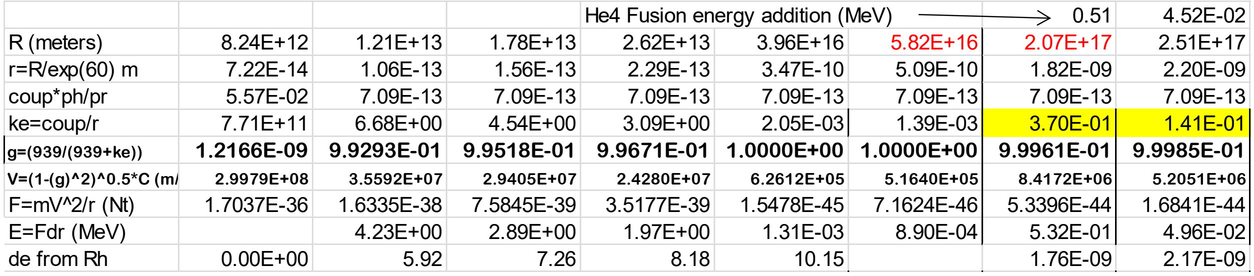
Radius increase associated with He4 fusion

Forces that determine expansion

We all use time ratios for expansion but what are the actual forces that cause particles to expand away from each other? I used cellular cosmology to calculate forces. The derivation below shows a different way to write equations that obey Newtonian gravity. The coupling constant for gravity is a published value 1.16e-51 Mev M (Wiki). The equation G=F r^/M^2 can also be written in terms of kinetic energy. That equation would be:

derive coupling constant c^2		
G/1.603e-13=2 ke R/Mm		
G*1.67e-27^2/1.603e-13=2 ke R/Nn		
Nn=1 for coupling constant		
1.16045E-51	mev m	
1.16716E-51	Mev m	Published
nt m^2/kg^2*kg^2 mev/(nt m)		
Mev m		
1.16e-51*exp(90)/2		
7.08107E-13	Ke r	(MeV m)

The coupling constant is scaled down to one proton orbiting a central mass of one proton at KE by applying exp(90)/2. The 2 makes it kinetic energy and exp(90) scales the calculation to one proton orbiting another proton. Kinetic energy (MeV) for a known radius r is 7.08e-13/r with r in meters.

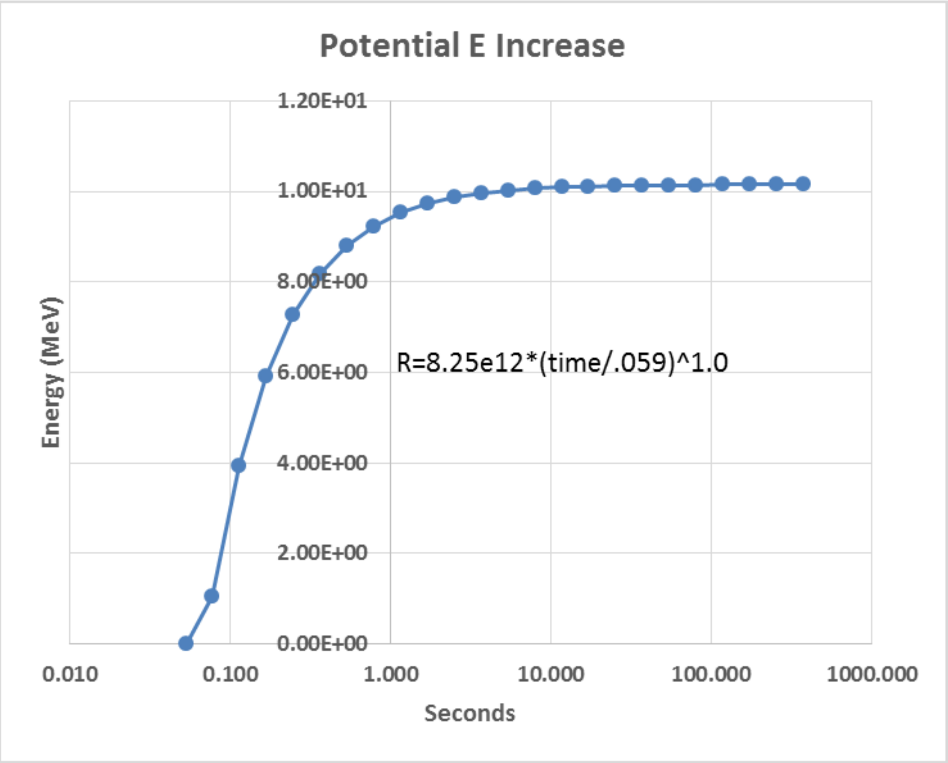


				He4 Fusion energy addition (MeV) →			0.51	4.52E-02
R (meters)	8.24E+12	1.21E+13	1.78E+13	2.62E+13	3.96E+16	5.82E+16	2.07E+17	2.51E+17
r=R/exp(60) m	7.22E-14	1.06E-13	1.56E-13	2.29E-13	3.47E-10	5.09E-10	1.82E-09	2.20E-09
coup*ph/pr	5.57E-02	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13
ke=coup/r	7.71E+11	6.68E+00	4.54E+00	3.09E+00	2.05E-03	1.39E-03	3.70E-01	1.41E-01
g=(939/(939+ke))	**1.2166E-09**	**9.9293E-01**	**9.9518E-01**	**9.9671E-01**	**1.0000E+00**	**1.0000E+00**	**9.9961E-01**	**9.9985E-01**
V=(1-(g)^2)^0.5*C (m/	**2.9979E+08**	**3.5592E+07**	**2.9405E+07**	**2.4280E+07**	**6.2612E+05**	**5.1640E+05**	**8.4172E+06**	**5.2051E+06**
F=mV^2/r (Nt)	1.7037E-36	1.6335E-38	7.5845E-39	3.5177E-39	1.5478E-45	7.1624E-46	5.3396E-44	1.6841E-44
E=Fdr (MeV)		4.23E+00	2.89E+00	1.97E+00	1.31E-03	8.90E-04	5.32E-01	4.96E-02
de from Rh	0.00E+00	5.92	7.26	8.18	10.15		1.76E-09	2.17E-09

Each column of calculations is a radius increment. R is the expansion curve and T is the temperature curve reported in the section above entitled "Constructing the expansion radius". The radius r is R/exp(60), again to scale the calculation down to the proton-proton level. Next we determine the orbital ke related to gravity (keg) by the definition of coupling constant above, i.e. Coup=keg*r. We know r and can determine keg. But we know that ke cannot fall below the energy contributed by photons because inertial forces *and* impact by photons drive expansion. The photon energy is kep=T*1.5*B where Boltzmann's constant B=8.6e-11 MeV/K. With this we put (keg+kep) in the equation for gamma and then determine orbital velocity. From here we can calculate the force F=mV^2/r. Above it is 5.3e-44 Nt at the point that 0.51 MeV He4 fusion occurs (more on this energy value below). This causes the radius to increase (dR=E/F) from 5.82e16 meters to 2.07e17 meters.

The remainder of the expansion curve to the present time does not affect our discussion of He4 formation and is included in Appendix 1.

The proton mass model has a value 10.15 MeV associated with expansion Kinetic Energy. The following chart shows the kinetic energy being converted to potential energy as a function of time.



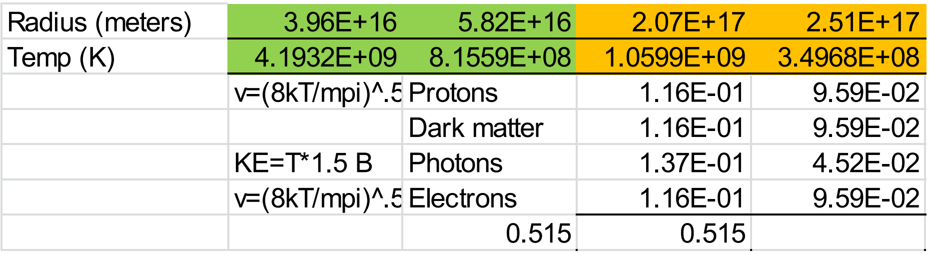
He4 fusion energy

Important values can be calculated at Rh where primordial helium4 forms. Helum4 formation [11] occurs when the SAHA equation for deuterium indicates that its probability is one. This is known to occur at 8e8K but the exact radius where this temperature occurs is critical. We can calculate the fusion energy added at that point. The value 0.25 in the figure below represents the fraction of normal matter fused to He4 and the value 4 represents the number of nucleons required to form He4 atoms. The value 7.07 MeV is He4 binding energy [3].

Binding Energy			
MeV	Number	dq MeV	
7.07	4.65E+76	3.29E+77	He4 binding energy*0.5*exp(180)*.25/4
0.11	7.45E+77	8.19E+76	Energy remaining from 10.15 MeV initial energy
		4.11E+77	sum dq MeV
		0.552	MeV/proton

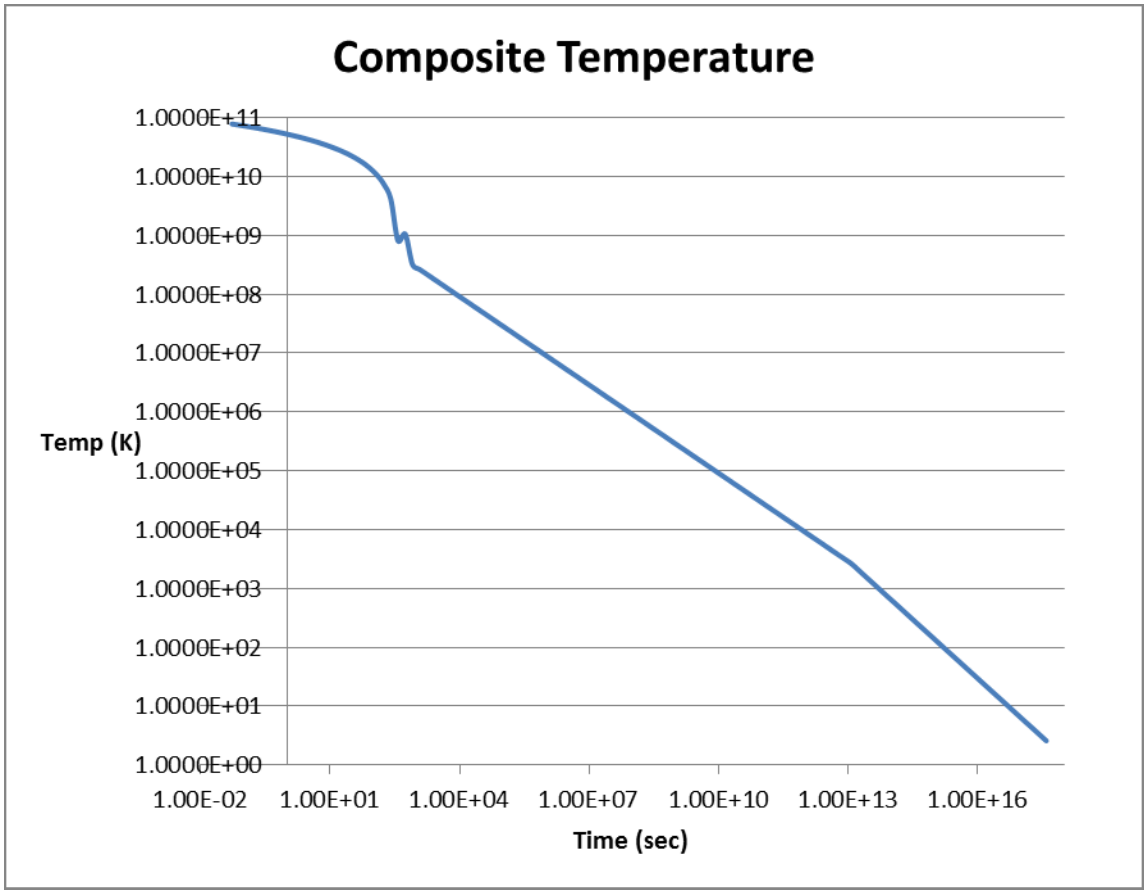
descanso.jpl.nasa.gov/SciTechBook/series1/Goebel_03_Chap3_plasphys.pdf

There are four components to the plasma; protons, dark matter, photons and free electrons (and massless neutrinos). An equation is found in the above reference for the energy of three components. The table below is for 1.06e9 K:



Radius (meters)	3.96E+16	5.82E+16	2.07E+17	2.51E+17
Temp (K)	4.1932E+09	8.1559E+08	1.0599E+09	3.4968E+08
	v=(8kT/mpi)^.5	Protons	1.16E-01	9.59E-02
		Dark matter	1.16E-01	9.59E-02
	KE=T*1.5 B	Photons	1.37E-01	4.52E-02
	v=(8kT/mpi)^.5	Electrons	1.16E-01	9.59E-02
		0.515	0.515	

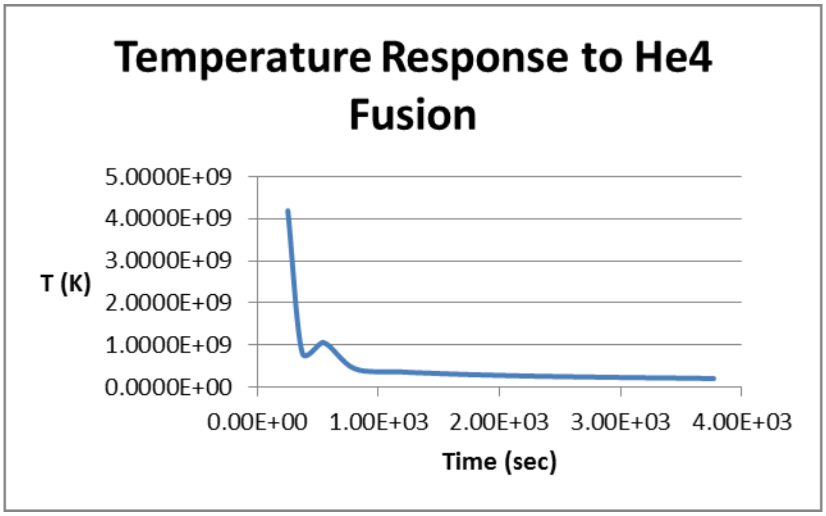
The total energy for the plasma components compares with the He4 energy release above (0.515 MeV/proton). Fusion of He4 causes a temperature spike to 1.06e9K. Dark matter saps 0.116 MeV from the total at 2.07e17 meters and continues to take smaller amounts as expansion progresses. As expansion occurs the temperature falls as Rh/R and yields 2.73K at the current time. Photon KE (MeV) determines the temperature (T=KE/(1.5B) where B is Boltzmann's constant 8.6e-11 MeV/K. The curve is interesting.



The beginning temperature (3.92e10 K at 10.15 MeV) starts to fall and dives when the kinetic energy is nearly depleted. When the temperature hits 8e8 K the SAHA equation for deuterium initiates He4 fusion. This causes a spike in temperature to 1.06e9 K but then continues to fall according to Rh/R. The break in the curve at 3e13 seconds is decoupling where expansion follows a 2/3 power rather than the earlier ½ power.

Temperature spike from He4 fusion

The temperature history decreases initially but as He4 fusion occurs, the temperature increases before finally decreasing to the Cosmic Background Temperature (CBR) due to expansion. The temperature spike caused by the release of 0.55 MeV/proton is shown below. Although protons release fusion energy, they are only 0.5 of the total mass.



Freeze-out Mechanism

Initially the number of neutrons is controlled by a Boltzmann relationship: n’/N=exp(-1.293/Ke) where Ke is in MeV and p’=N-n’. As the kinetic energy falls with expansion, neutrons become less prevalent until a condition known as freeze-out occurs. At this condition, temperature reduction due to expansion is high compared to the reaction rates and the reaction favoring protons stops progressing. The relative forward and reverse reactions determine the balance of neutrons and protons as early expansion occurs. An excerpt from Pebbles [4] Table 6.2 pg. 185 is included below. Reference 12 contains an excellent review of these reactions. They are a function of the density of the reactants. If dark matter is present, the radius will need to be larger to give the same number of reactions. This is missing from both Pebbles and reference 12.

T(10^10 K)		lam t	lamb t		n'/(n'+p')
22.5		4700	5000		0.483
13.1		900	1010		0.471
7.6		170	208		0.451
4.45		31	43		0.418
2.59		5.4	9.7		0.363
1.51		0.85	2.3		0.292

When n’/(n’+p’) takes on the approximate value 0.2, freeze-out has occurred because the forward reaction (lam t) cannot keep up with the reverse reaction rate (lamb t). This keeps more protons from forming from this mechanism fixing the ratio.

Decay mechanism

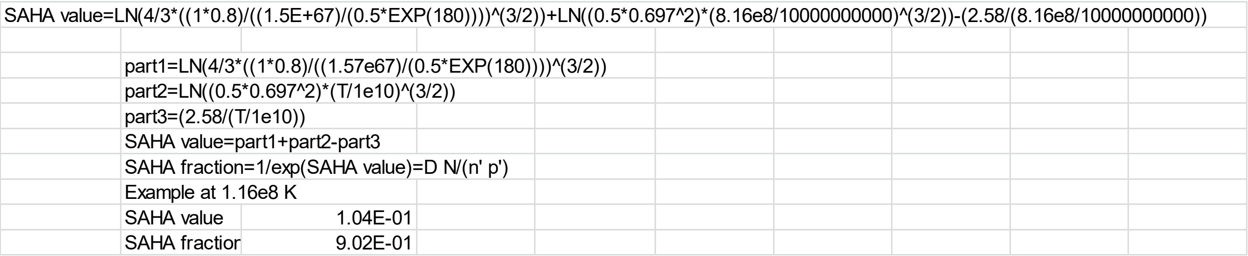
There is another mechanism that forms protons. The neutrons decay to protons with the relationship:

n'/N=(EXP(-0.693*t/866)) where t is time and 866 sec is the decay half time.

Photo-disintegration of Deuterium

Deuterium fraction is limited by photo-disintegration [4][6]. It is well known that deuterium readily fuses to He4 after the temperature falls to approximately 8e8 K.

The SAHA equation [4] is utilized to give the early deuterium fraction.



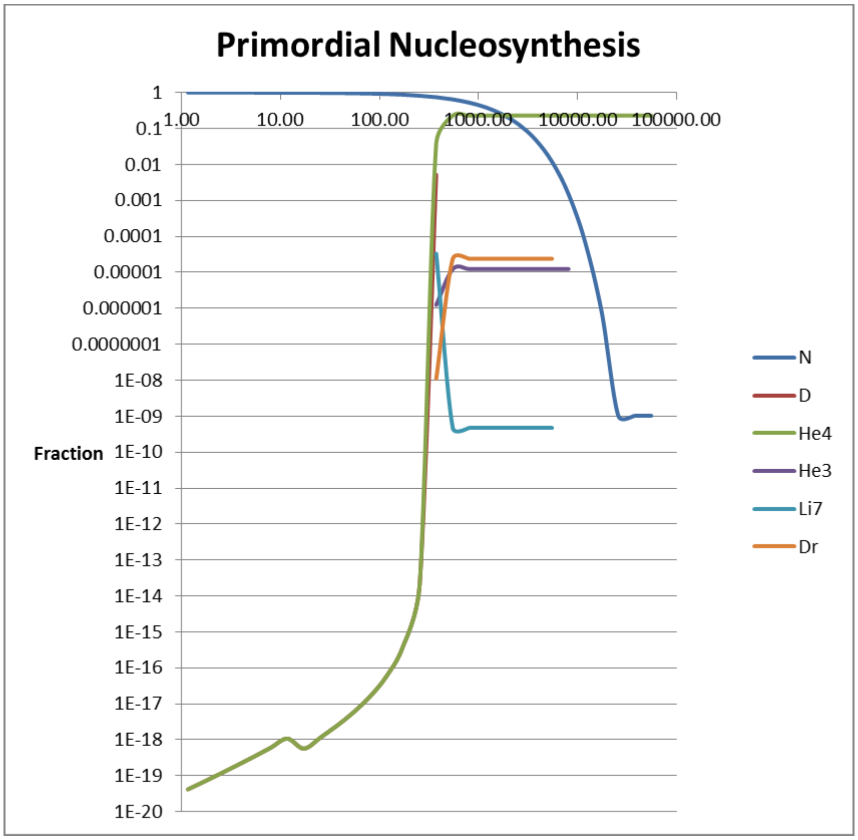
SAHA value=LN(4/3*((1*0.8)/((1.5E+67)/(0.5*EXP(180))))^(3/2))+LN((0.5*0.697^2)*(8.16e8/10000000000)^(3/2))-(2.58/(8.16e8/10000000000))		
	part1=LN(4/3*((1*0.8)/((1.57e67)/(0.5*EXP(180))))^(3/2))	
	part2=LN((0.5*0.697^2)*(T/1e10)^(3/2))	
	part3=(2.58/(T/1e10))	
	SAHA value=part1+part2-part3	
	SAHA fraction=1/exp(SAHA value)=D N/(n' p')	
	Example at 1.16e8 K	
	SAHA value	1.04E-01
	SAHA fractior	9.02E-01

Where: Ln stands for natural logarithm, D=deuterium, N=total number of nucleons, p'=protons, n'=neutrons, Omega baryons=0.5 and T/1e10 is the temperature in degrees K divided by 1e10. The value exp(180) is the number of particles in the universe [7] and the value 0.697 is h, the best value of the Hubble constant [3].
SAHA fraction=D N/(p' n') =1/exp(SAHA value). For example at equilibrium SAHA value=0 and fraction=1/exp(0)=1.

Deuterium and He4 formation

He4 formation can be calculated by applying the freeze-out mechanism to determine n'/N, then applying decay to n'/N. As temperature decreases D and He4 fraction is predicted by 1/exp(SAHA) but when T= 8e8K the SAHA fraction (DN)/(p' n') =1.0. At this condition, literature states that the deuterium D rapidly converts to He4. The SAHA equation is unity at 373 seconds and 5.82e16 meters radius. The reaction equilibrium occurs at SAHA fraction=1, D N/(p' n')=1. Calculation of He4 fraction: At this point N=0.5*exp(180)=7.47e77 and the number of neutrons n'=2.35e77. The He4 fraction= (2*n'/N/(1+n'/N)=0.24.

Details of primordial nucleosynthesis



Initially the universe is mainly neutrons. They readily form deuterium (D, the red curve) but its abundance is limited by photodisintegration since it has a low binding energy. The horizontal axis above is seconds from the beginning. The SAHA equation predicts the increasing fractions of He4 and deuterium and also predicts the temperature at which probability becomes 1 for the reactions that produce He4 (from free neutrons and deuterium). This occurs at 8e8K and 1e17 meters. After that point 25% of normal mass exists in the form of He4 atoms (the green curve). The blue curve shows that neutrons continue to decay. The yellow, purple and light blue curves are the residuals related to baryon/photon ratio. After the SAHA value becomes positive (maximum = 1.0), the D fraction becomes fixed. Appendix 2 contains two literature analyses of this period. Although they contain more dynamics of the individual reactions, they do not include the temperature spike that is critical to the correct baryon/photon ratio.

Baryon/photon ratio and deuterium residual

We are now in a position to calculate the important baryon/photon ratio and from the ratio calculate deuterium residual, He3 residual and Li7 residuals [20]. The baryon/photon ratio equation is below; all one has to do is put in the radius and temperature at that radius (R&T). This is exactly the point where temperature spikes. The point where He4 forms is 1.06e9K and 2.07e17 meters.

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Baryon/photon=(0.5*EXP(180)/(4/3*PI()*R^3))/(8*PI()/(4.31e-21*3e8)^3*(1.5*8.62e-11*T)^3)
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	1.0971E-09	7.7371E-10	7.3656E-10	1.3646E-09	5.8370E-08	5.8755E-10	1.1803E-08	1.1803E-08
Radius (meters)			1.0212E+00	1.0000E+00	5.82E+16	2.07E+17	2.51E+17	3.05E+17
Temperature (K)				1.35E+17	8.16E+08	1.06E+09	3.22E+08	2.65E+08
baryon/photon ratio				1.0400E+09	5.84E-08	5.88E-10	1.18E-08	1.18E-08
Time (seconds)				Measured	373	549	807	1186
D=4.6e-4*(B/P*1e10)^(-1.67)*1/exp(SAHA)				2.37E-05	1.10E-08	2.39E-05	2.39E-05	2.39E-05
He3=3e-5*(B/P*1e10)^-0.5				3.3e-5 to 1e-4	1.24E-06	1.24E-05	1.24E-05	1.24E-05
Li7=5.2e-10*(B/P*1e10)^-2.43+6.3e-12*(B/P*1e10)^2.43				6.00E-09	3.32E-05	4.73E-10	4.73E-10	4.73E-10
http://cds.cern.ch/record/262880/files/9405010.pdf				SAHA	1 (equilibrium)	3.01E+00	-5.47E+01	-7.20E+01

Measured values and calculated values for He3 and Lithium7 depend on the baryon/photon ratio. Reference 10 equations are included in the table. The deuterium residual agrees with measured values at baryon/photon ratio 6e-10. After the temperature spike, the temperature falls but the residual values are already frozen at a value close to the measured value 2.3e-5.

With 0.5*exp(180) protons, the baryon/photon ratio is 6e-10. Several isotopes are part of the primordial spectrum but once established they can't change at the lower temperatures. The literature equations for predicting deuterium, helium3 and lithium7 are on the left [20]. At the calculated baryon/photon ratio the deuterium residual is in the range and the other two measurements are close to the measured values. The Planck mission's baryon/photon ratio result was 6e-10. A review of the reaction rates in reference 12 indicates that the density at the temperature for He4 formation is critical. Rh above is 2e17 meters. The reason this Rh has to be larger than the equivalent Planck mission radius 9.06e16 meters is that a larger radius is required to enclose the required He4, D, He3 and Li7 reactions because dark matter is part of the density and it does not react. This is shown by a ratio of the densities (3/2 because there are three species). Both sets of data below give 6e-10 baryon/photon but the set labelled Planck are for a lower radius and a compensating decrease to 0.046 baryons fraction of critical density. The line labelled "with dark matter" below is for 0.5 baryon fraction of critical density.

T (K)	8.16E+08	1.06E+09	3.22E+08	2.65E+08	2.19E+08	1.80E+08	1.49E+08	1.23E+08
		Baryon/photon=(0.5*EXP(180)/(4/3*PI()*R^3))/(8*PI()/(4.31e-21*3e8)^3*(1.5*8.62e-11*T)^3)						
		baryon/photon	number densit	radius (m)				
			.5*exp(180)/vol					
	1.685	6.1985E-10	2.9797E+25	9.0686E+16		n+p	Planck	
		5.8755E-10	1.9941E+25	2.0736E+17	1.49E+00	n+p+d	with dark matter	

Result of deuterium abundance possible limitation

The baryon/photon ratio and deuterium abundance should not cause baryons to be severely limited like WMAP [4] and other documents suggest (0.046 fraction of critical density). The number of baryons associated with 0.5 fraction of critical density is okay with respect to this possible limitation

Conclusions

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 spikes and the radius increases. At this point the baryon/photon ratio is 6e-10 and residual values agree with measurements. The photon/baryon ratio reported for WMAP is as reported 4.4e-10 at the end of expansion but it was higher at the temperature spike.

There are two reasons that the baryon fraction was historically reduced to 0.046 fraction of final density. Firstly, the reactions reported in the literature did not include dark matter which is also 0.5 of final density. The radius at He4 formation has to be increased by 1.5 to include 3 species, not two in the reaction equations. Secondly, literature does not include the temperature spike to 1.06e9K. This is exactly the point that the residual fractions of D, He3 and Li7 form. With these two corrections the baryon fraction is 0.5 of current density and dark matter is also 0.5 of current density.

References:

1. Barbee, Gene. H., *A top down approach to fundamental interactions*, FQXi essay June 2012, revised Feb 2014, viXra:1307.0082.
2. Barbee, Gene. H., *Application of information in the proton mass model to cosmology*, viXra:1307.0090 revised January, 2015. Reference Microsoft ® spreadsheet entitled simple1c.xls, Barbee.
3. Bennett, C.L. et al. *First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Data*, Astrophysical Journal, 2001.
4. Peebles, P.J.E., *Principles of Physical Cosmology*, Princeton University Press, 1993.
5. Barbee, Gene H., *On the Source of the Gravitational Constant*, Prespacetime Journal, Volume 5 No 3, April, 2014. Originally viXra:1307.0085.
6. Bergstrom, L. and Goobar, A., *Cosmology and Particle Astrophysics*, 2nd Edition, Springer-Praxis Books in Astrophysics and Astronomy, 2004.
7. Barbee, Gene H., *On Expansion Energy, Dark Energy and Missing Mass*, Prespacetime Journal, Volume 5 No 5, May, 2014, viXra:1307.0089v7, January 2017.
8. http://burro.astr.cwru.edu/Academics/Astr222/Cosmo/Early/nucleosynth_fig.jpg.
9. http://www.phys.utk.edu/witek/NP621/Greene.pdf
10. http://cds.cern.ch/record/262880/files/940501.pdf Review of work by N. D. Schramm.
11. Barbee, Gene H., *Dark Energy*, viXra:1511.0185v3, January, 2017.
12. Patrick Peter, Jean Philippe Uzan, *Primordial Cosmology*, OUP Oxford, Feb 14, 2013.
13. Planck Collaboration, P.A.R. Ade, et.al., https://arxiv.org/pdf/1502.01589v3.pdf

Appendix 1 Expansion history

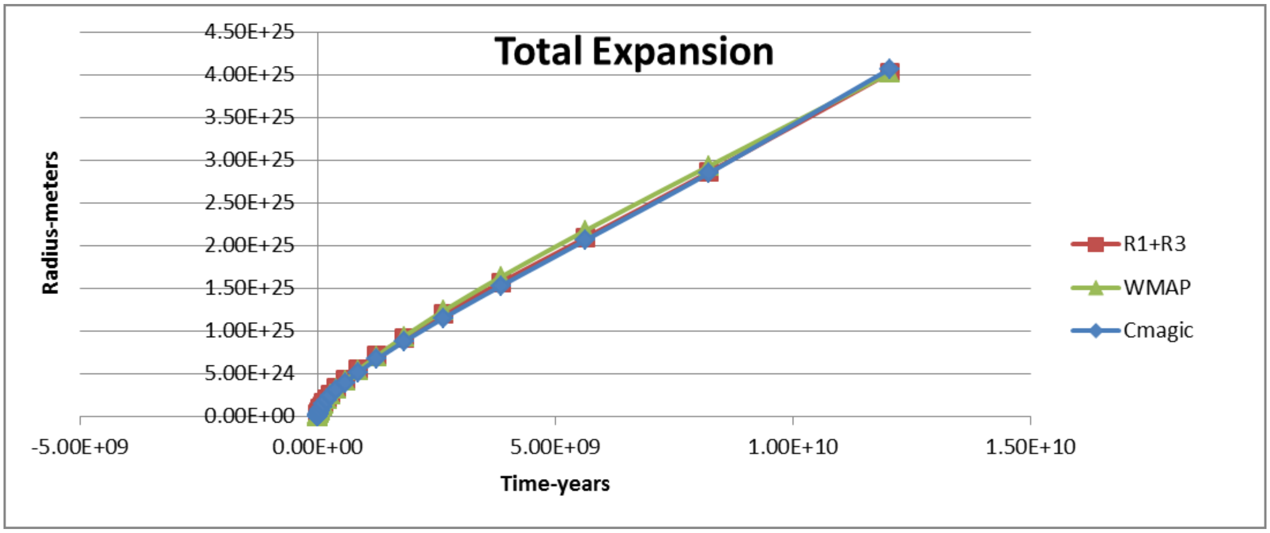
Constructing the expansion radius from He4 to the present time

There is uncertainty in current literature regarding the initial radius of the universe. Some say it was a point and an exponential expansion known as inflation quickly increased the radius. WMAP [4] indicates that they use an expansion radius consisting of two parts. We will construct the expansion curve starting at the current radius and work backwards in time to minimize uncertainty. To know the current radius, we must know the number of neutrons in nature. Based on probabilities for the neutron components a calculation for the number of neutrons can be performed. [Appendix 1 topic entitled “The number of neutrons in nature”]. At the current time the universe density is 9.14e-27 kg/m^3. This is also considered critical density. The volume that would contain exp(180)*1.67e-27 Kg=2.48e51 Kg is 2.48e51/9.14e-27=2.72e77 m^3. Assuming a sphere, the current radius is 4.02e25 meters. This includes both expansion components. The first expansion component is scalable with time ratios if we take out the controversial second component. We will use radius 3.14e25 meters as the current radius (this does not include the lambda component but we will add back photon energy) to bring the total radius to 4.02e25 meters.

The plasma dissipates at decoupling and from decoupling radius (Rd) to the present time the expansion is determined by R=Rd*(time/timed)^(2/3). Time (d) at decoupling was 3.19e13 seconds and time now is 3.79e17 seconds. Rd=3.14e25/(3.94e17/3.19e13)^(2/3)=3.06e22 meters. (Note: don’t worry too much about the times quoted. The radius is related to a time ratio and there will be more on this later).

Again working backward we construct the earlier part of the curve from Rd back to Rh, the point where primordial He formed. This is predicted by the SAHA value 1 for deuterium which occurs at 8e8 K. There is agreement that after inflation, plasma exists and expansion is radiation dominated [21]. The physics of radiation driven expansion is a function of time to the 0.5 power [10]. That is, Rh=3.06e22/(3.19e13/549)^0.5=2.07e17 meters. He4 forms right after the temperature falls to 8e8 K and increases the temperature to 1e9 K [Appendix topic “Details of primordial nucleosynthesis”]. Calculation of baryon density depends on radius, especially the radius when residual deuterium formed.

Interpretation of WMAP gives the following expansion history:



Appendix 2 Literature primordial nucleosynthesis

The temperature in the graph below is about 3e9 K at 12 seconds. The kinetic energy associated with this temperature is 1.5*B*T=0.39 MeV, where B is Boltzmann's constant 8.62e-11 MeV/K. One can see from the smoothly decreasing temperature in the horizontal axis that as Helium 4 fuses, there is no increase in temperature. This amount of energy should increase the temperature to about 1e9 K as shown in the graph showing the temperature spike.

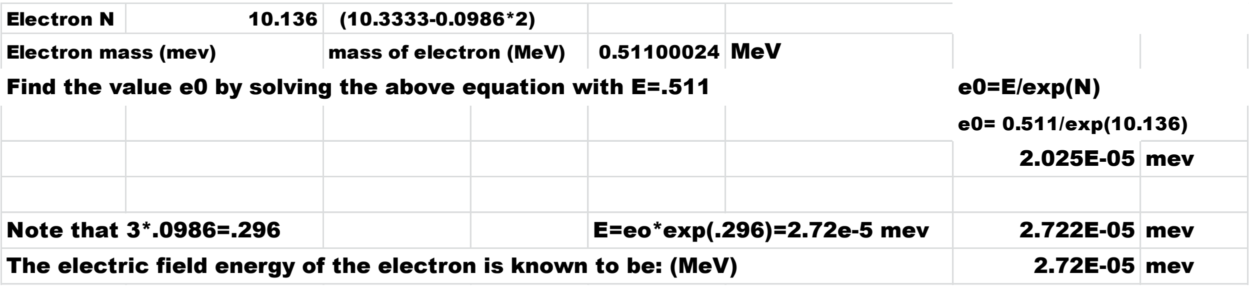
Appendix 3: Proton mass model

The formal definition of information is attributed to Claude Shannon [7]. Information (N) = -ln P (Inversely, P=1/exp(N) where exp(N) means the natural number 2.718 to the power N). Probabilities are the chance of one event divided by all possibilities. He used natural logarithmic relationships because probabilities (P) multiply but information is additive. The negative sign tells us that information is high when probabilities are low.

Can energy (E) be related to information? Using the right probability, the answer is yes. Probability P=e0/E where e0 is an energy constant that forms an energy ratio. Quantum mechanics deals with the square root of P (a complex number called psi). This is tied to wave/particle duality but the relationships of interest are described by probability P=e0/E=1/exp(N) and E=e0*exp(N).

N for fundamental energy values

The relationship E=e0*exp(N) will be used extensively. N is a logarithmic number. The key to N values for energy was correlation of data gathered by high energy labs [3][7]. Comparing N values for particles and knowing that the 0.511 Million Electron Volts (MeV) electron has a field equal to 2.72e-5 MeV, allowed the author to deduce that the electron N was 10.136 and its electromagnetic field energy N was 0.296=3*0.0986=3*ln(3/e) where e is the natural number 2.718. The energy constant e0=2.02e-5 MeV is calculated below from Particle Data Group [3] data for the electron mass. The universal equation for energy is E=2.02e-5*exp(N) MeV.

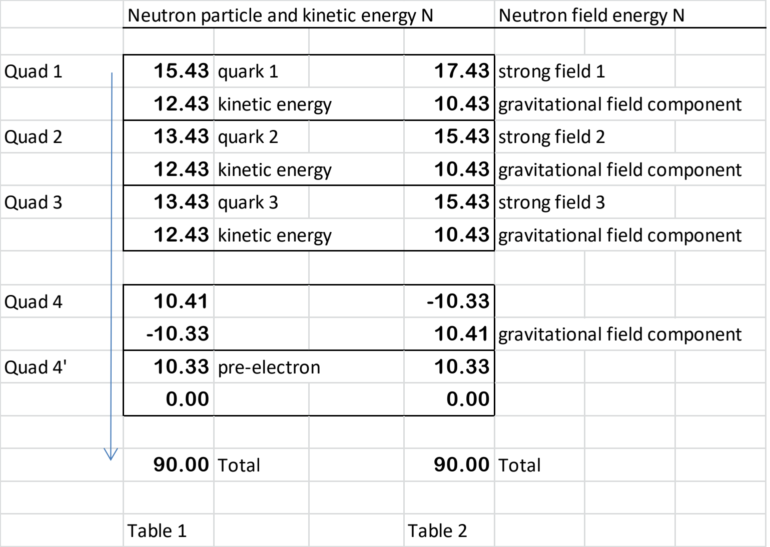


Electron N	**10.136**	**(10.3333-0.0986*2)**					
Electron mass (mev)		**mass of electron (MeV)**		**0.51100024**	**MeV**		
Find the value e0 by solving the above equation with E=.511						**e0=E/exp(N)**	
						e0= 0.511/exp(10.136)	
						2.025E-05	**mev**
Note that 3*.0986=.296				**E=eo*exp(.296)=2.72e-5 mev**		**2.722E-05**	**mev**
The electric field energy of the electron is known to be: (MeV)						**2.72E-05**	**mev**

Data showing an N value for fundamental energy observations is listed in Part 2 Topic 1. The data is from either from NIST, (National Institute of Standards and Technology), the Particle Data Group [5] maintained by UC Berkeley or other reported values [3][7]. There are three quarks confined in a neutron (and proton) but they are not observed individually. The higher energy bosons are variations of N=22.5 and the Higgs particle measured in July 2010 agrees well with the author's N value of 22.575. Time for fundamental particles is simply reciprocal time (1/time=frequency).

Neutron components

The author found N values for neutron components based on the way three quark masses and their kinetic energies add to the neutron mass. The related information components total N=90 for the neutron. They are listed in Table 1 below.

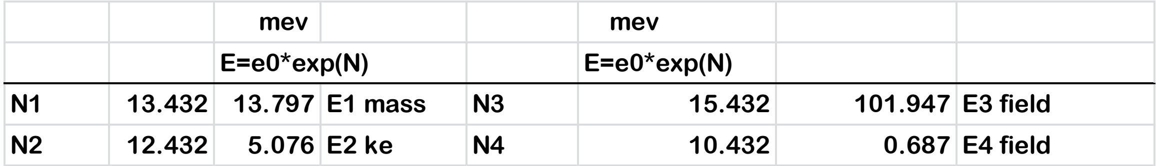


	Neutron particle and kinetic energy N			Neutron field energy N
Quad 1	15.43	quark 1	17.43	strong field 1
	12.43	kinetic energy	10.43	gravitational field component
Quad 2	13.43	quark 2	15.43	strong field 2
	12.43	kinetic energy	10.43	gravitational field component
Quad 3	13.43	quark 3	15.43	strong field 3
	12.43	kinetic energy	10.43	gravitational field component
Quad 4	10.41		-10.33	
	-10.33		10.41	gravitational field component
Quad 4'	10.33	pre-electron	10.33	
	0.00		0.00	
	90.00	Total	90.00	Total
	Table 1		Table 2	

Table 2 is similar to Table 1 except it contains N values for field energies of the neutron. Since the neutron does not carry charge, the electromagnetic field is absent but appears as a separation once the neutron decays to a proton (quads 4 and 4'). The strong residual field energy is part of a total energy balance. Sets of four N values labelled quads are involved in an information operation.

Table 1 represents mass plus kinetic energy and Table 2 represents field energy. Set 2 will be used as an example for a quad that contains four values. The N values 13.43+12.43 are separated into 15.43+10.43. This operation conserves N but energy is also conserved. After these operations mass is imbedded in field energy quantum orbits. Each N has a specific place and a specific energy described below. N1 always gives a mass, N2 always represents a kinetic energy value, N3 always specifies strong field energy and N4 always specifies a second field energy (associated with gravity).

E1 will be identified as a mass (a quark for the strong interaction)
E2 is identified as a kinetic energy (ke) addition to energy E1.
E3 is identified as strong field energy.
E4 is identified as a gravitational field energy component.



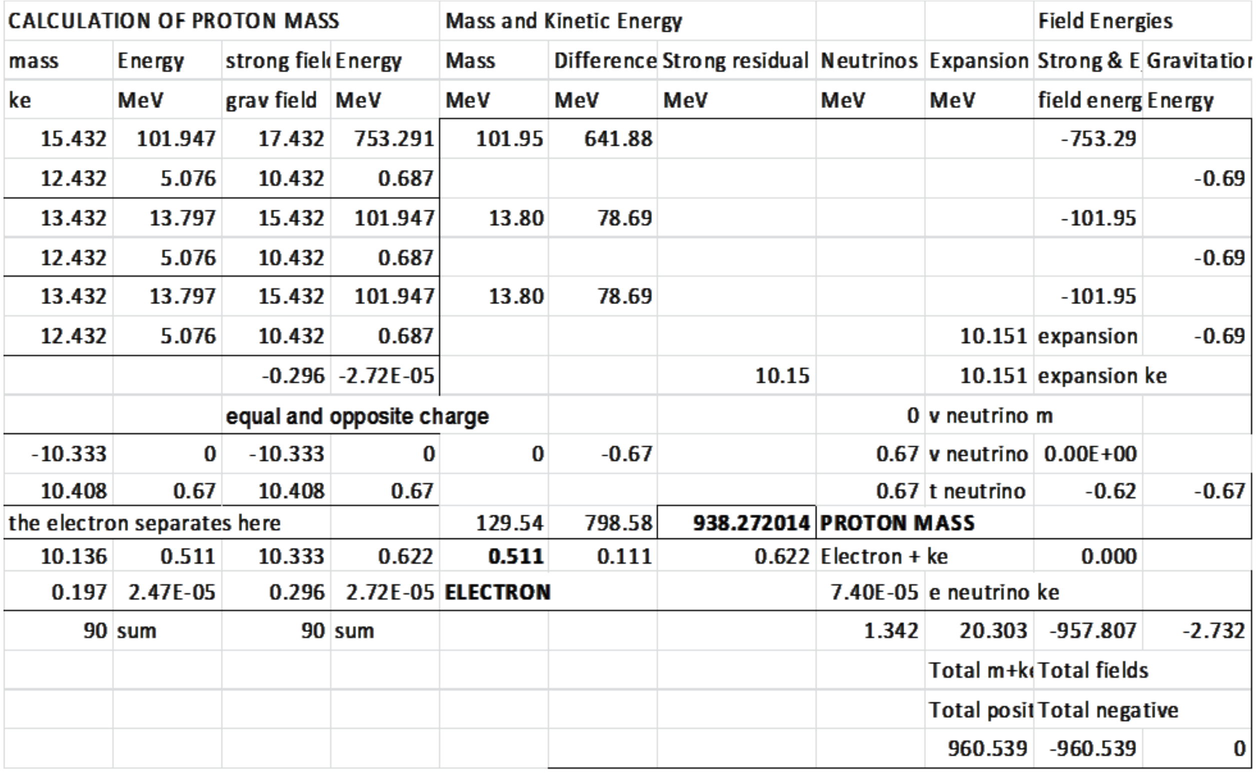
		mev			mev		
		E=e0*exp(N)			E=e0*exp(N)		
N1	13.432	13.797	E1 mass	N3	15.432	101.947	E3 field
N2	12.432	5.076	E2 ke	N4	10.432	0.687	E4 field

These above energy values are placed in a table below with mass plus kinetic energy (102.634 MeV) separated from field energy (102.634). The total energy across the interaction is conserved at zero with mass (E1) + ke (E2) +ke difference (E4+E3-E2-E1) balancing field energies (E3+E4 shown as negative). This information separation followed by energy conservation has powerful implications. The operation involving E1 and E2 can be read E1 is given exp(2) of kinetic energy. Since the numbers (N) are exponents (E=e0*exp(N)), the number 2 can be associated with a divisor 1/exp(2)=0.135 that increases the kinetic energy of E1. The value 0.135 is identical to the concept of gamma in relativity. Gamma is the divisor that increases the kinetic energy of a moving mass involved in the Lorentz transformation. The definition is: ke=m/gamma-m. These may be special case Lagrangians and the energy interaction is similar to a physics qauge transition.

Information (N) values from the neutron component table were used to a model the neutron's known mass, 939.56 MeV. Three quads of N values are associated with three quarks and the fourth set transitions to the electron. 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. Fundamental N values (13.431, 12.431, 15.431 and 10.431) are shown to the left of the box. These values are the source of the energies (E=e0*exp(N)) inside the box. The kinetic energy operator N=12.431 gives mass kinetic energy. It's associated energy=2.025e-5*exp(12.431)=5.01 MeV. This creates a quark orbit with kinetic energy and associated field energies. The kinetic energy column has several components. Kinetic energy for each quad =E3+E4-E1-E2-E2. The extra E2's are added back to form the column weak kinetic energy (10.15 MeV) and gravitational expansion energy (20.3 MeV). These energies play crucial roles in cosmology. The bottom quad is for the electron after it has decayed from the neutron.

Tables 1 and 2 above each sum to the value N=90 but are separated opposites. This separates zero energy into two types of energy. Mass plus kinetic energy is positive and field energy is negative. The total energy for each neutron (939.56 MeV) plus the external kinetic energy that drives expansion is 960.54 MeV but the fields are negative 960.54 MeV. This conserves the other initial condition; zero energy.

Energy (MeV) = 960.54-960.54=0.



CALCULATION OF PROTON MASS				Mass and Kinetic Energy					Field Energies	
mass	Energy	strong fiel	Energy	Mass	Difference	Strong residual	Neutrinos	Expansion	Strong & E	Gravitatio
ke	MeV	grav field	MeV	MeV	MeV	MeV	MeV	MeV	field energ	Energy
15.432	101.947	17.432	753.291	101.95	641.88				-753.29	
12.432	5.076	10.432	0.687							-0.69
13.432	13.797	15.432	101.947	13.80	78.69				-101.95	
12.432	5.076	10.432	0.687							-0.69
13.432	13.797	15.432	101.947	13.80	78.69				-101.95	
12.432	5.076	10.432	0.687					10.151	expansion	-0.69
		-0.296	-2.72E-05			10.15		10.151	expansion ke	
		equal and opposite charge					0	v neutrino	m	
-10.333	0	-10.333	0	0	-0.67		0.67	v neutrino	0.00E+00	
10.408	0.67	10.408	0.67				0.67	t neutrino	-0.62	-0.67
the electron separates here				129.54	798.58	**938.272014**	**PROTON MASS**			
10.136	0.511	10.333	0.622	**0.511**	0.111	0.622	Electron + ke		0.000	
0.197	2.47E-05	0.296	2.72E-05	**ELECTRON**			7.40E-05	e neutrino	ke	
90	sum	90	sum				1.342	20.303	-957.807	-2.732
								Total m+k	Total fields	
								Total posit	Total negative	
								960.539	-960.539	0

Values from the proton model unify the four forces (interactions) of nature [2].
One important value above is 20.3 of expansion potential energy that forms an orbit with about 10.15 MeV of kinetic energy and 10.15 MeV of potential energy. A neutron falls into the 2.723 MeV gravitational field and establishes an orbit at 7.22e-14 meters. This physics is the same as General Relativity except it occurs at the quantum scale. Another value of interest above is the difference between the neutron and proton mass, 1.293 that is made up of a neutrino of energy 0.671 and an electron with kinetic energy of 0.662 MeV.

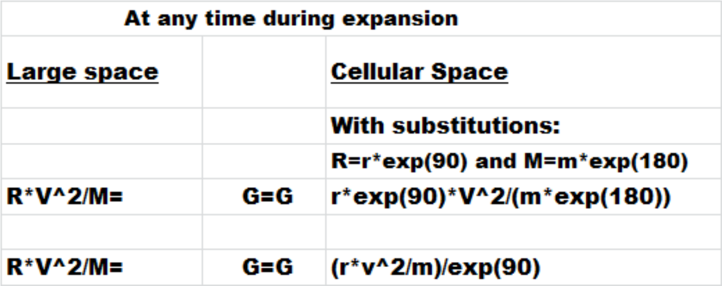
Appendix 4: Review of cellular cosmology

Consider large mass M (for our purposes the mass of the universe although the term universe seems a little presumptive) broken into exp(180) small cells, each with the mass of a proton labelled lower case m below. The mass (m) of a proton is 1.67e-27 kg. Fill a large spherical volume with exp(180) small spheres we will call cells. The value exp(180) comes from the section below entitled "Number of proton like masses in the universe". Consider the surface area of many small cells as a model of the surface of one large sphere with the same surface area. For laws of nature 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 surface model equivalent to the surface of many small cells is useful if the fundamentals of each cell are known.

In general relativity [6] the metric tensor (scholarly matrix equations from general relativity) is based on (ds^2=three distances^2 and (C*time)^2). Note that ds^2 is a surface area and it is this surface that we will break into the surface area of exp(180) small spheres. Let small r represent the radius of each small cell and big R represent the radius of one large sphere containing exp(180) cells with the same surface area. 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. We will evaluate the gravitational constant G of a large sphere and compare it with G of small cells but we will use similar substitutions to evaluate other forces.

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 (lower case r,v and m below are for cellular space):



At any time during expansion		
Large space		**Cellular Space**
		With substitutions:
		R=r*exp(90) and M=m*exp(180)
R*V^2/M=	**G=G**	**r*exp(90)*V^2/(m*exp(180))**
R*V^2/M=	**G=G**	**(r*v^2/m)/exp(90)**

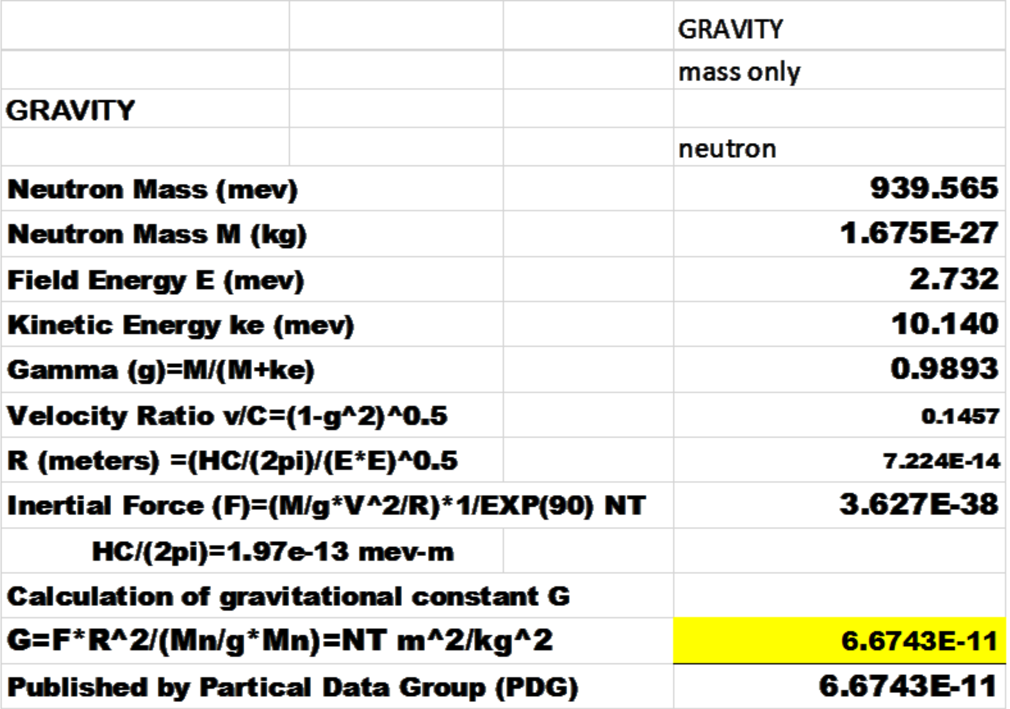
The extremely small value 1/exp(90) is the coupling constant for gravity. When measurements are made at the large scale as must done to measure G, the above derivation indicates that we should multiply cell scale values (r*v^2/m) by 1/exp(90) if we expect the same G. Geometric and mass relationships give the cell “cosmological properties”.

The procedure applied to the force equation F=MV^2/R yields the same result by applying substitutions that represent the relationship between one cell and the universe.

Appendix 5: Calculation of Gravitational Constant from the Proton Mass Model

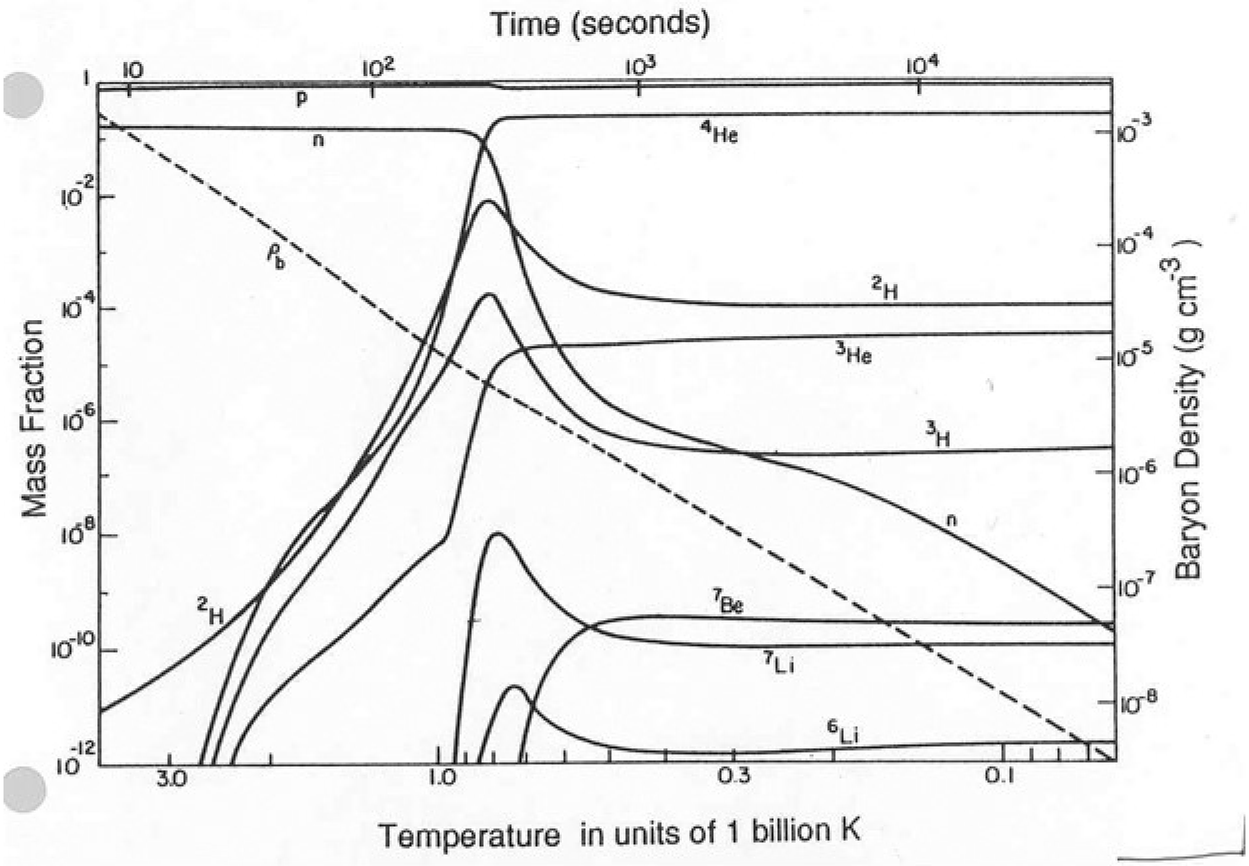
Using values for the proton mass model that the author believes unify nature’s forces (6), the gravitational constant is calculated below and agrees with the published constant, G=6.674e-11 N meters^2/kg^2.

The following table follows a format that organizes input values, intermediate results and the final result in a column of calculations. The goal is to use the fundamental radius 7.224e-14 meters to calculate the gravitational inertial force. The inputs listed at the top of the table originate in the neutron model above. Firstly, the mass of a proton in MeV and its mass in kg are specified in the table. The gravitational field energy 2.723 MeV gives R=7.224e-14 but there is kinetic energy (10.14 MeV) in the orbit that the neutron falls into. With mass and kinetic energy, gamma and V/C can be calculated. Next the inertial force is determined for the mass orbiting at radius R.



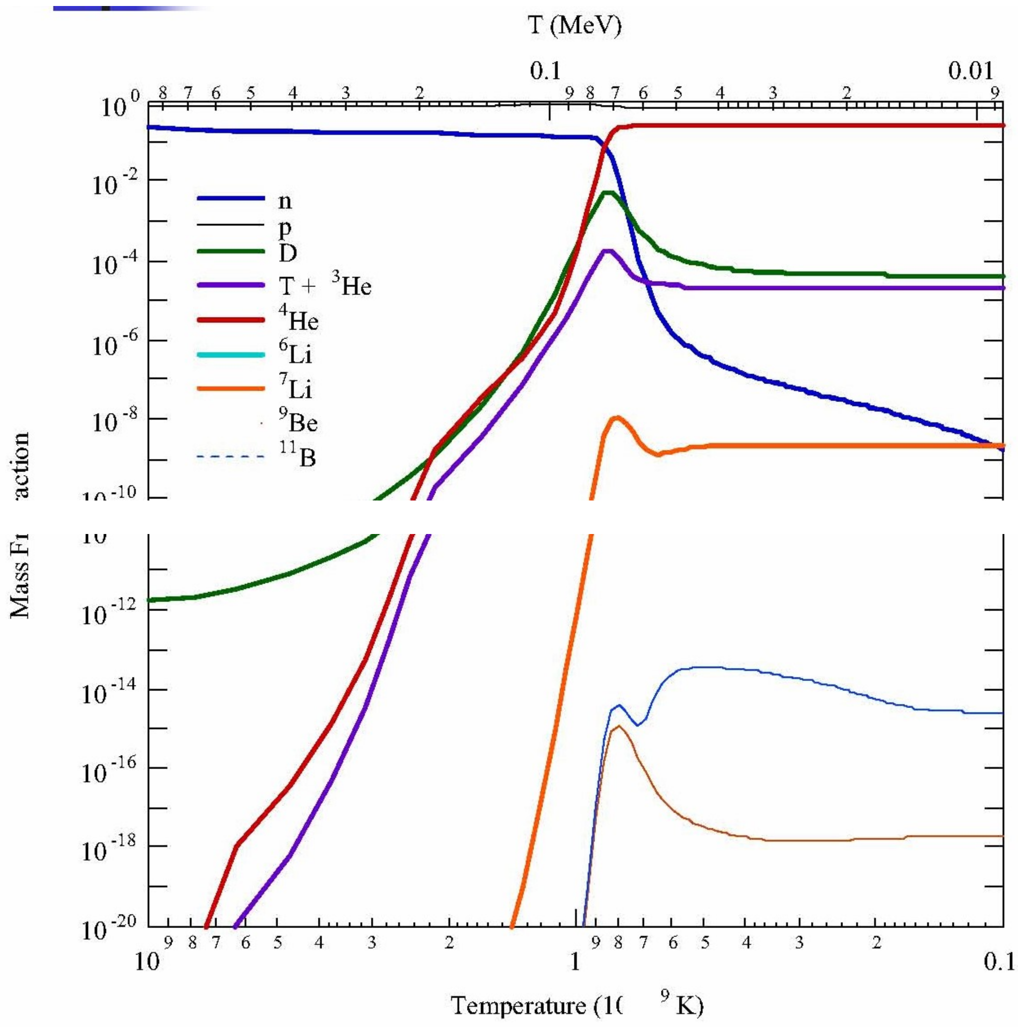
			GRAVITY
			mass only
GRAVITY			
			neutron
Neutron Mass (mev)			**939.565**
Neutron Mass M (kg)			**1.675E-27**
Field Energy E (mev)			**2.732**
Kinetic Energy ke (mev)			**10.140**
Gamma (g)=M/(M+ke)			**0.9893**
Velocity Ratio v/C=(1-g^2)^0.5			**0.1457**
R (meters) =(HC/(2pi)/(E*E)^0.5			**7.224E-14**
Inertial Force (F)=(M/g*V^2/R)*1/EXP(90) NT			**3.627E-38**
HC/(2pi)=1.97e-13 mev-m			
Calculation of gravitational constant G			
G=F*R^2/(Mn/g*Mn)=NT m^2/kg^2			**6.6743E-11**
Published by Partical Data Group (PDG)			**6.6743E-11**

The measured gravitation constant G [16] is calculated above from fundamentals. The constant 1/exp(90) scales the quantum level to the large scale we observe around us. It has the effect of dramatically reducing the force between neutrons and makes gravity very long range compared to the other forces. The inertial force 3.66e-38 N is the same force as the literature above and confirms the radius 7.22e-14 as the radius for quantum gravity.



http://burro.astr.cwru.edu/Academics/Astr222/Cosmo/Early/nucleosynth_fig.jpg

A similar graph from a different source [9] is shown below. Again, the temperature does not increase with He4 fusion.



http://www.phys.utk.edu/witek/NP621/Greene.pdf