Expansion Energy, Dark Energy and Missing Mass
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Abstract

The Wilkinson Microwave Anisotropy Probe WMAP [3][7] and similar projects led to expansion curves and cosmological parameters that are becoming generally accepted. The author developed expansion equations that agree with WMAP but are thought to be more fundamental. A unique cellular approach was used that allowed the kinetic energy and potential energy to be calculated. There are two components of expansion. The second component develops later and according to new calculations requires negligible kinetic energy. The concept of critical density (H= (8/3 pi G rhoC)^.5) incorrectly assumes that density characterizes kinetic energy for this component. Critical density (omega total=1) according to year 9 WMAP parameters [7] is composed of density fractions: omega dark=0.718, omega mass=0.235 and omega baryons mass=0.046. The low value for baryons (protons) leads to a problem known as missing mass. One goal of this paper is to reanalyze mass fractions with the new understanding that the energy associated with omega dark may be negligible. Based on a model of the proton [1], the author uses 10.11 MeV/particle as the kinetic energy (KE) of expansion. This energy is adequate to expand one half of all mass to 6.2e25 meters and provides further evidence that mass fractions quoted above might be incorrect. Using the WMAP procedure, equality and decoupling were re-analyzed with omega baryons=0.5. Results indicate that the measured CMB spot radius and temperature anisotropy are consistent with the higher baryon content. The author believes that the correct cosmological density parameters are omega dark energy=0, omega baryons=0.5 and omega dark matter=0.5.

Literature regarding primordial nucleosynthesis shows production of He4, deuterium and trace amounts of other elements without accounting for He4 fusion energy. The author's expansion model with initial kinetic energy 10.11 MeV/particle has a temperature curve that starts at 7e10 K decreases to temperatures consistent with He4 fusion then increases to account for He4 fusion energy. Subsequent expansion decreases the temperature to 2.73 K indicating that 10.11 MeV correctly anticipates the addition of 1.63 MeV He4 fusion. Implications for deuterium primordial abundance are discussed.

Key words: dark energy, missing mass, expansion kinetic energy, cosmological parameters, nucleosynthesis, expansion models.

Overview

The author uses a cellular model that describes gravity, space, time, expansion, kinetic and potential energy at the quantum level. The model [1][6][12] is summarized in Appendix 1 for convenience. Using a small cell of radius r to simulate a large radius R (literature would call this the radius of the universe) is critical to understanding cosmology. In this model, the universe is filled with the *surface* of many small cells that are equivalent to the *surface* of one large sphere. This is important conceptually because we can be inside the universe (something we all observe), each surface can be identical and the concept that there is no preferred location can be preserved. The relationship between many small cells and one large sphere requires the geodesics of cells to be multiplied by the small factor 1/exp(90), a value that the author shows is the gravitational coupling constant [1][6]. Expansion of each cell involves the kinetic energy of a proton like mass on the surface of each cell. The model's geometrical and numerically similarity allows many small cell surfaces to represent large scale cosmology. Important values for the model originate in the proton model [1] reviewed in Appendix 1. The model shows protons with 20.3 MeV that fall into "orbits" with 10.11 MeV of kinetic energy and 10.19 MeV of potential energy. Initially the mass on the cell surface has high velocity (0.15C) that gives an inertial force equivalent to gravity. Tangential kinetic energy (Appendix 1 contains a diagram) decreases directly with expansion ratio [6] and defines an orbit that maintains the gravitational constant at G. This "orbit" is again a model since it is temperature and pressure associated with kinetic energy that drives expansion [11]. After expansion, potential energy allows protons to fall (accelerate) toward each other and establish orbits as mass accumulation occurs. It is this energy that we see when orbits are established around galaxies and planetary systems. It is also this energy that provides pressures and temperatures high enough to initiate fusion.

Fundamental radius r

The field energy 2.732 MeV underlies the quantum mechanics for a fundamental radius r and a fundamental time t. This energy is found in the proton mass model [1] associated with gravitation and included in Appendix 2.

Proposal	(cell d305 "unified")		
Field Energy		2.732	mev
constant	HC/(2pi)	1.97E-13	mev-m
	R=constant/E	7.22E-14	m
	Field side	R side	
	H/E	2*pi*r/C	
time (t)	1.51E-21	1.51E-21	sec
Proposal p	(p=E/C)	9.11E-09	mev-sec/m
p*R/h		1.00	
qm test	M/C^2*R^2/t	6.58E-22	mev-sec
qm test/h	M/C^2*R^2/t/h	1.00	

convenient constant:	HC/(2*pi)		1.973E-13	mev-meters

r=1.973e-13/(2.732*2.732/1)^.5=7.224e-14 meters.
t=1.51e-21 sec.

Derivation of expansion equations

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

Nomenclature

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

First expansion component; R1
(r/r0)^3 increases as (t/alpha)^2 (kinetic energy requirement)
r=r0*g^(2/3)
R=r0*exp(60)*g^(2/3)
r0=1.93e-13/(2.723*2.723)^.5=7.22e-14 m
R1=(7.22e-14*exp(60))*g^(2/3)

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

r1+r3=(7.22e-14)*g^(2/3)+(7.22e-14)*g^(5/3)*H1*alpha/1.666
R1+R3=r1*exp(60)+r3*exp(60)
t=alpha*(R1/7.22e-14)^(3/2)
(R1/7.22e-14)^(3/2)=g=t/alpha

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

Fundamental time and initial time

Identify the radius and time for the gravitational orbit described above				
Fundamental radius=1.93e-13/(2.732*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		

The author uses dimensionless time, g=time/alpha in expansion equations, i.e. R=r0*g^(2/3). Define alpha as initial time. Time=1.51e-21 seconds*exp(N) where N→45 to approximately 90. Dimensionless time g starts at 1 when time is multiplied by exp(45) at the beginning. This makes alpha=1.51e-21*exp(45)=0.0529 seconds.

Expansion constant H3:

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

R0=7.22e-14*exp(60)=8.245e12 m, where r0=7.22e-14 m.

R1+R3=8.245e12*g^(2/3)+8.245e12*g^(5/3)*H3*alpha/1.66

The second part of the equation above R3=8.245e12*g^(5/3)*H3*alpha/1.666 contains alpha and unknown, H3. Alpha and H3 are evaluated with WMAP data. Decoupling, equality and Hubble's constant match data with alpha=0.0529 seconds and H3=3.24e-18/sec. If these value are used the resulting expansion curve compares favorably with both the WMAP concordance model and the Cmagic model [5]. The concordance model is based on Pebbles [4] with cosmological parameters from WMAP.

R3=8.245e12*g^(5/3)*3.24e-18*0.0529/1.666

R1+R3 was calculated with increasing g until overall H was 2.26e-18 [7]. Matching calculated H with measured H gives R1+R3= 6.2e25 meters at 4.42e17 seconds (14 billion years). R3 is now 0.45 of the total radius but expanding faster (5/3 power). Hubble's constant for R3 expansion matches data with H1=1.3e-18/sec, H3=3.24e-18/sec and H overall=2.26e-18/sec.

The concordance equations can be simplified. The second component (lambda component) called RL below is a function of omega lambda=0.72, Hubble's constant 2.26e-18/sec and time^(5/3), similar to R3.

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

Expansion Table (first 3 time steps)

The following table puts the derivations above into action. There are many results in tables below for R1+R3 expansion. The simulation starts at the fundamental radius and progresses to the right as time advances. The author uses a natural logarithmic scale with time=exp(45+c)*1.51e-21 seconds. Dimensionless time (g) = time/0.0529 starts with 1. If c above is a small value, the model contains more incremental steps. Rows in the model contain values of interest. Cell radius is r1+r3, using the derivation above. Rtotal = (r1+r3)*exp(60). Ke orbit is scaled to lower values by ke=10.11*7.22e-14/(r1+r3). Gamma=938.27/(938.27+ke). V/C=(1-gamma^2)^.5. Fgravity=M*V^2/(r1+r3)/exp(90), where M=1.67e-27 kg. With the above relationships, the calculated gravitation constant G=F/M^2*(r1+r3)^2/exp(90) is constant throughout expansion. The highlighted rows are kinetic energy and potential energy. Potential energy=PE+F*(delta R)/2*6.12e12 MeV/(NT-m) with initial force F=3.66e-38 NT.

alpha (initial time in sec		0.0529	Start		
logarithm used to increase time (LN)			45	45.24475	45.4895
time–seconds		EXP(LN)*1.54e-21	0.0528905	0.06756	0.086291
t fundamental		1.51E-21	1.514E-21	1.51E-21	1.51E-21
g time rati	1	time/alpha	1	1.28E+00	1.6315
				2.14E-09	2.74E-09
Cell radius	**7.22E-14**	**R=R1+R3**	**7.22E-14**	**8.50E-14**	**1.00E-13**
1.334E-18		R1	7.22E-14	8.504E-14	1.001E-13
		R3	7.11E-33	1.07E-32	1.61E-32
R universe	6.163E+25	(R1+R3)*exp(60)	8.25E+12	9.71E+12	1.14E+13
			0	3.05E+07	2.81E+07
Proton	938.27	mass mev	938.272	938.272	938.272
0.987	0.9893	gamma (g)	0.9893	0.9909	0.9923
ke orbit	10.111	mev	10.11	8.59	7.28
V/C orbit	0.1456		0.1456	0.1344	0.1239
velocity	3.00E+08	m/sec	4.37E+07	4.03E+07	3.71E+07
Fgravity (nt)		F=M V^2/R/exp(90	3.66E-38	2.64E-38	1.90E-38
G at end		G=F/M^2*R^2	6.67E-11	6.70E-11	6.71E-11
KE+PE			10.111	10.089	10.060
Dark energy PE		FINAL PE Mev	1.1025E-12	1.02E-12	9.37E-13
Pe=Pe+dPE=Pe+Fi dR/2			0.00E+00	1.50E+00	2.78E+00

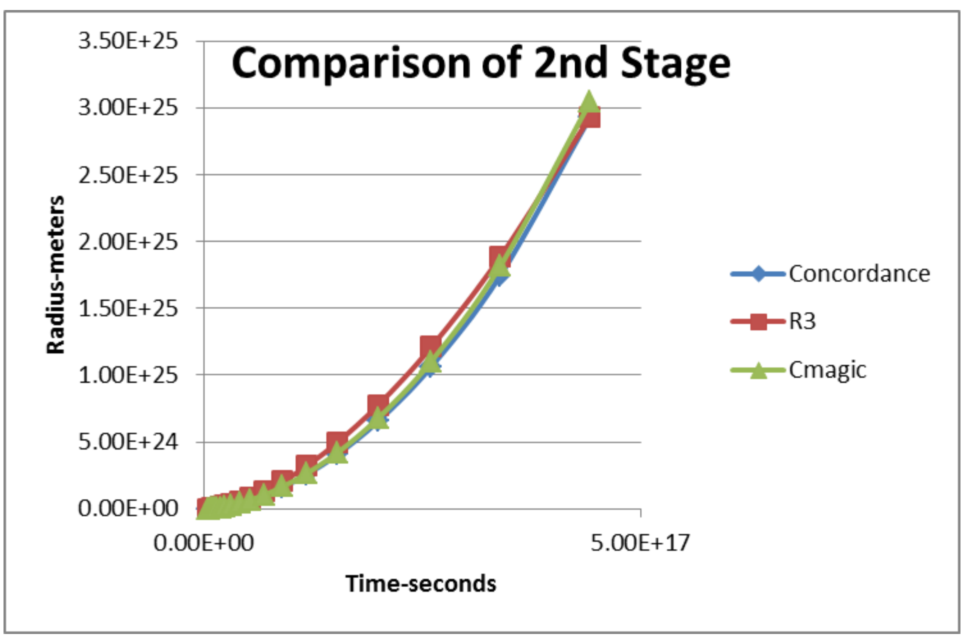
Expansion table (last few time steps)

R1+R3 is estimated to be about 6.2e25 meters at 14 billion years. The column labelled NOW is for measured value H= 2.29e-18/sec and H1 and H3 are highlighted to the right.

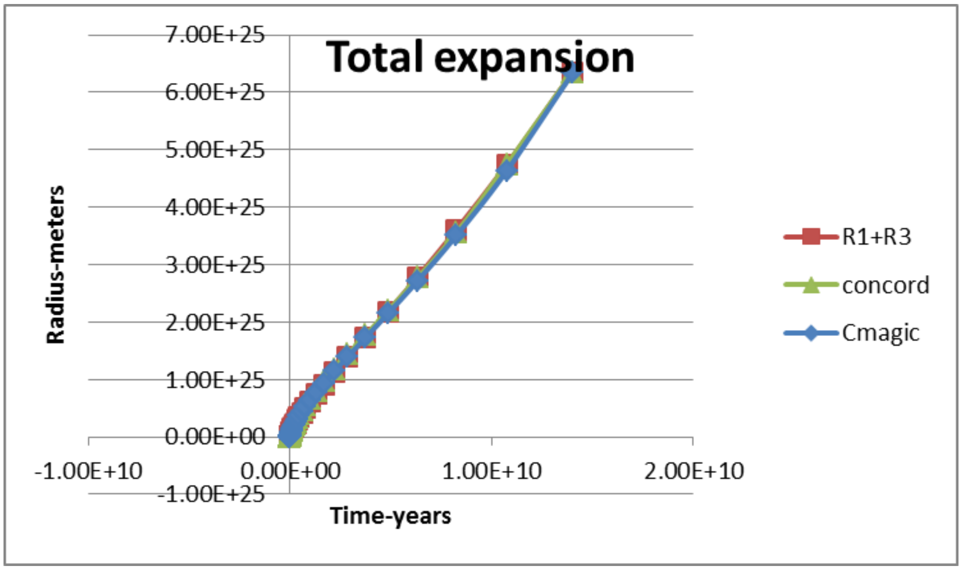
alpha (initial time in sec		0.0529	Start	Last few st	NOW	
logarithm used to increase time (LN)			45	88.32075	88.5655	
time–seconds		EXP(LN)*1.54e-21	0.0528905	3.45E+17	4.4E+17	
t fundamental		1.51E-21	1.514E-21	1.51E-21	1.51E-21	
g time rati	1	time/alpha	1	6.52E+18	8.32E+18	2.29E-18
Cell radius	**7.22E-14**	**R=R1+R3**	**7.22E-14**	**4.14E-01**	**5.40E-01**	
1.334E-18		R1	7.22E-14	2.520E-01	2.967E-01	1.33E-18
		R3	7.11E-33	1.62E-01	2.43E-01	3.30E-18
R universe	6.163E+25	(R1+R3)*exp(60)	8.25E+12	4.72E+25	6.16E+25	2.29E-18
			0	1.41E+08	1.51E+08	
Proton	938.27	mass mev	938.272	938.272	938.272	
0.987	0.9893	gamma (g)	0.9893	1.0000	1.0000	
ke orbit	10.111	mev	10.11	1.75E-12	1.34E-12	
V/C orbit	0.1456		0.1456	2.87E-12	2.44E-12	
velocity	3.00E+08	m/sec	4.37E+07	18.29	16.01	
Fgravity (nt)		F=M V^2/R/exp(90	3.66E-38	1.11E-63	6.51E-64	
G at end		G=F/M^2*R^2	6.67E-11	6.78E-11	6.78E-11	
KE+PE			10.111	9.985	9.985	
Dark energy PE		FINAL PE Mev	1.1025E-12	9.83E-12	1.13E-11	
Pe=Pe+dPE=Pe+Fi dR/2			0.00E+00	9.98E+00	9.98E+00	

The radius of each cell is now 0.54 meters and the velocity related to the reduced kinetic energy is 16 m/sec.

Expansion Comparisons



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



Detailed Equality to Decoupling Simulation

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

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

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

Photon mass density=8*PI()/(H*C)^3*(1.5*B*T)^4*1.78e-30				
mev^4 kg		kg/m^3		
(mev^3-m^3	mev			
http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/phodens.html				

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

Mass density in kg/m^3:

mass density is = 0.5*1.67e-27*exp(180)/Volume

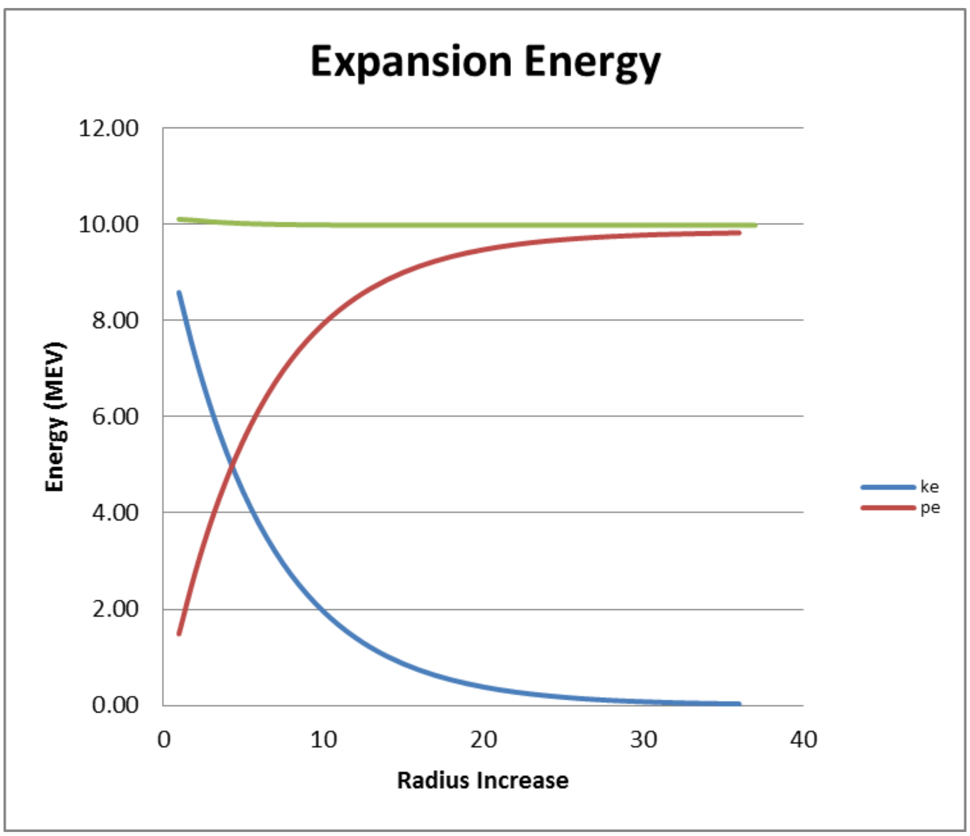
The SAHA equation for the electron is used to determine when decoupling of radiation occurs [4]. A SAHA value nearing one indicates that the plasma clears.

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

Equality of photon mass density and mass density occurs at radius 1.09e22 meters for the R1+R3 model. From this point waves progress until the temperature reaches 3530 K. At this point the SAHA equation indicates that decoupling occurs. The R1+R3 radius is 5.2e22 meters at decoupling. The wave has enlarged to 3.6e21 meters and this value divided by 2*pi*5.2e22=0.0109 radians. This matches the observed peak CMB anisotropy. The value 0.5*1.67e-27 kg*exp(180)/volume for mass density is half the total mass based on a proton. This is another clue that baryons are more numerous than WMAP analysis indicates but more information is provided below.

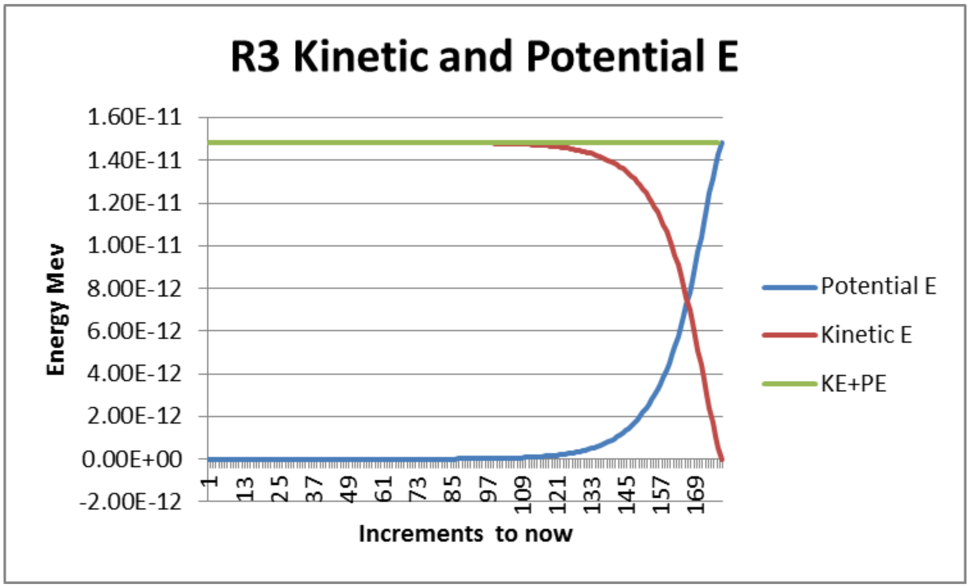
Expansion kinetic energy and potential energy

Since expansion is well characterized (and agrees with the author's calculated expansion), one can simply calculate expansion kinetic energy and expansion potential energy as a function of time and determine if initial KE is in fact converted to potential energy. Comparison of expansion kinetic with potential energy in the author's expansion model is included in the table above (the KE line and the PE line are highlighted in gold). The initial kinetic energy is reduced to the current value (labeled NOW) of 1.34e-12 MeV. The initial resisting force is the inertial force F=MV^2/R=3.66e-38 NT where V is the tangential velocity V/C=0.15 that decreases with increasing R. Final potential energy (integral of FdR) is 9.98 MeV in the NOW column. To obtain this result the author reduced the number of protons to one half exp(180). Why one half? The resisting force is based on each of all exp(180) masses. Details presented in reference 3 suggest that protons (baryons) make up one half of the total mass. The R1+R3 final density is based on all exp(180) masses. This is evidence that the other half of the mass is gravitationally active cold dark matter with mass 1.67e-27 kg with its own energy source (a mirror of the proton perhaps). Changes in energy are plotted below (the horizontal axis units are increments of time and they quickly saturate).



Dark Energy

The second component of expansion R3 is initially only 8.5e-7 meters and expands to about 2.9e25 meters. WMAP identifies the expansion energy for this component as “dark energy” and assigns a large portion of critical density to it. This expansion is again resisted by gravitational forces (3.66e-38 NT) and potential energy increases as expansion occurs. When the calculation was carried out, it was discovered that this component requires very little kinetic energy (on the order of 1.29e-11 out of 10.11 MeV). The result is shown below:



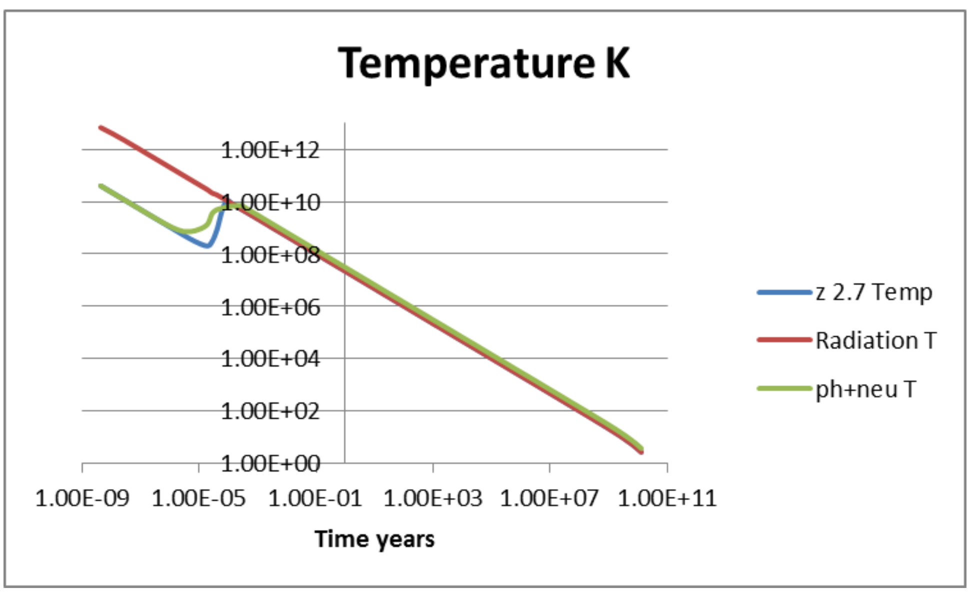
Very little energy is required because the radius is low in the first part of expansion when the resisting force is high. Recall that the WMAP conclusion [7] was the 0.72 of the total energy was missing and a search for “dark energy” was launched. The accepted formula H^2=4/3 pi G rhoC, where rhoC is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

Temperature associated with kinetic energy 10.11 MeV

Using the Boltzmann relationship T (K)=ke/(1.5 B), it is possible to assign a temperature to kinetic energy.

				Beginning		**NOW?**
KE temperature relationship						
ke=1.5*B*T				**10.11**		**1.34E-12**
T=ke/(1.5B)				**7.82E+10**		**0.01**
Boltzmann B (MeV/K)		**8.62E-11**				

The initial temperature 7.8e10 K is reasonable although the R1+R3 model's initial density is higher than other models. Cosmologists use the expansion ratio z to scale temperatures i.e. T(K)=z*2.725. However, starting with 7.6e10 K and scaling downward gives the surprising present temperature of 0.01 K. It is well known that Helium4 is produced at high temperatures and is the main element formed during primordial nucleosynthesis. Literature gives 23% to 25% as the range of He4 and indicates that it is produced in the first few minutes. He4 fusion releases 7.07 MeV per atom and 0.24*7.07 MeV=1.63 MeV. This is significant energy compared to 10.11 MeV and must be added to the photon only temperature. When it is added, the blue temperature curve moves up to the accepted 2.725*z red temperature curve. The scale in the graph below is from the beginning to 14 B years. He4 fusion is complete at about 200 seconds (the early discontinuity). The resulting radiation temperature was close to 2.73K at the end of expansion and followed the accepted temperature history. In this simulation, the important equality point on the natural log scale occurs well after the temperature has risen to the accepted temperatures scaled by expansion from 2.73K. It is also quite meaningful to the question of what kind of mass WMAP is dealing with. Hot matter (protons and electrons) fuse and emit radiation. The temperature would not increase to the accepted curve if it were cold dark matter.



The temperature of about 1e9 K is the temperature in the author's temperature model above where He4 fusion occurs. This is further confirmation of the proton model energy 10.11 MeV. This energy is the correct initial energy since it anticipates the addition of

1.63 MeV He4 fusion and gives the correct temperature at the end of expansion. There is strong support for protons being only a small fraction of omega total but the author believes that primordial nucleosynthesis calculations need to be revised. Literature [4][9] indicates that deuterium photo dis-integration was too high to allow He4 fusion until the temperature decreased to about 1e9 K. Literature nucleosynthesis temperature curves (Appendix 3) and the author's curves above are very similar at the beginning and He4 abundance would be similar. However the Appendix 3 graph does not include He4 fusion. The energy associated with 1e9 K is 0.15 MeV and if 1.63 MeV had been added, the temperature would increase to 1.3e10K.

There are additional considerations with adding fusion energy to primordial nucleosynthesis calculations. Although the calculations are beyond our scope, a graph of the SAHA criteria [4] for deuterium formation is shown in Appendix 3. The SAHA criteria used is the natural logarithm of the SAHA value. As the SAHA criteria increased to 0, He4 fused and T9 (the temperature divided by 1e9 K) increased. With the addition of fusion energy, the SAHA criteria became negative again and caused photo dis-integration of deuterium. The temperature finally fell due to expansion and the SAHA criteria rose to 0 where deuterium was again formed [10]. It is this deuterium that we measure uniformly throughout space at an abundance level of 5e-5 and it is not limited by the photon/baryon ratio.

Neutron decay

The neutron decays with a half-life of 886 seconds. The author's neutron mass model changes to the proton mass model [1] with the release of a neutrino with energy 0.671 MeV and an electron (0.551 MeV+.1114 ke) with energy 0.662 MeV (their total is the difference in mass between a neutron and proton). This energy must also be added to the photon density. For demonstration this energy can be converted to temperature and is shown above as the green temperature curve. It also jogs up. The end of this event is at about 6000 seconds and at the end of expansion, its value is 3.79 K. The photon + neutrino + electron "temperature" is 1.39 times the photon only curve. Temperature is to the power 3 in the equation: Photon density=K*T^3 and this means photon density is 2.7 times higher than 2.725 K based photon density. This small change allows the baryon fraction to be 0.5 while baryon/photon density is the accepted value 6e-10.

Summary Comparison

Differences between this proposal and WMAP analysis are summarized below.

WMAP w/o dark	WMAP [7] NOW		Neutron Decay 886 sec	Proposal Equality	Now
6.207E+25	6.21E+25	Radius	2.62E+16	8.32E+21	6.16E+25
	1.00E+78	Volume (m^3)	7.56E+49	2.41E+66	9.79E+77
	2.82E-01	Baryon number density=.5*exp(180)/v	9.85E+27	3.09E+11	7.61E-01
6.100E-10	6.100E-10	baryons/photon	1.50E-10	1.50E-10	1.50E-10
	5.77E+08	Photon number density	6.55E+37	2.05E+21	5.06E+09
?	0.235	Cold matter fraction		0.5	0.5
		cold matter density in kg/m^3			1.27E-27
0	0.719	Dark Energy		0	0
2.67E-27	9.50E-27	critical density	Final density=1.67e-27*exp(180)/Volu		2.54E-27
?	0.0464	Baryon fraction		0.5	0.5
		baryon matter density in kg/m^3			1.27E-27

WMAP parameters [7] on the left side of the table are for critical density (omega total or rhoC)=9.5e-27 kg/m^3. Omega dark fraction is 0.72, cold dark mass fraction is 0.24 and baryon mass fraction is 0.046. H^2=8/3 pi G rhoC is based on initial kinetic energy becoming potential energy and the author's calculations show that the second component of expansion (dark energy) is essentially zero, making omega dark energy nil. This means 0.72*9.5e-27/m^3=6.83e-27 must be subtracted from critical density. The new value is 9.5e-27-6.83e-27=2.67e-27 kg/m^3. The three columns on the right side of the table give values from the R1+R3 model for three conditions: neutron decay, equality and now. The total mass/volume is exp(180)*1.67e-27 kg/1e79=2.54e-27 kg/m^3. This compares favorably with the lowered WMAP critical density.

Baryon density is given by 0.5*exp(180)/volume at each of the radius values. The increase in energy for the now condition gives a density of 5e9 photons +neutrinos +electrons. With current baryon density 0.76 baryons/m^3, the baryon/photon ratio is 0.76/5.06e9=1.5e-10. This is in agreement with WMAP and other literature.

Cold Dark Matter

Reference 8 is an attempt to correlate meson and baryon masses. In many cases it appears that there are "mirror particles" and it is the author's opinion that the cold dark mass fraction 0.5 may be a neutron like mirror particle that interacts only gravitationally. Anomalous galaxy velocity profiles and dark matter lensing strongly indicate that there is a significant amount of cold dark matter in the outer portion of galaxies. This means that cold dark matter expanded. The model shows that 10.11 MeV was adequate to expand protons but did not expand cold dark matter against the combined gravitational resistance force=3.66e-38 NT. Since the model shows the cold dark matter fraction at 6.2e25 it apparently has its own energy source. It appears to the author that the proton mass model also models cold dark mass.

Red shift of spots

The acoustic mass that accumulated at decoupling caused light released from the higher density spot to be red shifted. The red shift measured by WMAP was 74 micro-degrees for the dominate wave component. The author evaluated the spot temperature utilizing equations from Bennett [3]. The estimates below are for the spot size determined above with cluster mass estimated by density at decoupling multiplied by the spot volume.

		Spot Radius	Spot Volume		Volume at Decoupling	
		meters	m^3		m^3	
		4.61294E+21	4.11E+65		8.04E+68	
	Density decoupling=0.5*1.67E-27*EXP(180)/8.04e68				(Kg/m^3)	1.55E-18
		Spot mass = spot density* spot volume			Kg	6.36E+47
f(M/spot)=1+1/(1-(2*6.675e-11*Spot Mass/(spot dia*3e8^2)))^0.5-1						1.06E+00
	T(micro K)=(2.725-2.725/(1+(f(M/spot)-1)/2000))*1e6					75.49

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

Conclusions

Expansion and associated energy changes were evaluated using a cellular model based on two expansion components. In this model, there is one proton like mass/cell and all cells are formed by identical laws. Inflation is defined as duplication by exp(180) supported by the cosmological principle. The model predicts that a large radius of 6.2e25 meters characterizes the universe. This agrees with the concordance model using measured values from the WMAP project. The author believes that space is created by exp(180) cells each with an initial radius of 7.22e-14 meters expanding to universe size space.

The proton mass model [1] is an accurate source of constants for cosmology, including expansion kinetic energy. The manner in which it gives initial temperatures consistent with He4 formation yet predicts a final temperature of 2.73 K is remarkable. The kinetic energy is enough to expand one half the cells to their present radius of 0.54 meters against gravitational resisting force in a way that kinetic energy is converted to potential energy. Based on the author's WMAP re-analysis, equality of matter and energy density occurs with 0.5*exp(180) protons/m^3.

The second expansion component developed late when resisting forces were low. The calculated energy (known as dark energy) was negligible and the author believes that critical density estimates from the equation containing H^2=8/3 pi G rhoC must be revised downward to 2.7e-27 kg/m^3. WMAP identifies density fractions as dark energy (0.718), cold dark matter (0.235) and baryons (0.046). Re-analysis in this document supports the values 0, 0.5 and 0.5 respectively.

Analysis of equality and decoupling using WMAP concepts show that the calculated spot size gives the reported value 0.0109 radians. Also, the spot temperature agrees substantially with the measured value for the first maximum.

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Appendix 1: Relationship between Quantum Scale Gravitational Fundamentals and Universe Size Space

Consider large mass M broken into exp(180) cells, each with the mass of a proton. Fill a large spherical volume with exp(180) small spheres. In general relativity the metric tensor is based on (ds^2=three dimensions dr^2+(C*dt)^2). The surface area of a 2-sphere would be broken into many small spheres with an equal surface area. Let r represent the radius of each small cell and R represent the same surface area of one large sphere containing exp(180) cells. Position a proton on the surface of each cell (and one in the center?). The total energy will be that of 1 (or 2) protons/cell plus a small amount of kinetic energy. We may either consider the energy density of the whole or the energy density of the many cells. We will evaluate the energy density of large sphere and compare it with the energy density of many small cells.

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

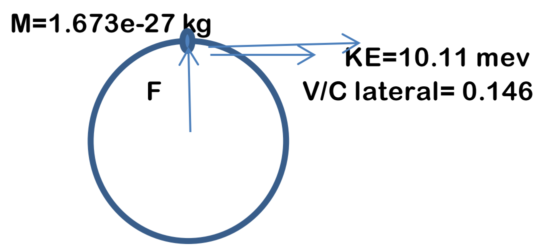
For gravitation, we consider velocity V, radius R and mass M as the variables that determine the geodesic. With G constant, M=m*exp(180) and R=r*exp(90) the gravitational constant would be calculated for large space and proton size space as follows:

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 value 1/exp(90) is the gravitational coupling constant. When measurements are made at the large scale as must be done to determine G, the above derivation indicates that we should apply the value 1/exp(90) to the quantum scale if we expect the same G.

Cell size space

The following diagram is the initial radius of one cell. The orbital kinetic energy (10.11 MeV) causes tangential velocity V/C=0.15. (Velocity is tangential because we are dealing with surfaces).



The values in the following table are believed to be the source of gravitation [1][6] at the cellular level:

Gravitational Constant

In large space the Newtonian equation F=GMM/r^2 gives the force between objects. For example two particles of mass 938.27 MeV (1.67e-27 kg) gives F=6.67e-11*(1.67e-27)^2/(7.22e-14)^2=3.58e-38 NT. Gravitation at the cellular level is described in reference 1 and 6. Note the equation below for the same force involves the small value 1/exp(90). Reference 1 indicates that this is the coupling constant for gravity.

GRAVITY		
	proton	neutron
Neutron Mass (mev)	**938.2720**	**939.565**
Neutron Mass M (kg)	**1.673E-27**	**1.675E-27**
Field Energy E (mev)	**2.732**	**2.732**
Kinetic Energy ke (mev)	**10.111**	**10.140**
Gamma (g)=M/(M+ke)	**0.9893**	**0.9893**
Velocity Ratio v/C=(1-g^2)^0.5	**0.1456**	**0.1457**
R (meters) =(HC/(2pi)/(E*E)^0.5	**7.224E-14**	**7.224E-14**
Inertial Force (F)=(M/g*V^2/R)*1/EXP(90) N	**3.656E-38**	**3.666E-38**
HC/(2pi)=1.97e-13 mev-m		
Calculation of gravitational constant G		
G=F*R^2/(M/g^2)=NT m^2/kg^2	**6.6739E-11**	**6.6743E-11**
Published by Partical Data Group (PDG)	**6.67E-11**	**6.6743E-11**

The author believes that the radius 7.22e-14 meters is the fundamental radius of exp(180) cells that define the beginning radius of a large volume associated with the universe. As these cells expand to about 0.5 meters each they define a large radius of about 6.2e25 meters. The author also believes that the value 1.51e-21 sec defines fundamental time. As this value repeats, time increases.

Appendix 2: Proton mass model

Reference 2 starts with an information based model based on exp(180) that anchor the following masses and kinetic energies for three quarks. Together they model the measured proton mass 938.272 MeV. It is simplified below:

					Gravitational	
		Residual ke				Field
Mass	Difference KE		Expansion		Strong field	
mev	mev	mev	mev	KE	MeV	MeV
101.95	641.88				-753.29	
						-0.69
13.80	78.69				-101.95	
						-0.69
13.80	78.69				-101.95	
						-0.69
		10.15		20.30	expansion pe	
				0.00	expansion ke	
	-0.67		0.67	v neutrino		
			0.05	neutrinos		-0.67
129.54	798.58	**938.27**	**PROTON MASS**		2.72E-05	
0.51	0.11	e ke			-2.72E-05	
ELECTRON						
			Total m+ke		Total Negative	
	0.62	938.27	0.72	**959.92**	**-959.92**	-2.73
				MeV	MeV	

	Mass and Kinetic Energy			Field energy		
	Mass	ke		Strong	Gravitational	
				field ener	Energy	
	MeV	MeV		MeV	MeV	
Quark S	101.947	641.880		-753.291	-0.687	
Quark U	13.797	78.685		-101.947	-0.687	
Quark D	13.797	78.685		-101.947	-0.687	
	129.541	799.251		-957.185	-2.061	
	129.541	799.251	-0.671			
		10.151				
Proton		938.272	Mev			

Simplified Proton mass Model

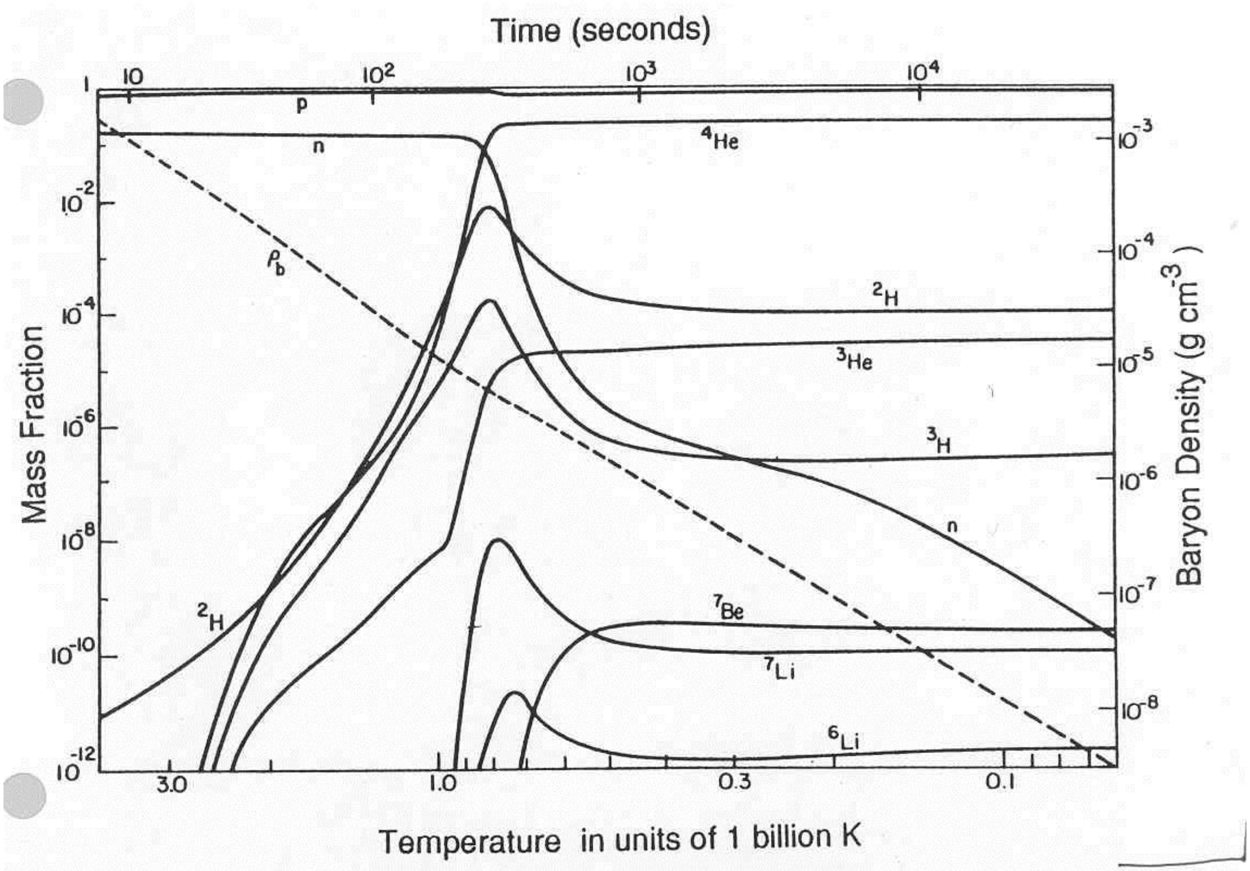
	Mass and Kinetic Energy			Field energy	
	Mass	KE	Strong	Strong	Gravitational
			Residua	field energy	Energy
	MeV	MeV		MeV	MeV
Strong	130.16	799.25		-957.18	-2.73
Strong Residua		10.15			
Neutron		939.57	-20.30		-959.92
below, the Neutron decays to a proton, electron and neutrino					
neutrinos		0.05			
Proton		938.27		2.72E-05	
ejected neutrino		0.67		E/M charge splits	
Electron	0.51	0.11		-2.72E-05	
Gravitational k		10.15	10.11		
Gravitational p		10.15	10.19		
Total		959.92			

The values in the above table unify the four forces (interactions) of nature [2].
For this paper, 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.

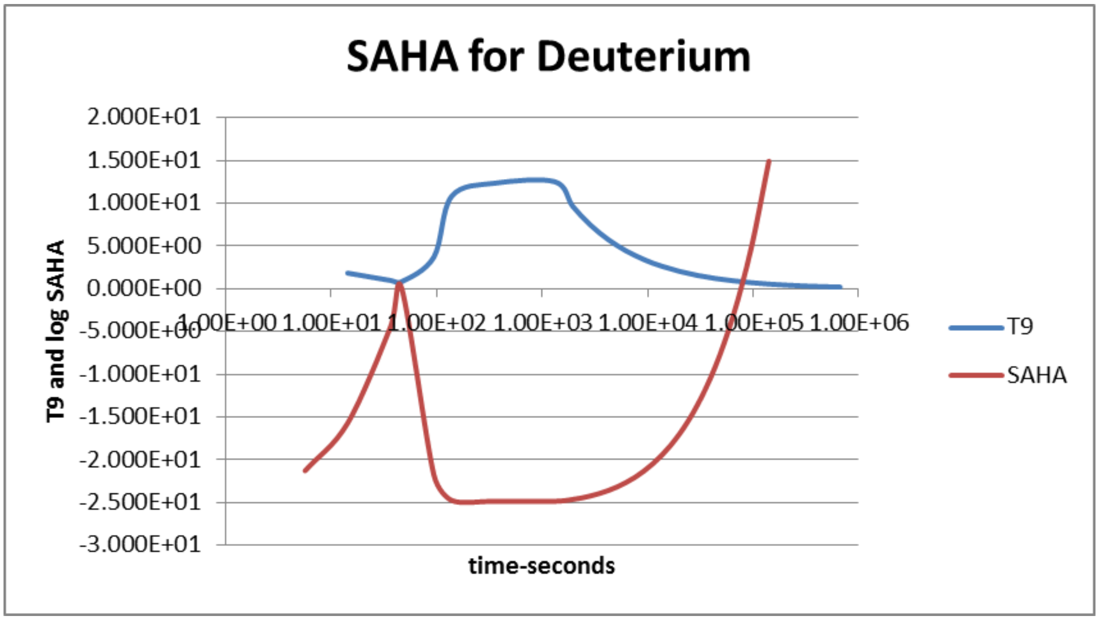
Another value of interest above is the difference between the neutron and proton mass, 1.293 that is made up of a neutrino of energy 0.671 and an electron with kinetic energy of 0.662 MeV. These are the missing energies that allow baryon fraction to be 0.5.

Appendix 3: Literature time and temperature

The following graph is reproduced from literature showing primordial nucleosynthesis as a function of time and temperature.



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



SAHA for Deuterium
2.000E+01
1.500E+01
1.000E+01
5.000E+00
0.000E+00
-5.000E+00
-1.000E+01
-1.500E+01
-2.000E+01
-2.500E+01
-3.000E+01
1.00E+00 1.00E+01 1.00E+02 1.00E+03 1.00E+04 1.00E+05 1.00E+06
T9 and log SAHA
time-seconds
T9
SAHA