

## **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 ( $H = (8/3 \pi G \rho C)^{.5}$ ) incorrectly assumes that density characterizes kinetic energy for this component. Critical density ( $\omega_{\text{total}}=1$ ) according to year 9 WMAP parameters [7] is composed of density fractions:  $\omega_{\text{dark}}=0.718$ ,  $\omega_{\text{mass}}=0.235$  and  $\omega_{\text{baryons mass}}=0.046$ . 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  $\omega_{\text{dark}}$  may be negligible. Based on a model of the proton [1], the author uses 9.8 MeV/particle as the kinetic energy (KE) of expansion. This energy is adequate to expand one half of all mass to  $6.33e25$  meters and provides further evidence that mass fractions quoted above might be incorrect. Using the WMAP procedure, equality and decoupling were re-analyzed with  $\omega_{\text{baryons}}=0.5$ . 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  $\omega_{\text{dark energy}}=0$ ,  $\omega_{\text{baryons}}=0.5$  and  $\omega_{\text{dark matter}}=0.5$ .

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 9.8 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 9.8MeV 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] 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 numerical 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 about 20 MeV that fall into "orbits" with 9.8 MeV of kinetic energy and 9.8 MeV of potential energy. Initially the mass on the cell surface has high velocity (0.14C) 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. 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 2.683 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.

Gravitational Action		E	2.6831E+00	mev
		const HC/(2pi	1.97E-13	mev-m
		R=const/E	7.3543E-14	m
		t	1.54135E-21	sec
		Field side	R side	E'=m/g
	E=Hv	H/E	2*pi*R/V	
	t=H/E=2piR/V	1.541E-21	1.541E-21	sec
		1.54135E-21		
1	qm test	m/c^2x^2/t	6.5821E-22	mev-sec
	qm test/h	m/c^2x^2/t/h	1.00	

convenient constant:	HC/(2*pi)	1.973E-13	mev-meters
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$$r = 1.973e-13 / (2.683 * 2.683 / 1)^{.5} = 7.35e-14 \text{ meters.}$$

$$t = 1.54e-21 \text{ sec.}$$

## 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

$(r/r_0)^3$  increases as  $(t/\alpha)^2$  (kinetic energy requirement)

$$r=r_0*g^{(2/3)}$$

$$R=r_0*\exp(60)*g^{(2/3)}$$

$$r_0=1.93e-13/(2.683*2.683)^{.5}=7.35e-14 \text{ m}$$

$$R1=(7.35e-14*\exp(60))*g^{(2/3)}$$

Second expansion component: R3

$$dr/(r*dt)=H3$$

$$dr=H3*r*dt$$

$$dr=H3*\alpha*r *dg \quad (dt=\alpha dg)$$

$$dr=H3*\alpha*r_0*g^{(2/3)} *dg$$

$$r=H3*\alpha*r_0*g^{(5/3)}/1.6666$$

$$R3=H3*\alpha*(7.35e-14*\exp(60))*g^{(5/3)}/1.666$$

$$r1+r3=(7.35e-14)*g^{(2/3)}+(7.35e-14)*g^{(5/3)}*H1*\alpha/1.666$$

$$R1+R3=r1*\exp(60)+r3*\exp(60)$$

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

## Fundamental time and initial time

Fundamental time= fundamental radius*2*pi()/C=(7.35e-14*2*pi())/3e8	
Fundamental time=	1.541E-21 seconds

The author uses dimensionless time,  $g=\text{time}/\alpha$  in expansion equations, i.e.  $R=r_0*g^{(2/3)}$ . Define alpha as initial time.  $\text{Time}=1.54e-21 \text{ seconds}*\exp(N)$  where

$N \rightarrow 45$  to approximately 90. Dimensionless time  $g$  starts at 1 when time is multiplied by  $\exp(45)$  at the beginning. This makes  $\alpha = 1.54e-21 * \exp(45) = 0.0538$  seconds.

### Expansion constant H3:

The expansion model will be called the “R1+R3” expansion model.

$R_0 = 7.35e-14 * \exp(60) = 8.39e12$  m, where  $r_0 = 7.35e-14$  m.

$R_1 + R_3 = 8.39e12 * g^{(2/3)} + 8.39e12 * g^{(5/3)} * H_3 * \alpha / 1.66$

The second part of the equation above  $R_3 = 8.39e12 * g^{(5/3)} * H_3 * \alpha / 1.666$  contains  $\alpha$  and unknown,  $H_3$ .  $\alpha$  and  $H_3$  are evaluated with WMAP data. Decoupling, equality and Hubble’s constant match data with  $\alpha = 0.0583$  seconds and  $H_3 = 3.24e-18/\text{sec}$ . 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.

$R_3 = 8.39e12 * g^{(5/3)} * 3.24e-18 * 0.0538 / 1.666$

$R_1 + R_3$  was calculated with increasing  $g$  until overall  $H$  was  $2.26e-18$  [7]. Matching calculated  $H$  with measured  $H$  gives  $R_1 + R_3 = 6.33e25$  meters at  $4.42e17$  seconds (14 billion years).  $R_3$  is now 0.46 of the total radius but expanding faster (5/3 power). Hubble’s constant for  $R_3$  expansion matches data with  $H_1 = 1.3e-18/\text{sec}$ ,  $H_3 = 3.24e-18/\text{sec}$  and  $H$  overall =  $2.26e-18/\text{sec}$ .

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  $2.26e-18/\text{sec}$  and  $\text{time}^{(5/3)}$ , similar to  $R_3$ .

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

### Expansion Table (first 3 time steps)

The following table puts the derivations above into action. There are many results in tables below for  $R_1 + R_3$  expansion. The simulation starts at the fundamental radius and progresses to the right as time advances. The author uses a natural logarithmic scale with  $\text{time} = \exp(45 + c) * 1.54e-21$  seconds. Dimensionless time ( $g$ ) =  $\text{time} / 0.0583$  starts with 1. If  $c$  above is a small value, the model contains more incremental steps. Rows in the model contain values of interest. Cell radius is  $r_1 + r_3$ , using the derivation above.  $R_{\text{total}} = (r_1 + r_3) * \exp(60)$ . Ke orbit is scaled to lower values by  $k_e = 9.78 * 7.35e-14 / (r_1 + r_3)$ .  $\Gamma = 938.27 / (938.27 + k_e)$ .  $V/C = (1 - \Gamma^2)^{.5}$ .  $F_{\text{gravity}} = M * V^2 / (r_1 + r_3) / \exp(90)$ , where  $M = 1.67e-27$  kg. With the above relationships, the calculated gravitation constant

$G=F/M^2*(r1+r3)^2/exp(90)$  is constant throughout expansion. The highlighted rows are kinetic energy and potential energy. Potential energy= $PE+F*(\Delta R)/2*6.12e12$  MeV/(NT-m) with initial force  $F=3.44e-38$  NT.

			$45=LN(0.0538/1.54e-21)$	<a href="#">cells hidden</a>
alpha (initial time in sec)	0.0538		Start	
logarithm used to increase time (LN)			45	45.24475
time--seconds	$EXP(LN)*1.54e-21$		0.053845966	0.06878
		$1.54E-21$	$1.54135E-21$	$1.54E-21$
g time ratio	1	time/alpha	1	$1.28E+00$
Cell radius	$7.35E-14$	$R=R1+R3$	$7.35E-14$	$8.66E-14$
$1.310E-18$		R1	$7.35E-14$	$8.658E-14$
		R3	$7.37E-33$	$1.11E-32$
R universe	$6.325E+25$	$(R1+R3)*exp(60)$	$8.40E+12$	$9.89E+12$
	938.27	mass mev	938.272	938.272
0.987	0.9897	gamma (g)	0.9897	0.9912
ke orbit	9.781	mev	9.78	8.31
V/C orbit	0.1433		0.1433	0.1322
velocity	$3.00E+08$	m/sec	$4.30E+07$	$3.96E+07$
G at end	$6.678E-11$	$G=F/M^2*R^2$	$6.65E-11$	$6.66E-11$
$Fi=MV^2/R/exp(90)$		1	$3.438E-38$	$2.487E-38$
$Pe=Pe+dPE=Pe+Fi dR/2$			$0.00E+00$	$1.45E+00$

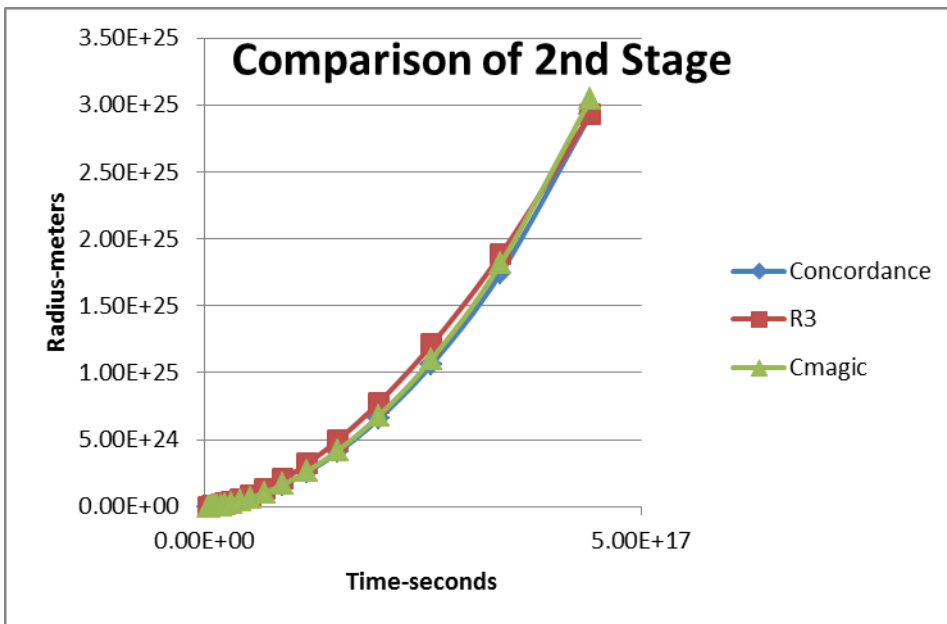
### Expansion table (last few time steps)

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

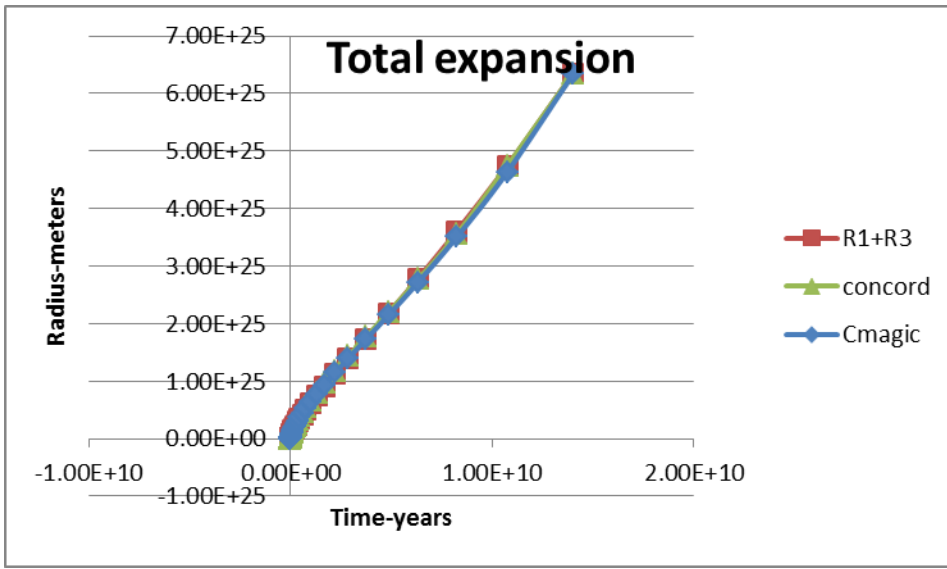
alpha (initial time in sec)	0.0538		Last few steps	NOW		
logarithm used to increase time (LN)			88.32075	88.5655	90	
time--seconds	EXP(LN)*1.54e-21		3.5085E+17	4.4814E+17	1.8811E+18	
t fundamental	1.54E-21		1.5414E-21	1.5414E-21	1.5414E-21	
g time ratio	1	time/alpha	6.5157E+18	8.3225E+18	3.4934E+19	2.25E-18
Cell radius	7.35E-14	R=R1+R3	4.24E-01	5.54E-01	3.54E+00	
1.310E-18		R1	2.566E-01	3.020E-01	7.859E-01	1.31E-18
		R3	1.67E-01	2.52E-01	2.75E+00	3.24E-18
R universe	6.325E+25	(R1+R3)*exp(60)	4.8426E+25	6.33E+25	4.039E+26	2.25E-18
			1.42E+08	1.52E+08		
Proton	938.27	mass mev	938.272	938.272	938.272	
0.987	0.9897	gamma (g)	1.0000	1.0000	1.0000	
ke orbit	9.781	mev	1.68E-12	1.29E-12	2.01E-13	
V/C orbit	0.1433		2.77E-12	2.36E-12	9.06E-13	
velocity	3.00E+08	m/sec	17.93	15.69	6.21	
Fgravity (nt)	F=M V^2/R/exp(90)		1.04E-63	6.09E-64	1.49E-65	
Fg=GMM/R^2/exp(90)			1	1.040E-63	6.093E-64	1.494E-65
Fi=MV^2/R/exp(90)			1	1.04E-63	6.09E-64	1.49E-65
Dark energy PE	FINAL PE Mev		1.00E-11	1.16E-11	2.98E-11	
Pe=Pe+dPE=Pe+Fi dR/2			9.66E+00	9.66E+00	9.66E+00	

The radius of each cell is now 0.55 meters and the velocity related to the reduced kinetic energy is 15.7 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 <sup>3</sup>
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 <sup>3</sup>
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<sup>3</sup>.

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		
<a href="http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/phodens.html">http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/phodens.html</a>			

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

Mass density in kg/m<sup>3</sup>:

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

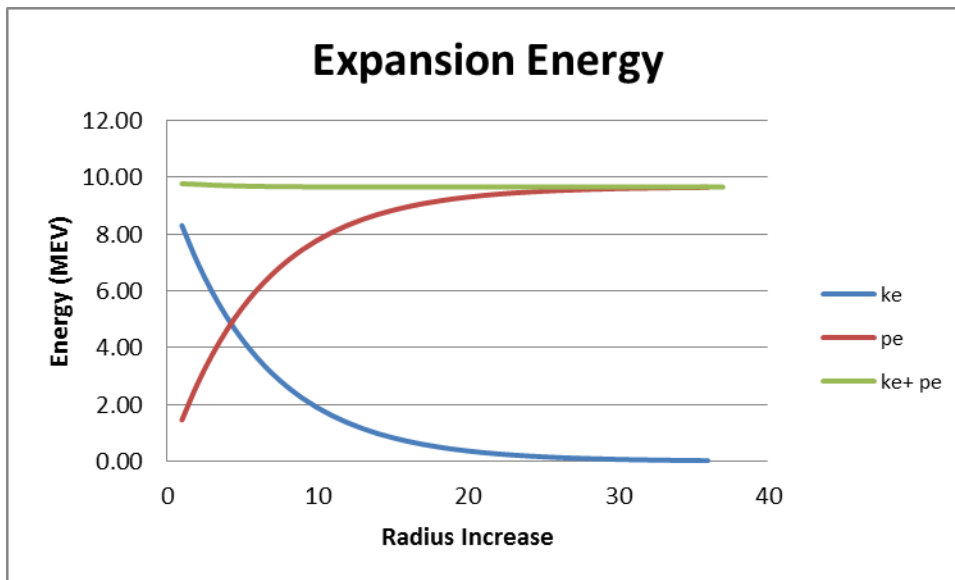
SAHA Value=4*2^0.5/PI()^0.5*1/3.63e20*1.6e-9*(T/0.511)^(3/2)*EXP(1.36e-5/(8.62e-11*T))
--

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

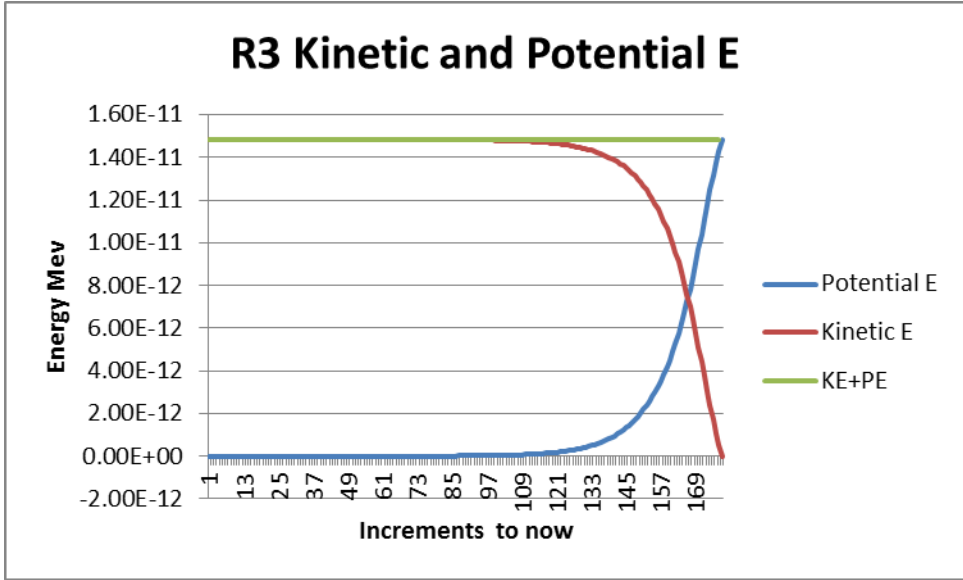
Since expansion is well characterized (and agrees with the author's calculated expansion), one can simply calculate expansion kinetic energy and expansion potential energy as a function of time and determine if initial KE is in fact converted to potential energy. Comparison of expansion kinetic with 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  $1.29e-12$  MeV. The initial resisting force is the inertial force  $F=MV^2/R=3.44e-38$  NT where V is the tangential velocity  $V/C=0.14$  that decreases with increasing R. Final potential energy (integral of  $FdR$ ) is 9.68 MeV in the NOW column. To obtain this result the author reduced the number of protons to one half  $\exp(180)$ . Why one half? The resisting force is based on each of all  $\exp(180)$  masses. Details presented in reference 3 suggest that protons (baryons) make up one half of the total mass. The  $R1+R3$  final density is based on all  $\exp(180)$  masses. This is evidence that the other half of the mass is gravitationally active cold dark matter with mass  $1.67e-27$  kg with its own energy source (a mirror of the proton perhaps). Changes in energy are plotted below (the horizontal axis units are increments of time and they quickly saturate).



## Dark Energy

The second component of expansion  $R3$  is initially only  $8.47e-7$  meters and expands to about  $2.9e25$  meters. WMAP identifies the expansion energy for this component as "dark energy" and assigns a large portion of critical density to it. This expansion is again resisted by gravitational forces ( $3.44e-38$  NT) and potential energy increases as expansion occurs. When the calculation was carried out, it was discovered that this

component requires very little kinetic energy (on the order of  $1.29 \times 10^{-11}$  out of 9.8 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  $H^2 = \frac{4}{3} \pi G \rho C$ , where  $\rho C$  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  $H^2 = \frac{4}{3} \pi G \rho C$  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.

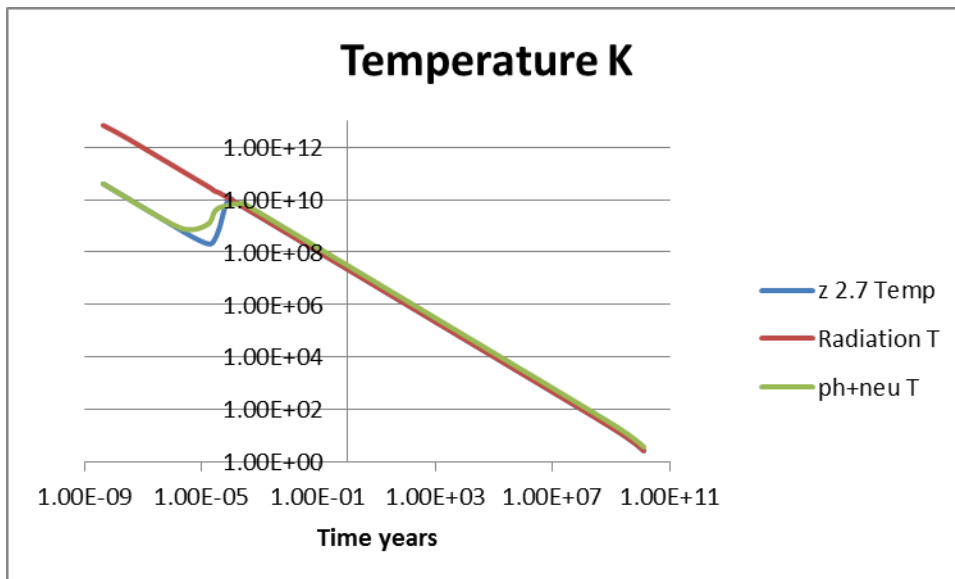
### Temperature associated with kinetic energy 9.8 MeV

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

KE temperature relationship		Beginning	Current expansion state
$ke = 1.5 B T$		9.80 mev	$1.26 \times 10^{-12}$
$T = ke / (1.5 B)$		$7.58 \times 10^{10}$ K	0.010 K
Boltzmann B	$8.61952 \times 10^{-11}$ mev/K		
	$M = m \cdot \exp(0)$	$2.49 \times 10^{51}$	$2.18 \times 10^{-08}$ kg
	R	$1.847 \times 10^{24}$	$1.62 \times 10^{-35}$ r'
	V (meters/sec)	$3.00 \times 10^{08}$	$3.00 \times 10^{08}$ v (meters/sec)
	G	$6.68 \times 10^{-11}$	$6.68 \times 10^{-11}$

The initial temperature  $7.6 \times 10^{10}$  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.  $T(K) = z \cdot 2.725$ . However, starting with  $7.6 \times 10^{10}$  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  $0.24 \times 7.07 \text{ MeV} = 1.63 \text{ MeV}$ . This is significant energy compared to 9.8 MeV and must be added to the photon only temperature. When it is added, the blue temperature curve moves up to the accepted  $2.725 \times z$  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 2.72K. 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 9.8 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 0.14 MeV and if 1.63 MeV had been added, the temperature would increase to  $1.3e10$ K.

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 disintegration 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= $K \cdot T^3$  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	Proposal Equality	Now
			886 sec		
6.351E+25	6.35E+25	Radius	2.5468E+16	1.98E+22	6.35E+25
	1.07E+78	Volume (m <sup>3</sup> )	6.9196E+49	3.25E+67	1.07E+78
	3.64E-01	Baryon number density= $.5 \cdot \exp(180)/\text{vol}$	1.0762E+28	2.29E+10	6.95E-01
6.100E-10	6.100E-10	baryons/photon	baryons/(phot	4.49E-10	4.49E-10
	5.77E+08	Photon number density	1.0158E+37	5.10E+19	1.55E+09
?	0.235	Cold matter fraction		0.5	0.5
		cold matter density in kg/m <sup>3</sup>			1.16E-27
0	0.719	Dark Energy		0	0
2.6695E-27	9.50E-27	critical density	1.67e-27*exp(180)/Volume		2.32E-27
?	0.0464	Baryon fraction		0.5	0.5
		baryon matter density in kg/m <sup>3</sup>			1.16E-27

WMAP parameters [7] on the left side of the table are for critical density ( $\omega_{total}$  or  $\rho_C$ )= $9.5e-27$  kg/m<sup>3</sup>.  $\omega_{dark}$  fraction is 0.72, cold dark mass fraction is 0.24 and baryon mass fraction is 0.046.  $H^2=8/3 \pi G \rho_C$  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<sup>3</sup>. 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= $2.3e-27$  kg/m<sup>3</sup>. This compares favorably with the lowered WMAP critical density.

Baryon density is given by  $0.5*\exp(180)/\text{volume}$  at each of the radius values. The increase in energy for the now condition gives a density of  $1.55e9$  photons +neutrinos +electrons. With current baryon density  $0.695$  baryons/m<sup>3</sup>, the baryon/photon ratio is  $0.695/1.55e9=4.5e-10$ . 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 9.8 MeV was adequate to expand protons but did not expand cold dark matter against the combined gravitational resistance force= $3.44e-38$  NT. Since the model shows the cold dark matter fraction at  $6.33e25$  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 meters	Spot Volume m <sup>3</sup>	Volume at Decoupling m <sup>3</sup>
	4.61294E+21	4.11E+65	8.04E+68
	Density decoupling= $0.5*1.67E-27*EXP(180)/8.04e68$		(Kg/m <sup>3</sup> ) 1.55E-18
	Spot mass = spot density* spot volume		Kg 6.36E+47
$f(M/\text{spot})=1+1/(1-(2*6.675e-11*Spot\ Mass/(\text{spot\ dia}^3e8^2)))^{0.5-1}$			1.06E+00
$T(\text{micro K})=(2.725-2.725/(1+(f(M/\text{spot})-1)/2000))*1e6$			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  $6.33e25$  meters characterizes the universe. This agrees with the concordance model using measured values from the WMAP project. The author believes that space is created by  $\exp(180)$  cells each with an initial radius of  $7.35e-14$  meters expanding to universe size space.

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 0.55 meters against gravitational resisting force in a way that kinetic energy is converted to potential energy. Based on the author's WMAP re-analysis, equality of matter and energy density occurs with  $0.5 * \exp(180)$  protons/m<sup>3</sup>.

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  $H^2 = 8/3 \pi G \rho C$  must be revised downward to  $2.7e-27$  kg/m<sup>3</sup>. 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  $(ds^2)$ . 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. *At a particular time in expansion*, 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.

$$\begin{aligned} \text{Area} &= 4 \pi R^2 \\ \text{Area} &= 4 \pi r^2 * \exp(180) \\ A/A &= 1 = R^2 / (r^2 * \exp(180)) \\ R^2 &= r^2 * \exp(180) \\ r &= R / \exp(90) \\ M &= m * \exp(180) \end{aligned}$$

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:

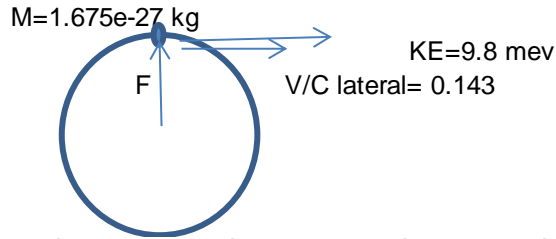
At any particular time in expansion	
Large space	Cell size space
$RV^2/M =$	$G = G$ With substitutions $r * \exp(90) * v^2 / (m * \exp(180))$ $(rv^2/m) / \exp(90)$

Note the value  $1/\exp(90)$ . 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 (9.8 MeV) causes tangential velocity  $V/C = 0.147$ . (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  $F=6.67e-11*(1.67e-27)^2/(7.35e-14)^2=3.46e-38$  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
Proton Mass (mev)		938.272
Proton Mass M (kg)		1.673E-27
Field Energy E (mev)		2.683
Kinetic Energy ke (mev)		9.720
Gamma (g)=M/(M+ke)		0.9897
Velocity Ratio $v/C=(1-(g)^2)^{.5}$		0.1428
$R=HC/(2\pi)*(E*E)^{.5}$		<b>7.3543E-14</b>
Inertial Force= $(Mg*C^2/R)*1/EXP(90)$ NT		<b>3.4524E-38</b>
$HC/(2\pi)=1.97e-13$ mev-m		
Calculation of gravitational constant G		
Inertial Force= $(Mg*C^2/R)*1/EXP(90)$ NT		3.4524E-38
Radius R (Meters)		7.3543E-14
Mass M (kg)		1.673E-27
Gravitational Constant ( $G=F*R^2/M^2=NT\ m^3/kg\ s^2$ )		6.67428E-11
		6.67428E-11
PE fall		19.34
KE orbit		9.720
$F(NT)=PE/R=19.34*1.603e-13/7.3543e-14$		<b>3.4524E-38</b>

The author believes that the radius  $7.35 \times 10^{-14}$  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  $6.24 \times 10^{25}$  meters. The author also believes that the value  $1.54 \times 10^{-21}$  sec defines fundamental time. As this value repeats, time increases.

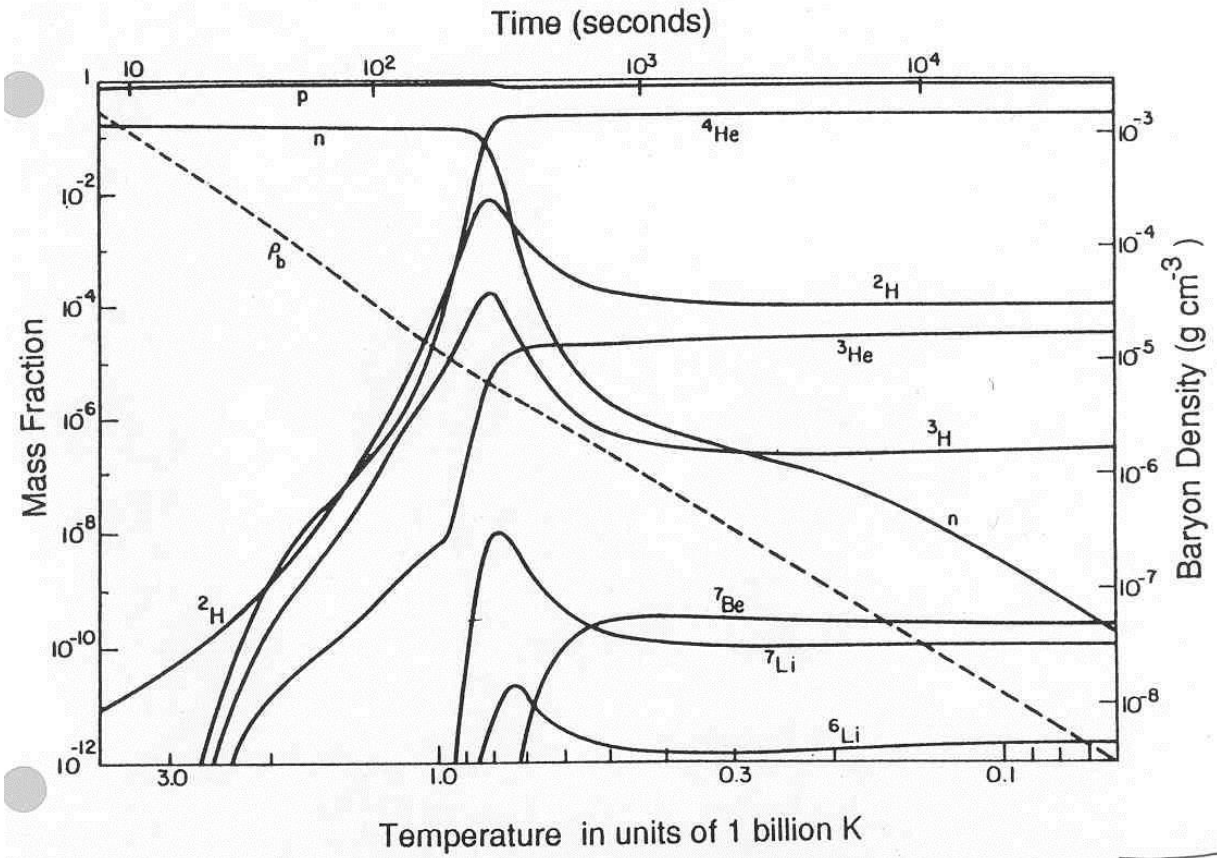
## Appendix 2: Proton mass model

ell g228			Mass and Kinetic Energy				Field Energies		
mass	strong field	Energy-mev	Mass	Difference ke	Strong residual ke	Neutrinos	Expansion ke	Strong & E/M Gravitation	
ke	grav field		mev	mev	mev	mev	mev	field energy	Energy
15.432	17.432	753.291	101.947	641.880				-753.29	
12.432	10.432	0.687							-0.69
13.432	15.432	101.947	13.797	78.685				-101.95	
12.432	10.432	0.687							-0.69
13.432	15.432	101.947	13.797	78.685				-101.95	
12.432	10.432	0.687							-0.69
	-0.296	-2.72E-05				10.151	20.303	expansion pe	
charge	equal and opposite charge						0.000	expansion ke	
10.408	0.075		0.000	0.000	-0.671	→ 0.671 v neutrino			
-10.333									
rates here to form proton and electron			129.541	799.251	<b>938.272013</b>	<b>PROTON MASS</b>			
10.136	10.333	0.62	<b>0.511</b>	0.111				5.44E-05	-0.622
0.197	0.296	2.72E-05	<b>ELECTRON</b>			→ 2.47E-05 e neutrino			
			130.052	0.111		0.671	20.303	-957.185	-2.683
90.000	90.000				1.673E-27		Total m+ke	Total fields	
							Total positive	Total negative	
							959.868	-959.868	0.00E+00

For this paper, one important value above is 20.3 of expansion potential energy that forms an orbit with about 10 MeV of kinetic energy and 10 MeV of potential energy. Another value 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. The gravitational field energy 2.683 MeV is the basis of the fundamental radius  $7.35 \times 10^{-14}$  meters.

## 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](http://burro.astr.cwru.edu/Academics/Astr222/Cosmo/Early/nucleosynth_fig.jpg)

