Expansion Energy, Dark Energy and Missing Mass

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Abstract

The Wilkinson Microwave Anisotropy Probe WMAP [4] and PLANCK [29] led to cosmological parameters that are becoming generally accepted. There are two components of expansion. The second component develops later and is related to Einstein's constant lambda, associated with dark energy. The concept of critical density (H= (8/3 pi G rhoC)^.5) is related to the accepted Hubble constant 2.26e-18/sec. Critical density (omega total=1) according to year 9 WMAP parameters [26] is composed of density fractions: omega dark=0.719, omega mass=0.235 and omega baryons mass=0.046. The low value for baryons (protons) leads to a problem known as missing mass. This paper reviews the equations used to estimate expansion. The concept of critical density is examined by converting the basic equations to the kinetic energy and potential energy associated with expansion. It is shown that the concept is being misused. The equation (H= (8/3 pi G rhoC)^.5) is useful but rhoC is simply the density at the present time.

We will review historical limitations on baryon content. A reliable expansion history and temperature history are constructed. With this we can re-analyze the baryon/photon ratio important to understanding residual deuterium. Also, He4 calculations are examined considering dark matter. The other historical limitation on baryon content is interpretation of WMAP temperature anisotropy data. The period from equality to decoupling was re-analyzed with omega baryons=0.5 of final density.

It is proposed that dark energy is photon energy release from stars, not lambda. The author believes that the correct cosmological parameters are 0.5 normal and 0.5 dark matter fraction of final density.

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

Why baryon content has been limited to 0.046 fraction of critical density

Firstly, what is critical density?

The standard method of simulating expansion involves the Friedmann-Lemaitre-Robertson-Walker (FLRW) model [10]:

H^2=H0^2*(OmegaMatter*(1+z)^3+OmegaR*(1+z)^2+OmegaLambda)
Where:
OmegaTotal=1   WMAP result
Rhoc=H0^2/(8/3 pi G)   (critical density)
OmegaR(1+z)^2=0 (wrong shape)
OmegaMatter separated into =Omega cold dark matter and baryons
OmegaLambda is the cosmological constant
H0=2.26e-18/sec   WMAP 9 year result
z=(rf/r-1) where radius is the developing radius and rf is the final radius.

Historically, the equations are written to be consistent with geometric models of the universe involving metric tensors that characterize a four dimension universe where ds^2= three distances^2 and (C*time)^2. The model is also known as the lambda cold dark matter model or the concordance model.   Lambda stands for the famous Einstein constant and is related to the concept of dark energy. The equations are derived from the FLRW model and show that it is identical to the equations most use to characterize the first component of expansion, i.e. R=R0*(time/time0)^power. The present radius is calculated from this equation, starting from 8.24e12 meters. This calculation is based on rho and t/to ratios explained later. We will also substitute another concept for the lambda component.

set OmegaR=0				
set OmegaLambda=0				
set OmegaMatter=Rho/RhoC where RhoC=critical density				
1+z=Rend/R				
(H0/H)^2=(t/t0)^2				
set Rho=Rhoc=9.14e-27 kg/m^3 at 3.14e25 meters				
R=R0*(t/t0)^(2/3)				
R0=8.24e12 meters				
t0=.059 sec				
t=3.93e17 sec				
R=3.14e25	meters			

The derivations above look correct and yield the accepted expansion equation, i.e. R/R0=(t/t0)^(2/3). The basic concept is that kinetic energy at the beginning will be converted to potential energy. The power (2/3) in the expansion equation is for conversion of kinetic energy to potential energy.

The equations below appear to define critical density RhoC.

	substituting to give rho
ke	pe
1/2Mv^2	Fr
1/2Mv^2	GMM/r
ke/M	pe/M
1/2v^2	GMMr^2/r^3)/m
	GMr^2/r^3)
	4/3*Gr^2(M/(4/3*pi r^3))
1/2 v^2	(4/3 pi G rho) r^2
v^2	(8/3 pi G rho) r^2
v/r=H	(8/3 pi G rho)^.5

G		6.67480E-11			
Ho		2.26E-18			
rhoC	8/3 pi G/Ho^2	9.124E-27	2.26E-18^2/(8/3*PI()*6.674e-11)		

The equation is useful to relate the Hubble constant 2.26e-18/sec to rho but it only works because the present density is 9.14e-27 kg/m^3.

Kinetic energy and critical density

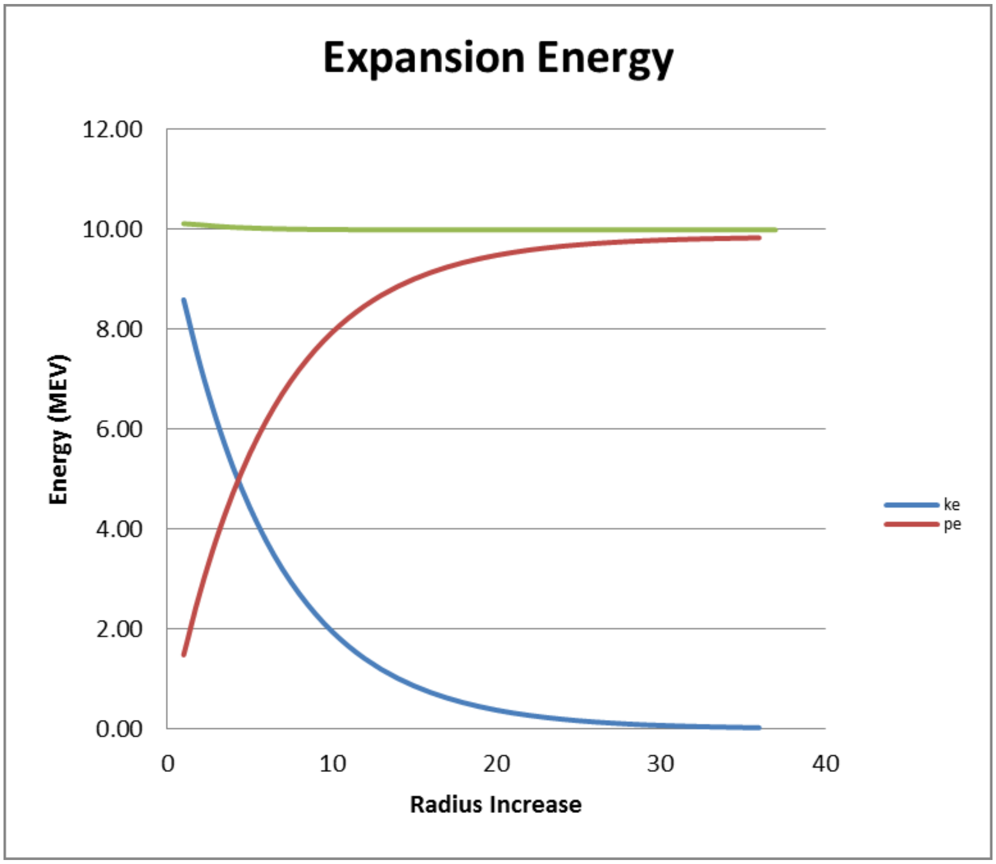
We can see problems with critical density when we relate it to kinetic energy. The velocity can be found by multiplying V/R*R. From here, we can find kinetic energy at the current time ½*m*V^2.

	H=(8/3*PI()*6.67e-11*9.14E-27)^0.5			
v/r=H	2.26E-18	1/sec		
v=v/r*R	9.08E+07	m/sec with R=4.02e25 m		
ke=1/2*mv^2	43.1	mev		
pe=4/3 G m r^2 rho				
pe=(4/3*PI()*6.67e-11*9.14E-27)*1.67E-27*4.02E+25^2/1.6e-13				
	43.07			

We are starting to see a problem. Kinetic energy should be converted to potential energy during expansion. Potential energy should be high and kinetic energy should be low at the current time but the equations above give the same value. Go back and write the equations without substituting rho into the equation:

		not substituting to give rho
const=	ke+	pe
const=	1/2mv^2+	Fdr
const=	1/2mv^2+	GMm/r^2*dr

As expansion progresses velocity v becomes smaller and kinetic energy becomes smaller. But potential energy becomes larger because it is an integral of force F*dr. F is becoming smaller because r^2 in the bottom of the equation is becoming larger. Here are actual results from expansion equation from R0=8.24e12 meters to 3.14e25 meters.



Observe how flat the curves are late in expansion. Force is very low at large r^2 and the energy required is very low. We will also show that late stage expansion requires 1.5e-12 MeV of kinetic energy to replace the second component of expansion (lambda), not 0.719 of the kinetic energy 43 MeV calculated above. The difference is 13 orders of magnitude. The critical density concept is being misused late in expansion.

Cellular Cosmology

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][Appendix 1 “Gravitational Constant”]. 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 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 (see topic “Cell size space” below) 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

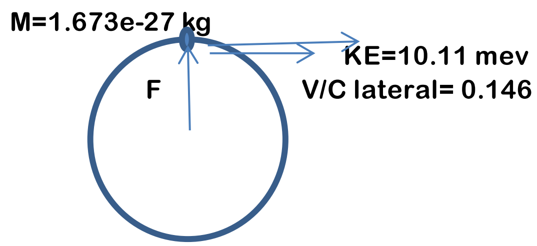
Cellular cosmology is useful because we know some of the constants required to model the universe. The constants are found in the proton mass model, shown below. The proton model above has been described many times (see appendix topic “Review of the proton and neutron mass models”).

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

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.

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:

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		

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

The author uses a natural logarithmic scale with time=exp(45+c)*1.51e-21 seconds. The author uses dimensionless time, g=time/alpha=time/0.0529, starting at 1 in expansion equations, i.e. R=r0*g^(2/3). Time=1.51e-21 seconds*exp(N) where N=45 increases. This makes alpha=1.51e-21*exp(45)=0.0529 seconds.

Fundamental expansion force

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:

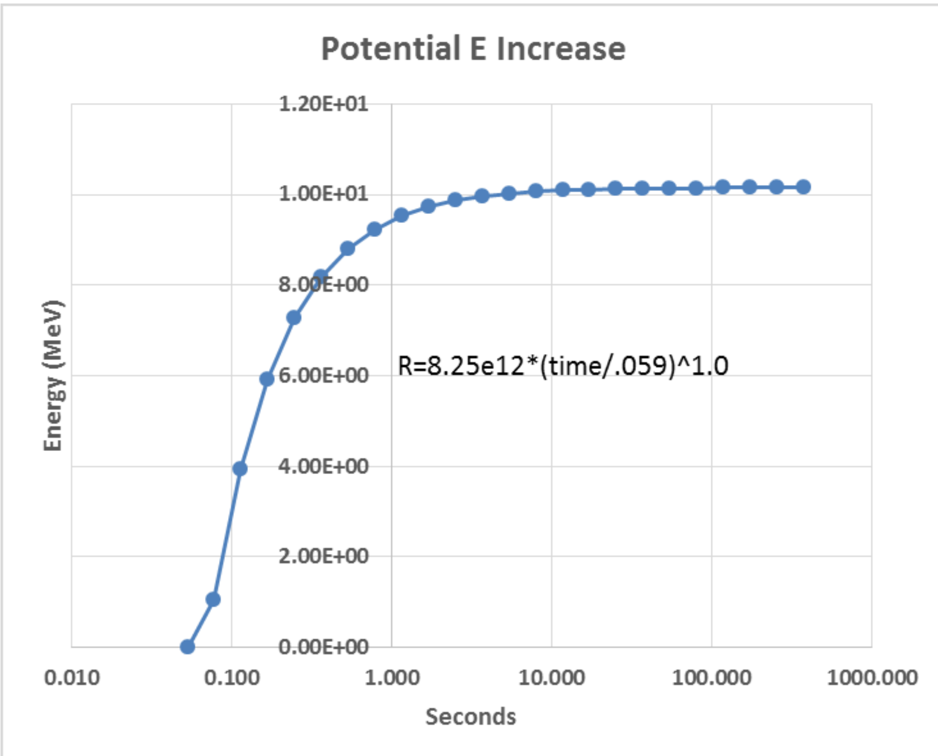
derive coupling constant c^2		
G/1.603e-13=2 ke R/Mm		
G*1.67e-27^2/1.603e-13=2 ke R/Nn		
Nn=1 for coupling constant		
1.16045E-51	mev m	
1.16716E-51	Mev m	Published
nt m^2/kg^2*kg^2 mev/(nt m)		
Mev m		
1.16e-51*exp(90)/2		
7.08107E-13	Ke r	(MeV m)

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.

R (meters)	8.24E+12	1.21E+13	1.78E+13	2.62E+13
r=R/exp(60) m	7.22E-14	1.06E-13	1.56E-13	2.29E-13
coup*ph/pr	5.57E-02	7.09E-13	7.09E-13	7.09E-13
ke=coup/r	7.71E+11	6.68E+00	4.54E+00	3.09E+00
g=(939/(939+ke))	**1.2166E-09**	**9.9293E-01**	**9.9518E-01**	**9.9671E-01**
V=(1-(g)^2)^0.5*C (m/	**2.9979E+08**	**3.5592E+07**	**2.9405E+07**	**2.4280E+07**
F=mV^2/r (Nt)	1.7037E-36	1.6335E-38	7.5845E-39	3.5177E-39
E=Fdr (MeV)		4.23E+00	2.89E+00	1.97E+00
de from Rh	0.00E+00	5.92	7.26	8.18

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=ke*r. We know r and can determine keg. From here we can calculate the force F=mV^2/r. (Gravity is an inertial force and related to velocity around a circle.) Above it is 1.7e-36 Nt for the first increment. Before we leave this table there is a check on the E calculation.

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



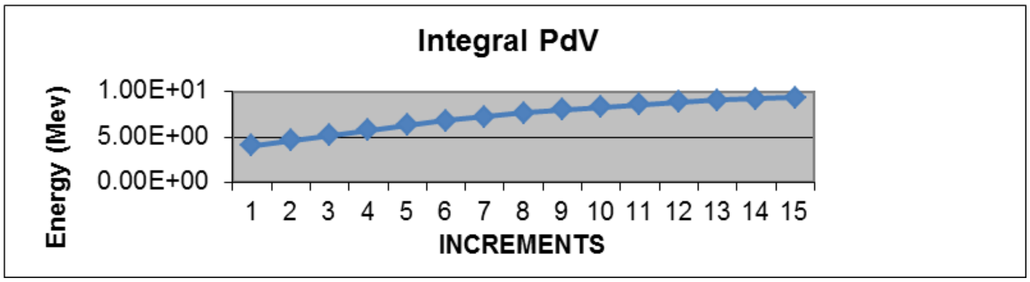
This increase in potential energy means that kinetic energy is reduced and is the low value 0.11 MeV at 1e17 meters expansion. This calculation is made possible by the use of the simple equation F=mV^2/R/exp(90) and Potential energy = integral F*dR.

We can now actually calculate the next radius in incremental calculations from fundamental forces and do not have to rely on the equation r=r0*(time/time0)^.5. The equation is r=rprior+E/F*1.6e-13/exp(90). From here we can take the scaling associated with cellular cosmology out and calculate R=r*exp(60).

For convenience we can still use the r=ro(time/time)^power. But we must understand why the universe expands. It expands because the orbital kinetic energy (ke) is decreasing in the equation gamma=938.27/(938.27+ke). Ke orbit is scaled to lower values by ke=10.15*7.22e-14/(r1+r3). 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. Potential energy=PE+F*(delta R)/2*6.12e12 MeV/(NT-m) with initial force F=3.66e-38 NT.

Note: The force F can also be converted to pressure by the equation P=F/area, where area=4*pi*r^2.

Volume/cell (m^3)=4/3*pi*r^3	1.58E-39
Density (kg/m^3)=1.67e-27/vol	1.06E+12
Temperature (K) =MeV/(1.5B)	7.82E+10
Pressure=7829*D*T (NT/m^2)	6.49E+26



We must know the gas constant (approximately 7829 for hydrogen) but it does not apply to plasma and this limits the approach. We learn from this that pressure drives expansion.

Constructing the expansion radius

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).

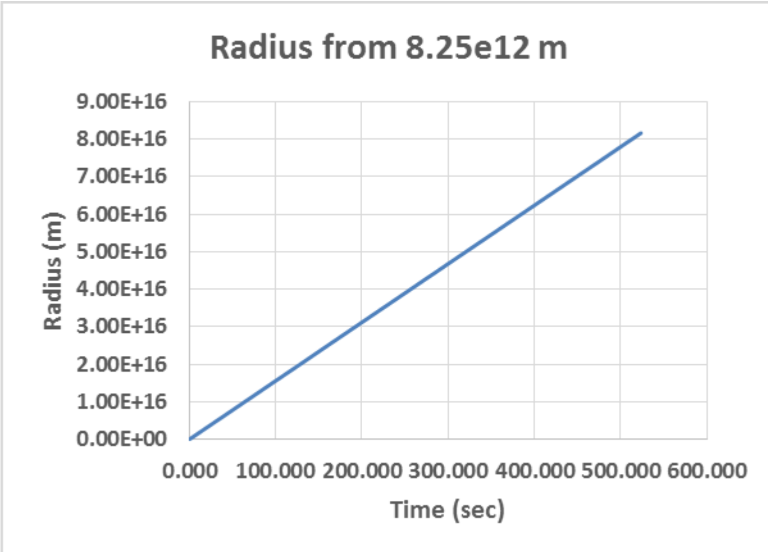
Again working backward we construct the earlier part of the curve from Rd back to Rh, the point where primordial He formed. This is predicted by the SAHA value 1 for deuterium which occurs at 8e8 K. There is agreement that after inflation, plasma exists and expansion is radiation dominated [21]. The 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.

Radius and temperature history from beginning to He4 fusion

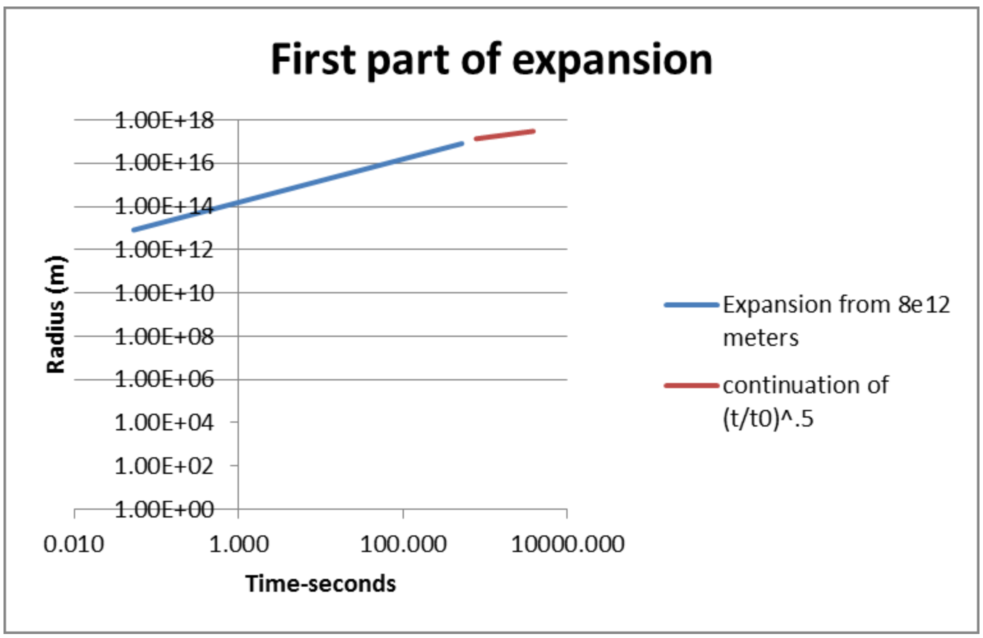
We find values in the proton mass model that give the starting radius. It is related to values from the proton mass model, specifically E=2.732 MeV in the equations below. R0=7.22e-14*exp(60)=8.25e12 meters (the value exp(60) is to scale one cell radius to full radius assuming exp(180) neutrons and three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

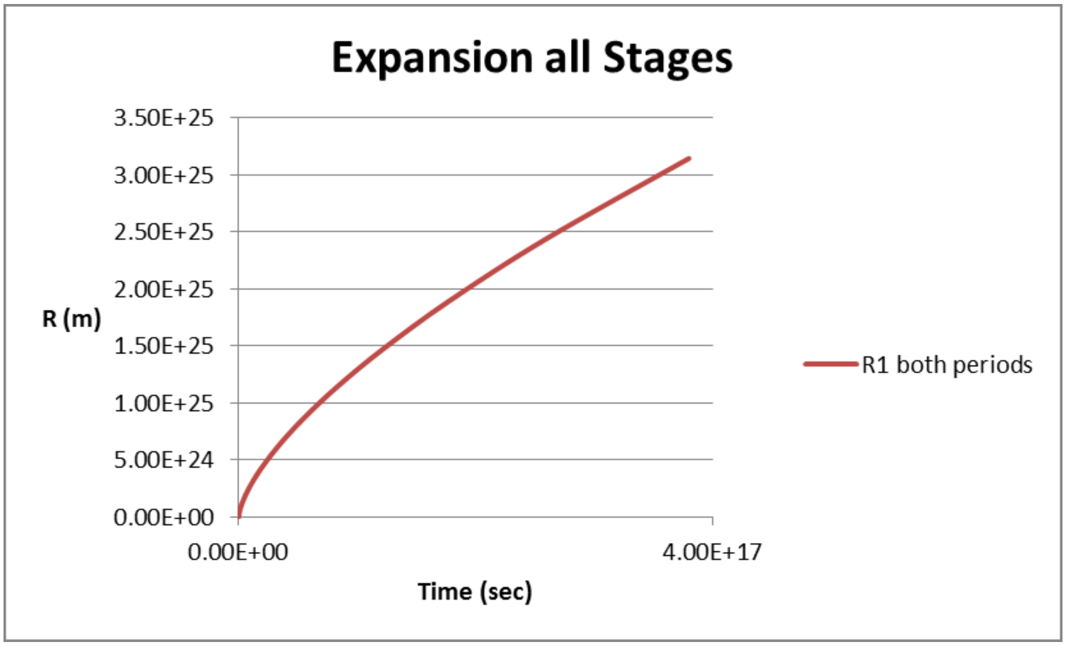
It gives the energy required to expand the radius (10.15 MeV labeled above as expansion kinetic energy (ke). What we don't know is the relationship between time and radius. However direct expansion with time; i.e. R=R0*(time/time0)^1 works perfectly. I use a time scale that starts at the natural log 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:



All the criteria are met using information from the proton model. The curve constructed from these three periods is shown below:



Constructing the temperature history from He4 fusion to present

If we are to calculate an accurate baryon/photon ratio, we need the temperature history earlier than the present values 2.725K and 4.02e25 meters. Important values can be calculated at Rh where primordial helium4 forms. The temperature throughout the entire curve from that point to the end is due to heat addition from primordial fusion to He4. 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. The SAHA equation is unity at 373 seconds and 5.82e16 meters radius. Details are included in the appendix topic entitled “Details of primordial nucleosynthesis”. 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

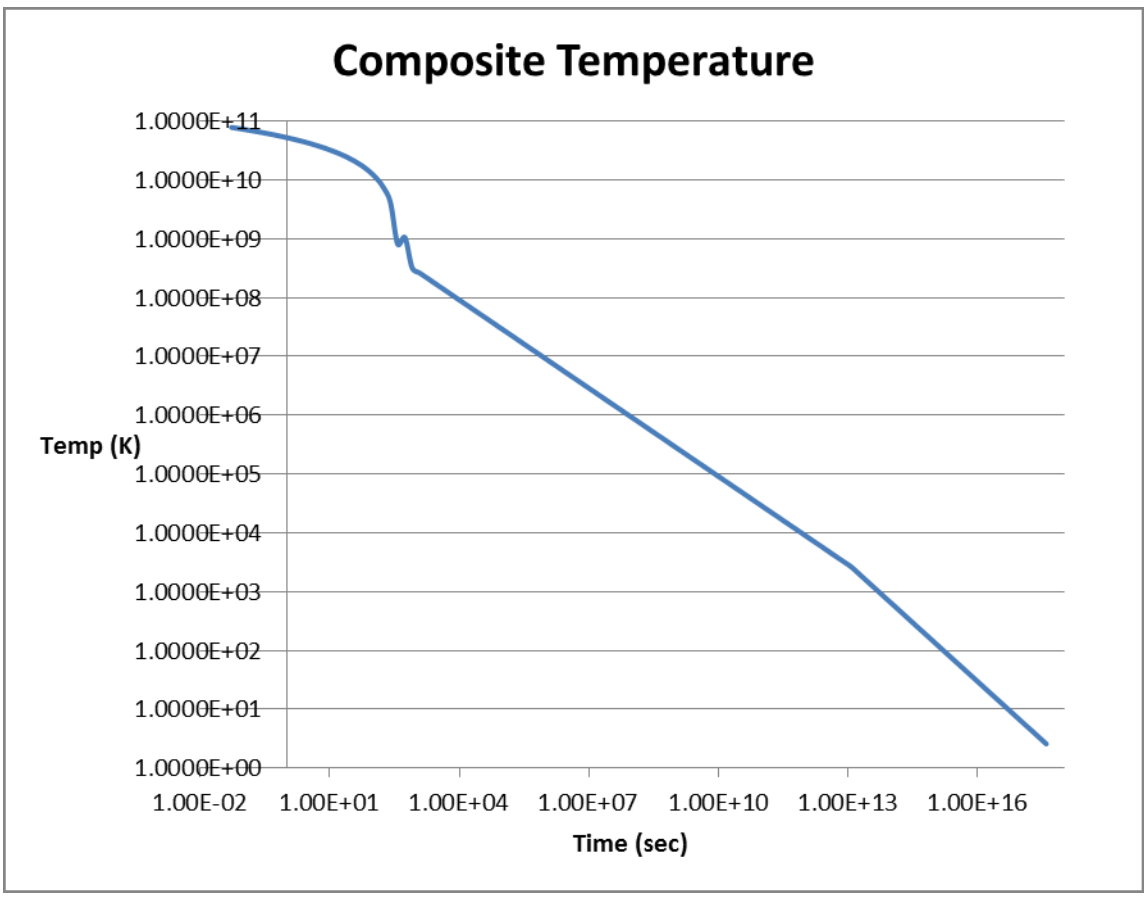
In addition to fusion energy there is a small amount of energy still available from the original 10.15 MeV. Kinetic energy 10.04 MeV was converted into potential energy to expand the initial radius and only 0.11 MeV remains at 2e17 meters.

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

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

8.47E+15	1.25E+16	1.83E+16	2.69E+16	3.96E+16	5.82E+16	2.07E+17	2.51E+17	3.05E+17	3.70E+17
1.7703E+10	1.4326E+10	1.0948E+10	7.5707E+09	4.1932E+09	8.1559E+08	1.0599E+09	3.2159E+08	2.6524E+08	2.1876E+08
T (K)	1.06E+09	938.27	1.67012E-27	v=(8kT/mpi)^.5	Protons	1.16E-01	9.59E-02	7.91E-02	6.52E-02
		938.27	1.67012E-27		Dark matter		9.59E-02	7.91E-02	6.52E-02
T (K)	1.06E+09	938.27	1.67012E-27	KE=T*1.5 B	Photons	1.37E-01	4.16E-02	3.43E-02	2.83E-02
T (K)	1.06E+09	0.511	9.0958E-31	v=(8kT/mpi)^.5	Electrons	1.16E-01	9.59E-02	7.91E-02	6.52E-02
				1	0.399	0.399	Tphotons at present (K) →		2.57

The total energy for the plasma components compares with the He4 energy release above (0.551 MeV/proton). The temperature 1.06e9K is one temperature we need to define the temperature curve and 2.725K is the other temperature. 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 as the current value. 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.

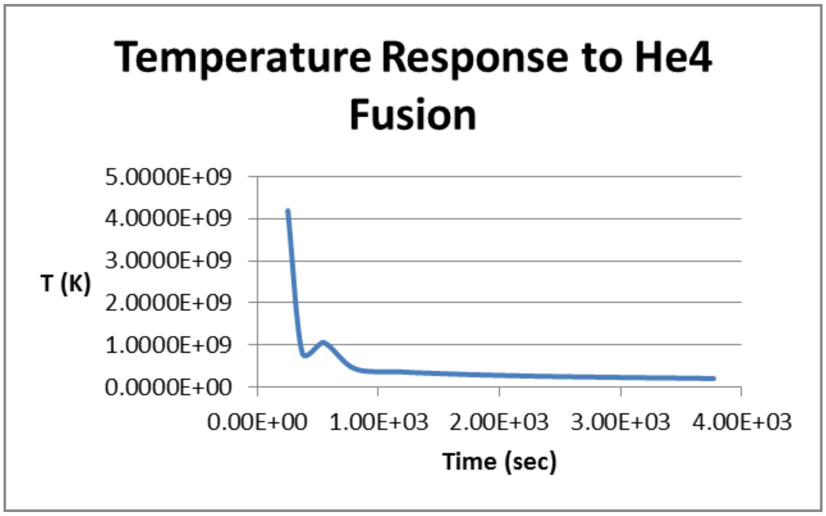
Energy history summary

Energy is available at the beginning and added in two additional places in the expansion curve. An initial kinetic energy of 10.15 MeV/proton comes from the proton mass model [1] [10](Appendix 1). The current energy can be calculated from the Boltzmann relationship; E=1.5*B*T, where B is 8.62e-11 MeV/K. Secondly He4 fusion releases 1.6 MeV/proton when He4 forms (called primordial nucleosynthesis in the literature). Finally, stars light up and release radiation energy. The arrows labelled reduced show the change in the energy value/proton due to expansion.

	Summary of energy releases during expansion					
	Stage 1 start Initial Energy	Stage 2 start He4 fusion	Stage 3 start r=r*t^(2/3)	Stage 4 start Star energy	Expanded Energy now (MeV/proton)	
R meters	8.25E+12	2.00E+17	2.03E+21	6.70E+24	3.12E+25	no stars
		reduced				
MeV/proton	10.15	→ 0.11				
MeV/proton		0.555	reduced →	→	1.82E-10	
MeV/proton				e addition →	1.50E-12	
R delta (meters)					8.70E+24	
					4.02E+25	stars

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.



The radius increase to 2.07e17 meters and temperature spike to 1.06e9 K are the conditions that establish the residual deuterium. WMAP does not report these values and they cannot measure this exact point. After this spike, the temperature decreases to near it present value. Lastly, energy is added by star formation after radius 2e24 meters (z=15). This brings the temperature to the measured value 2.73 K.

Review of historical baryon fraction limitations

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). The point where He4 forms is 1.06e9K and 2.07e17 meters.

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)

	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

With 0.5*exp(180) protons, the baryon/photon ratio is 6e-10 but continues to change after He4 formation. We cannot use present day values for this critical calculation as literature suggests. 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 22 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 reactions [22] to match data 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.

Baryon fraction at equality

The second limitation is related to the radius and temperature where equality of radiation and mass occurs. The thought was that baryons had to be limited so that equality occurred early enough to allow development of the primary hot spot [4] at decoupling. The radius 2.31e21 divided by 2*pi*Radius R (above in table) equals 0.0106 radians. Also dark matter is not subject to the plasma and probably started to generate density variations we see in the microwave background radiation before baryons. Details are in the appendix entitled "detailed equality to decoupling simulation". This is the primary hot spot measured by WMAP but it is based on 0.5 baryon fraction of critical density, not the 0.046 baryon fraction of critical density reported as a baryon limitation.

WMAP interpretation that ratio of peaks determines dark/light ratio

The third limitation on baryon fraction was based on the interpretation of hot spots measured by WMAP and refined by PLANCK. We will first review the WMAP data [4][26] reduction (the data fits a power spectrum expected by acoustic waves).

L	L*(L+1)/2pi*cl micro K^2	La	L*(L+1)/2pi	cl	delta temp K	radius (meters
		0.735				5.10E+23
220	5580.1	299.32	7738.11	0.72	7.47E-05	2.32E+21
412	1681.0	560.54	27081.17	0.06	4.10E-05	1.24E+21
531	2601.0	722.95	45022.14	0.06	5.10E-05	9.60E+20
850	2500.0	1156.46	213038.79	0.01	0.00005	6.00E+20
1200	1020.0	1632.65	424496.26	2.64E-03	3.34664E-05	4.25E+20

WMAP data was updated for 9 years as additional data came in. But listen to the language in the report: “The peak at 74.5 micro-degrees K is due to the baryon-photon fluid falling into pre-existing wells resulting from Gaussian disturbances from inflation and dark matter”. The question I have is how did the pre-existing wells end up at the center of 3282 spheres? Further, how do we know that the ratio of hot spot peaks determines normal to dark matter ratio?

Jeans waves were no longer dampened after equality. Jeans waves are characterized by the following equation (for the .5x wave discussed below).

WL=0.57*3e8/3^0.5/(PI()*6.67e-11*6.24e11*1.783E-30*3e8^2*(baryon density+photon density))^0.5

Calculation of dt

The temperature peaks called dt are in micro degrees (2.730074 K). The thermal peaks are a function of density. The density ratio is a function of current density (9.14e-27 Kg/m^3 which includes dark plus normal mass in this document) and the density shortly after decoupling is 2.44e-18 kg/m^3. The density ratio =1.3*(9.14e-27/2.44e-18)^.5=7.92e-5. At peak wavelength (sin pi()/2), densification will be 1. The derivation for dt solves the following equation for dt: Densratio= (1.3*(9.14e-27/2.45e-18)^.5=((2.73+dt)^3/2.73^3-1).

	densratio=(2.730027^3/2.73^3-1)				
	densratio=((2.73+dt)^3/2.73^3-1)				
	densratio+1=((2.73+dt)^3/2.73^3)				
	(densratio+1)^.333=((2.73+dt)/2.73)				
		2.70E-05	check	2.9671E-05	
		0.000074	2.74E+00	2.7408E+00	
	2.73*(densratio+1)^.333=((2.73+dt))				
	dt=2.73*(densratio+1)^.333-2.73				
	densratio=1.3*(9.14E-27/2.45e-18)^0.5				
	dt=2.73*(1.3*(9.14e-27/2.45e-18)^.5+1)^.333-2.73				
	adjust dt for radius data				
	dt=((densification)*2.73*(1.3*(9.14e-27/2.45e-18)^.5+1)^.333-2.73				
dt	7.28E-05	(72.8 microdegrees with densification=1)			
	densification varies with sine theta				

(Check is verification that a simplifying assumption doesn't affect the result).

A sine wave has a peak of 1 at pi/2 radians. The fraction of the peak is called densification. No densification would be zero and rarefication would be less than 1. The waves don't all peak at once, they follow sine waves, varying through the cycle 0,1,-1,0. The equation for peak dt=(densification)*2.73*(1.3*(9.14e-27/2.44e-18)^.5+1))^.333-2.73. The Jeans waves [10] give the same hot spots listed above but the harmonics of the primary waves are weaker by a factor of harmonic^.5.

					2.4657E-18	angle (rad)=2*PI()*phase+PI()/2*(wl/WL)				
Wavelength	Wave*harmor	harmonic	dt=harmonic^.5*((sin(angle))*2.73*(1.3*(9.13e-27/2.46e-18)^.5+1)^.333-2.73							
2.31E+21	2.31E+21	1	72.0	7.92E-05	0	1.57079633	1	5183.4	5580.09	**2.319E+21**
3.30E+21		0.375	44.1	7.92E-05	0	1.57079633	1	1943.8	1797.76	**1.238E+21**
2.31E+21	1.15E+21	0.5	50.9	7.92E-05	0	1.57079633	1	2591.7	2601	**9.600E+20**
1.15E+21	5.76E+20	0.5	50.9	7.92E-05	0	1.57079633	1	2591.7	2600	**6.001E+20**
2.31E+21	4.61E+20	0.2	32.2	7.92E-05	0	1.57079633	1	1036.7	1200	**4.251E+20**

Harmonics are sequential divisions of the primary waves listed in the first column. There are two waves of interest, one with primary wavelength 2.3e21 meters and the second with 1.15e21 meters primary wavelength wavelength.

Above, the temperature predictions in the box compare favorably with WMAP data. The specific wavelengths concentrating the density and producing temperature variations are listed in the rightmost column (the wavelengths also agree with the WMAP data shown above). Angle (radians)=2*pi()*phase+pi()/2*(wl/2.3e21). I put the 4 waves in a table, identified where the peaks were and watched the way they add and subtract as a function of L (the horizontal axis that WMAP used). I used excel ® to do power spectrums and it was clear that the second and third peaks were lower like the WMAP data. Details are in Appendix 2.

Result of possible baryon limitation from hot spot data
The entire equality to decoupling analysis was based of 0.5 baryon fraction of critical. The hot spots measured by WMAP can be calculated from the Jeans wavelengths. Density and wavelength are the variables of interest. There is no reference to dark and normal mass in the calculation. The hot spots are Jeans waves and harmonics of Jeans waves that start at equality. The ratio of the first and second spots is NOT the dark to normal matter ratio. I believe I have characterized the hot spots and they do not limit baryon fraction to 0.046 fraction of critical density.

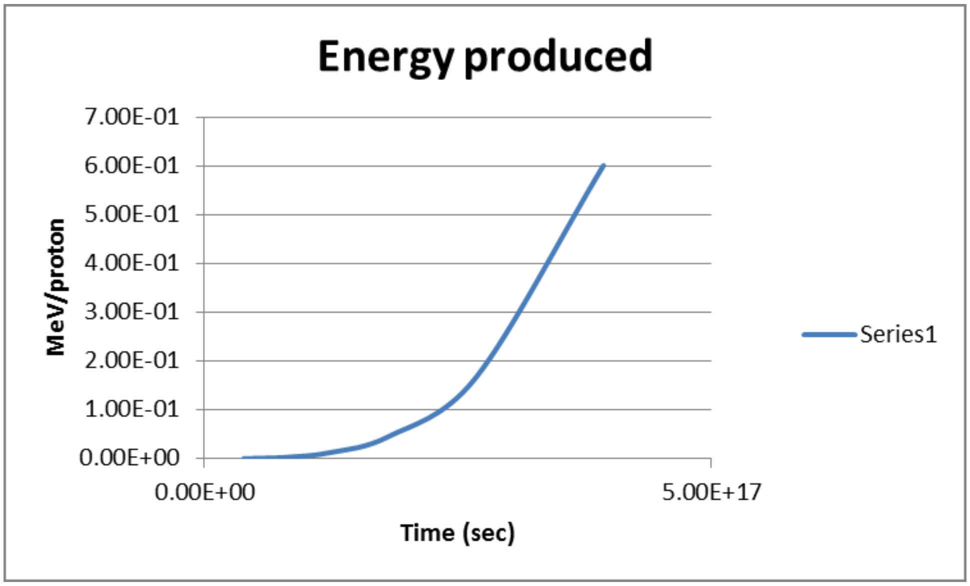
Dark Energy [18][27]

The calculation procedure introduced in the section above "Fundamental expansion force" was carried through to the current time.

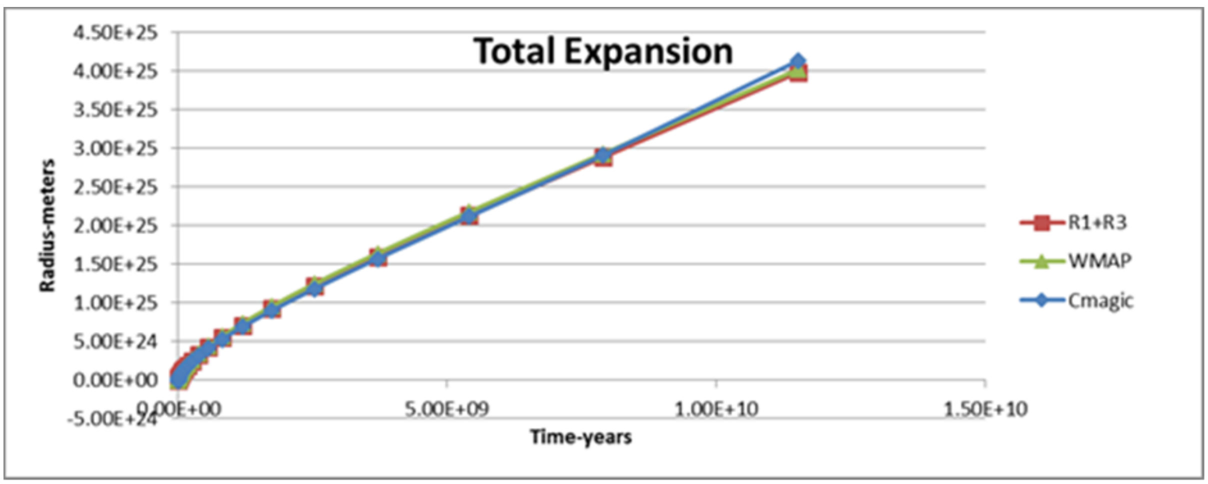
7.61E-02	9.84E-02	1.27E-01	1.65E-01	2.13E-01	2.75E-01	r=R/exp(60) m	1.27E+00
7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	coup*ph/pr	
9.31E-12	7.20E-12	5.57E-12	4.31E-12	3.33E-12	2.58E-12	ke=coup/r	
1.9858E-14	**1.5360E-14**	**1.1880E-14**	**9.1891E-15**	**7.1075E-15**	**5.4975E-15**	**g=(939/(939+ke))**	
4.2247E+01	**3.7155E+01**	**3.2677E+01**	**2.8738E+01**	**2.5274E+01**	**2.2228E+01**	**V=(1-(g)^2)^0.5*C (m/sec)**	
3.2082E-62	1.9193E-62	1.1483E-62	6.8696E-63	4.1098E-63	2.4587E-63	F=mV^2/r (Nt)	
4.22E-12	3.26E-12	2.52E-12	1.95E-12	1.51E-12	1.17E-12	E=fdr (MeV)	
7.61E-02	9.84E-02	1.27E-01	1.65E-01	2.13E-01	2.75E-01	predicted r (m)	
2.137E-14	5.376E-14	1.273E-13	2.916E-13	6.543E-13	1.449E-12	e addition	2.84E-12
1.26E+01	9.74E+00	7.52E+00	5.77E+00	4.30E+00	2.73E+00	Temp w/o star	0.354
1.66E-04	4.17E-04	9.87E-04	2.26E-03	5.07E-03	1.12E-02	delta T stars	1.045
1.260E+01	9.739E+00	7.521E+00	5.774E+00	4.303E+00	2.743E+00	Temp with Stars	
7.62E-02	9.88E-02	1.29E-01	1.70E-01	2.34E-01	3.52E-01	r=rp+(E+de)/F*1.6e-13/EXP(90)	
8.70E+24	1.13E+25	1.47E+25	1.94E+25	2.67E+25	4.02E+25	R=r*EXP(60)	with star de
9.97E+21	4.19E+22	1.66E+23	6.36E+23	2.38E+24	8.83E+24	delta R stars	

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. From here we now actually calculate the next radius in incremental calculations from fundamental forces and do not have to rely on the equation r=r0*(time/time0)^.5. The equation is r=rprior+E/F*1.6e-13/exp(90). From here we can take the scaling out and calculate R=r*exp(60).

Above we took the lambda component out but added 1.7e10 MeV to replace it. It is proposed that late stage expansion is related to energy released by stars [18]. Late in expansion stars are lighting up and the overall fusion energy produced is on the order of 0.6 MeV/proton. Only a tiny fraction of this energy (on the order of 1e-10) actually expands free protons (protons not tied up in orbits). Appendix topic “Fraction of star energy delivered to protons” addresses this fraction.



I added energy starting at z=16 where stars light up. This results in an expansion curve with photon energy increasing expansion (in place of the lambda component). Calculations show that this keeps the expansion curve from following the curve proportional to time^(2/3) after stars. Photon energy flattens the curve just like the lambda component.



Dark Matter Proposal [27]

It is proposed that dark matter is a contained neutron or equivalent mass wave. Since it exists among normal matter it has the same density. By particle/wave duality the wavelength would be 1.3e-15 meters radius. This is a long filament but there is reason to believe it can coil until it is stretched into a long filament by masses at the associated nodes. It could explain observations of the cosmic web. The node represents mass accumulation, i.e. clusters and galaxies. Originally dark and normal matter is distributed with most matter in the web. Mass accumulation into the node occurs very gradually at first but increases rapidly at about 1e7 years after the beginning. Now most of the matter is in the nodes but a long residual web exists. It is made of dark matter, attracts some normal matter and has gravitational properties that clear out huge volumes of space we see as voids.

Cosmological Parameter Comparison

It was shown above that the concept of critical density cannot be used for dark energy. However the current density is 9.14e-27 kg/m^3 and this value is related to measurement of the Hubble constant 2.26e-18/sec. WMAP literature parameters [26] are listed on the left side of the table. Omega is listed as 9.14e-27 kg/m^3. The dark energy, cold dark mass and baryon fractions are listed as 0.72, 0.24 and 0.046 respectively. The total mass/volume is exp(180)*1.67e-27 kg/1e79=9.14e-27 kg/m^3. Baryon density is given by 0.5*exp(180)/volume at each of the radius values. Cosmological parameters with dark energy removed (and replaced with star photons) are shown below. The table shows the normal (0.5) and dark matter fractions (0.5).

WMAP [4]			R1+R3	R1+R3	R1+R3
NOW			equality	decoupling	NOW
published					
4.02E+25	Inferred Radius (m)		5.40E+21		4.02E+25
				R1	3.14E+25
2.26E-18	H0				
8809	Temperature at equality (K)			31584	
	Photon mass density				
	Proton mass density				
2973	Temperature (K) decoupling			2643	
0.0106	Spot angle (radians)			0.0107	
0.254	baryon number density				2.737
5.77E+08	Photon number density				5.77E+08
4.400E-10	baryons/photon				4.75E-09
0.235	Dark matter fraction				0.500
6.57E-27	dark matter density in kg/m^3				4.57E-27
4.24E-28	baryon matter density in kg/m^3				4.57E-27
0.719	Dark energy fraction				0
9.14E-27	critical density				9.14E-27
0.0464	Baryon fraction				0.500
2.72E+77	Overall volume (m^3)			6.60E+65	2.72E+77
2.814E-01	overall mass density			rhoC	Volume
				9.135E-27	2.72E+77
				rhoC*Volume	exp(180)
				1.484E+78	1.489E+78
				mass (Kg)	2.4873E+51

Number of proton like masses in the universe

We can now calculate the number of proton like masses in the universe. The critical density 9.14e-27 kg/m^3 is baryons plus dark matter. The current radius R1+R3 is 4.02e25 meters and this gives 2.72e77 meters^3. Multiplying critical density by volume gives the number of proton like masses in the universe. This means that the total proton like masses in the universe is exp(180). We do not know if dark matter has a proton like mass but this is an interesting number to the author because exp(180) was the starting point for a unifying theory [1][12][appendix 1].

rhoC	Volume	rhoC*Volume	exp(180)	rhoC*V/exp(180)
9.135E-27	2.72E+77	1.49E+78	1.49E+78	1.000

Some details of the WMAP parameters are compared below with the revised parameters presented in the rightmost column.

Conclusions

The proton mass model [Appendix 1] is an accurate source of constants for cosmology, including expansion kinetic energy. It gives initial temperatures consistent with He4 formation and specifies the initial kinetic energy. Expansion and associated energy changes were evaluated using a cellular model based on two expansion components. In this model, there is one orbiting proton like mass/cell and all cells are formed by identical laws. 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 model predicts that a large radius of 4.02e25 meters characterizes the universe. The fusion kinetic energy released is enough to expand the cells to their present radius/cell of 0.352 meters against gravitational resisting force (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.

Analysis of equality and decoupling using WMAP concepts show that the calculated spot size gives the reported value 0.0107 radians. Again, the value 0.5 baryon fraction appears correct. Analysis of the Jeans waves shows that density and sinusoidal densification explain the hot spots. Analysis of baryon/photon ratio indicates that 6e-10 is correct. However, the radius at He4 formation is larger to enclose the same number of reactions. The concordance model uses the equation R=R0(time/time0)^(2/3) and a second exponential (lambda) component but is not specific about R, R0 or the expansion curve. Without radius values at the point that He4 forms, including the temperature spike it is unlikely that the 6e-10 baryon/photon is related to 0.046 baryon density. We cannot rely on the current baryon/photon ratio 4.4e-10 because it does not reflect the ratio at the temperature spike.

The second expansion component developed late when resisting forces were low. A new calculation procedure using cellular cosmology allows us to estimate whether photon energy released from stars after z=16 was large enough to replace the lambda component. The calculated energy requirement was low and the proposal appears promising.
WMAP identifies density fractions as dark energy (0.719), cold dark matter (0.235) and baryons (0.046) but the concept of critical density cannot be relied on. Re-analysis in this

document supports the values 0.5 baryon and 0.5 dark matter as fractions of the current density, 9.14e-27 kg/m^3.

A new dark matter proposal was made in January, 2017. Dark matter appears to be a gravitationally contained neutron/wave that can be very elongated. Residual matter lies along these elongated waves.

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Appendix 1: 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][5]. 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][5][25]. 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.

The values in the above table unify the four forces (interactions) of nature [2][9].
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.

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) [1][9][Text section "Cellular cosmology"].

			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 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.

Fraction of star energy delivered

We calculated that there would be about 0.6 MeV/proton considering the fusion energy of all the stars. We now show the fraction of that energy actually available to expand free protons. At this point most matter is in galaxies, etc. that are in orbit. Classically, it is not available to expand any longer because it is gravitationally bound. I assumed that free protons make up about 10% of all matter at the present time but this can be refined. Protons have a cross-section to photons of 2e-31 meters (PDG). We have to take into account the number of photons/baryon and the area ratios. The stars have an area but they are only a small fraction of the entire sky area. When all of this estimated, the fraction of the star energy that is actually delivered to their targets is on the order of 1e-10.

2.00E-31	cs=cross section of target proton=2e-31
1.48E+21	n=number of stars=1e21
3.43E-08	np/nb=number of photon/baryon (1/1e-10 for example)
1.52E+18	source area is the area of each star (pi^r^2 for example, where r is star radius)=1.52e18
4.13E+51	sky area= inside surface area of the universe modelled as sphere (4pi^Runiverse^2)=2.9e52 meters^2
3.19E-36	fraction=(cs*n*np/nb*source area)/(np/nb*area sky)=cs*n*np/nb*4*pi*rstar^2/area sky
1.49E+77	number of free protons (about 0.1 of all protons)
4.13E+51	sky area
1.15E-10	fraction of star energy (.6 MeV/proton) delived to expanding protons

Appendix 2 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. But again, the simulation using 0.5 fraction of final density and the temperature and radius history developed above gives equality at the right point for the calculated hot spot to match WMAP measurements at decoupling. Acoustic oscillations are no longer dampened at equality 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. The values 1.16e20 meters (red) to 2.31e21 meters (green) represent progression of a wave traveling at C/3^0.5 meters per second.

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:

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.

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))

Radius R (meters)	3.03E+21	3.67E+21	4.45E+21	1.41E+22	1.71E+22	2.08E+22	2.52E+22	3.05E+22	3.95E+22
Z=Rf/R-1	10374.47	8556.39	7056.88	2220.64	1831.34	1510.26	1245.44	1027.03	15.87
photon density (Kg/m^3)								decoupling	hidden cells
Temperature (K)	3.62E+04	2.98E+04	2.46E+04	7748	6.39E+03	5.27E+03	4.35E+03	3585	2.77E+03
8*PI()/(H*C)^3*(1.5*B*T)^3	1.35E+21	7.57E+20	4.25E+20	1.33E+19	7.44E+18	4.17E+18	2.34E+18	1.31E+18	6.08E+17
Proton mass dens=0.5*1.67E-27*EXP(180)/(4/3*PI()*R^	1.07E-14	6.01E-15	3.37E-15	1.05E-16	5.90E-17	3.31E-17	1.86E-17	1.04E-17	4.82E-18
photon mass dens=8*PI()/(HC)^3*(1.5*B*T)^3	**1.12E-14**	**5.20E-15**	**2.41E-15**	**2.36E-17**	**1.09E-17**	**5.06E-18**	**2.34E-18**	**1.08E-18**	**3.88E-19**
dens ratio= proton mass dens/photon mass dens	1.05E+00	8.66E-01	7.14E-01	2.25E-01	1.85E-01	1.53E-01	1.26E-01	1.04E-01	8.05E-02
progression of wave (spot) at C/3^.5	1.71E+19	2.66E+19	4.07E+19	4.40E+20	6.48E+20	9.54E+20	1.40E+21	2.06E+21	**3.04E+21**
Spot size (radians=spot/(2*pi*R)	0.0009	0.0012	0.0015	0.0049	0.0060	0.0073	0.0089	0.0108	0.0122

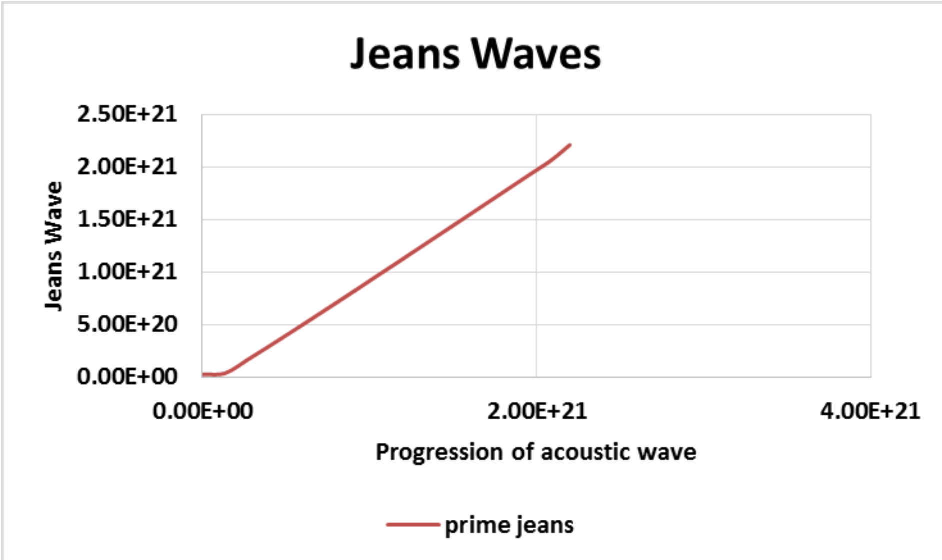
The wave has enlarged to 2.3e21 meters and this value divided by 2*pi*3.06e22=0.0107 radians. This matches the WMAP peak wavelength.

Details of hot spots measured by WMAP

Jeans waves are acoustic waves related to baryon-photon density. Jeans waves were no longer dampened after equality and they cause the hot spots, not dark matter. Jeans waves are characterized by the following equation (for the .5x wave discussed below):

WL=0.57*3e8/3^0.5/(PI()*6.67e-11*6.24e11*1.783E-30*3e8^2*(baryon density+photon density))^0.5

One wavelength is the sinusoidal progression from zero to one followed by progression to negative one and back to zero. The waves of interest here are stated as half waves of quarter waves (0.5x and 0.25x). Here is a plot of the wavelength for each point across expansion from equality to decoupling.



Jeans wavelength [10] is plotted against progression of an acoustic wave at velocity (3e8/3^.5) starting at equality and peaking at decoupling. Jeans waves are a function of density and the density is decreasing. This means the calculation for the Jeans wavelength at each point across the same distance is increasing. Jeans waves are sinusoidal waves and have peaks and valleys that change the density. The diagram below shows the progressing wave half way to decoupling. The right hand side of the range contains the peaks measured by WMAP. We can identify the prime wavelength that's sinusoidal peak is at 2.3e21 meters. They are on the chart above and a function of the Jeans waves shown across the bottom of the diagram. We can identify first harmonic (h) and second harmonic peaks. In addition it contains a 50 and a 33 micro-degree peak. The peaks have been placed so their wavelengths are at the 0.5x Jean wave-lengths in black along the bottom of the figure. The 50 micro-degree peak in red is the 1st harmonic of the 0.25x Jeans waves (the red wavelengths at the bottom).

2.98E+20	4.40E+20	6.48E+20	9.54E+20	1.40E+21	2.06E+21	3.04E+21	4.47E+21
0.0041	0.0049	0.0060	0.0073	0.0089	0.0108	0.0122	0.0139
33.0	dt		50.0	dt	74.7	dt	
1130	L		517	L	220	L	
4.25E+20	2nd h .5x wave		1.1500E+21	1st h 0.5x wav	2.30E+21	prime 0.5 wave	
		50.00	dt				
		810	L				
		5.75E+20	1st h 0.25x wave				
5.03E+20	6.85E+20	9.30E+20	1.26E+21	1.70E+21	2.29E+21	3.41E+21	5.05E+21
2.52E+20	3.42E+20	4.65E+20	6.29E+20	8.50E+20	1.15E+21	1.70E+21	

The Jeans wavelength equation can be compared as follows:

	temp data	Wavelength	Wave*harmor	harmonic
.5x wave	74.0	2.31E+21	2.31E+21	1
.5x wave troug	41	3.30E+21		0.375
1st h 0.5x wav	51.0	2.31E+21	1.15E+21	0.5
1st h 0.25x wa	50.0	1.15E+21	5.76E+20	0.5
2nd h 0.5x wa	33.0	2.31E+21	4.61E+20	0.2

Harmonics are labelled by the factor. Harmonics are sequential divisions of the primary wave.

Calculation of dt

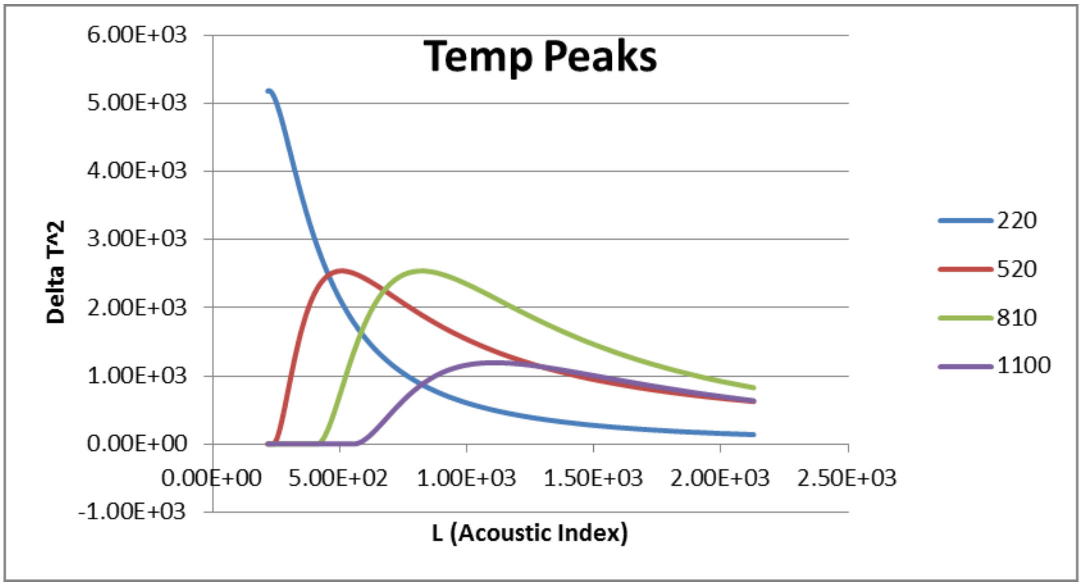
The temperature peaks called dt are in micro degrees (2.730074 K). The thermal peaks are a function of density. The density ratio is a function of current density (9.14e-27 Kg/m^3 which includes dark plus normal mass in this document) and the density at decoupling 2.45e-18 kg/m^3. The density ratio =1.3*(9.14e-27/2.44e-18)^.5=7.92e-5. At peak wavelength (sin pi()/2), densification will be 1. The full derivation is in the text section "Calculation of dt".

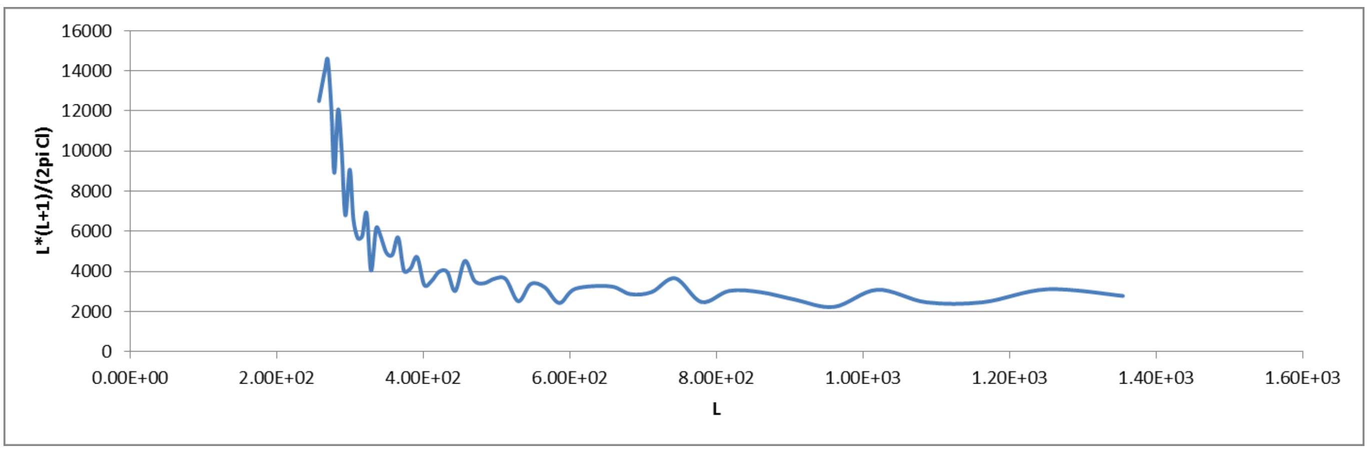
Densification is the fraction of the peak equal to sin(angle). No densification would be zero and rarefication would be less than 1. The waves don't all peak at once, they follow sine waves, varying through the cycle 0,1,-1,0. The equation for peak dt=harmonic^.5*(sin(angle))*2.73*(1.3*(9.14e-27/2.45e-18)^.5+1))^.333-2.73. The harmonics are lower amplitude waves by the factor harmonic^.5.

					2.4657E-18	angle (rad)=2*PI()*phase+PI()/2*(wl/WL)				
Wavelength	Wave*harmor	harmonic	dt=harmonic^.5*((sin(angle))*2.73*(1.3*(9.13e-27/2.46e-18)^.5+1)^.333-2.73							
2.31E+21	2.31E+21	1	72.0	7.92E-05	0	1.57079633	1	5183.4	5580.09	**2.319E+21**
3.30E+21		0.375	44.1	7.92E-05	0	1.57079633	1	1943.8	1797.76	**1.238E+21**
2.31E+21	1.15E+21	0.5	50.9	7.92E-05	0	1.57079633	1	2591.7	2601	**9.600E+20**
1.15E+21	5.76E+20	0.5	50.9	7.92E-05	0	1.57079633	1	2591.7	2600	**6.001E+20**
2.31E+21	4.61E+20	0.2	32.2	7.92E-05	0	1.57079633	1	1036.7	1200	**4.251E+20**

Above, the temperature predictions in the box compare favorably with WMAP data. The specific wavelengths concentrating the density and producing temperature variations are listed in the rightmost column (the wavelengths also agree with the WMAP data shown above). Angle (radians)=pi()/2*(2.3e21*factor/2.3e21). I put 4 waves in a table, identified where the peaks were and watched the way they add and subtract as a function of L (the horizontal axis that WMAP used called the multipole moment).

The reason the second and third peaks are lower is the harmonic waves are weaker than the primary wave by a factor harmonic^.5. It has nothing to do with dark matter, only density.

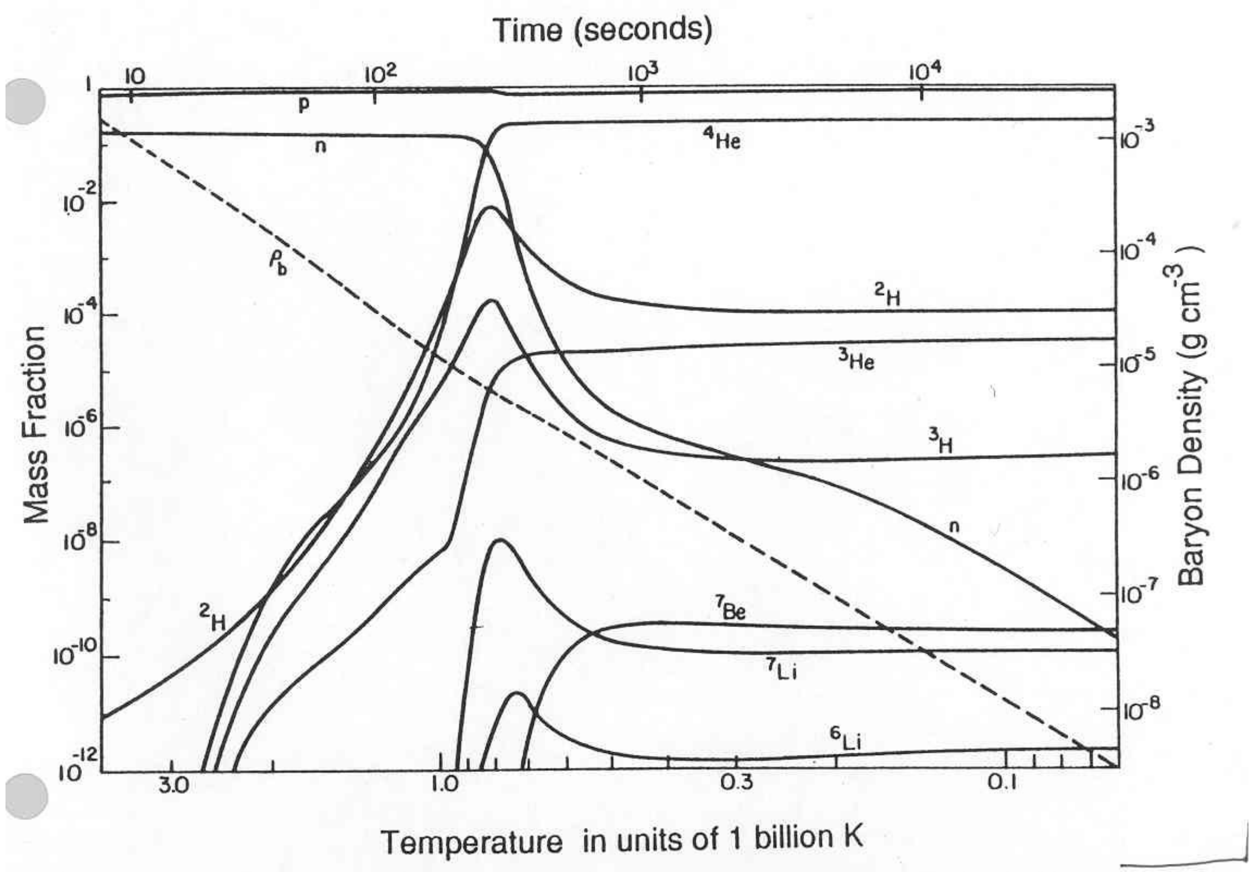




The plot above is the Fourier transform. We lose the vertical scale accuracy but once again you can see the power in the second and third peaks are lower, similar to the WMAP analysis.

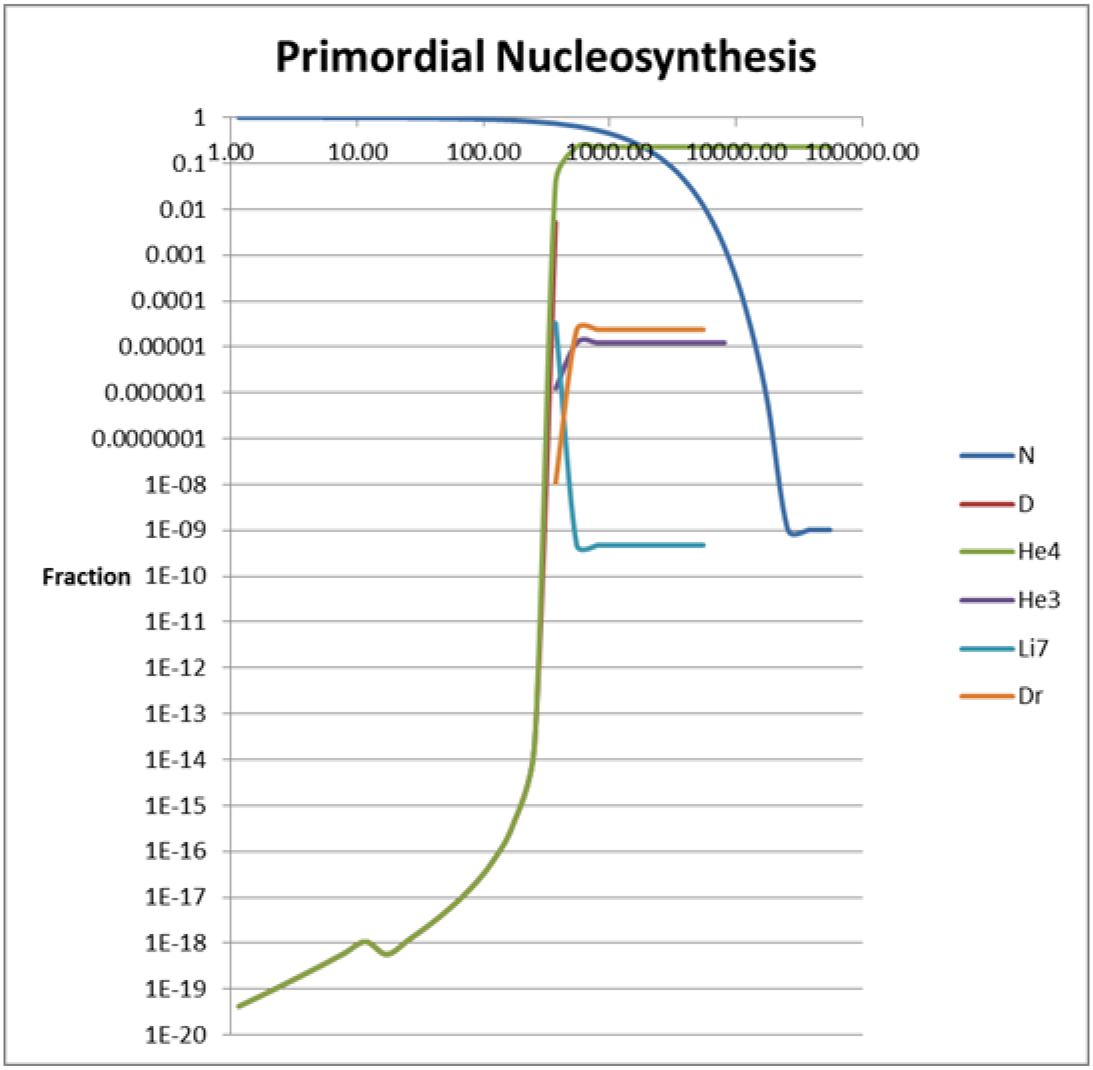
Appendix 3: Literature time and temperature

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



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

The literature can be compared to the author's analysis below.



Appendix 4: Does photon energy contribute to expansion?

Above, we calculated delta T and delta R with only gravitational energy. I am not sure the energy is that low. If photons help drive expansion, the photon energy is kep=T*1.5*B. With this we put (keg+kep) in the equation for gamma and then determine orbital velocity.

8.70E+24	1.13E+25	1.46E+25	1.88E+25	2.43E+25	3.14E+25	R (meters)		
5.10	3.94	3.05	2.36	1.82	1.41	Temp (K) w/o stars		
7.62E-02	9.85E-02	1.27E-01	1.65E-01	2.13E-01	2.75E-01	r=R/exp(60) m		
7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	coup*ph/pr		
6.68E-10	5.17E-10	4.00E-10	3.09E-10	2.39E-10	1.85E-10	ke=coup/r		
1.4247E-12	1.1020E-12	8.5233E-13	6.5925E-13	5.0991E-13	3.9440E-13	g=(939/(939+ke))		
3.5783E+02	3.1470E+02	2.7677E+02	2.4341E+02	2.1408E+02	1.8827E+02	V=(1-(g)^2)^0.5*C (m/sec)		
2.2987E-60	1.3752E-60	8.2273E-61	4.9220E-61	2.9447E-61	1.7617E-61	F=mV^2/r (Nt)		
5.06E-10	3.91E-10	3.03E-10	2.34E-10	1.81E-10	1.40E-10	E=fdr (MeV)		1.330E+00
1.873E-03	7.393E-03	2.763E-02	1.012E-01	3.674E-01	1.330E+00	delta T stars	0.943	
2.416E-13	9.537E-13	3.564E-12	1.305E-11	4.740E-11	1.716E-10	e addition	2.85E-10	see fq189 for deriv
7.62E-02	9.86E-02	1.28E-01	1.67E-01	2.26E-01	3.52E-01	r=rp+1/F*E*1.6e-13/EXP(90)		
8.71E+24	1.13E+25	1.46E+25	1.90E+25	2.58E+25	4.02E+25	R=r*EXP(60) with star de		
5.098E+00	3.949E+00	3.076E+00	2.459E+00	2.191E+00	2.741E+00	Temp with Stars		
9.41E+20	6.21E+21	3.88E+22	2.37E+23	1.44E+24	8.72E+24	delta R stars		

The calculated gravitational kinetic energy is only 2e-12 MeV from inertia but if we include the photon energy of about 1.8e-10 MeV (associated with the temperature without stars equal to 1.41 K in the second line in the table). In this case expansion is mainly due to photons. From here we can calculate the force F=mV^2/r. Above it is 5.7e-46 Nt for the first increment. The columns of calculations above are carried through to the current time below. But we can add a small energy e to the calculation and find out its effect on radius. We can now answer the question "how large does e have to be to explain the second component of expansion?" We will focus on the column on the right (the present time).

The value E=Fdr=1.4e10 MeV checks as the energy required to calculate the next radius.

r=rp+E/F*1.6e-13/EXP(90)		
0.275=0.213+1.4e-10/2.944e-61*1.6e-13/exp(90)		
0.275345748		
3.14E+25	R=0.275*exp(60) m	
8.77E+24	delta R (4.02e25-3.14e25)	

Now look at the e addition line. Adding 1.7e-10 MeV increases the radius of the universe to 4.02e25 from 3.14e25 meters (delta=8.77e24 meters). This is equivalent to the expansion component associated with lambda and dark energy.

The effect of 1.7e-10 MeV on the temperature is a delta of 1.36 degrees K. But the calculations in section entitled "Constructing the temperature history" indicated that the temperature dropped to 2.73K. When you add 1.36K to 2.73K degrees you have 4.09K. This is higher than measured but did WMAP mask the temperature of stars out of their measurements?