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Dark Energy Revealed

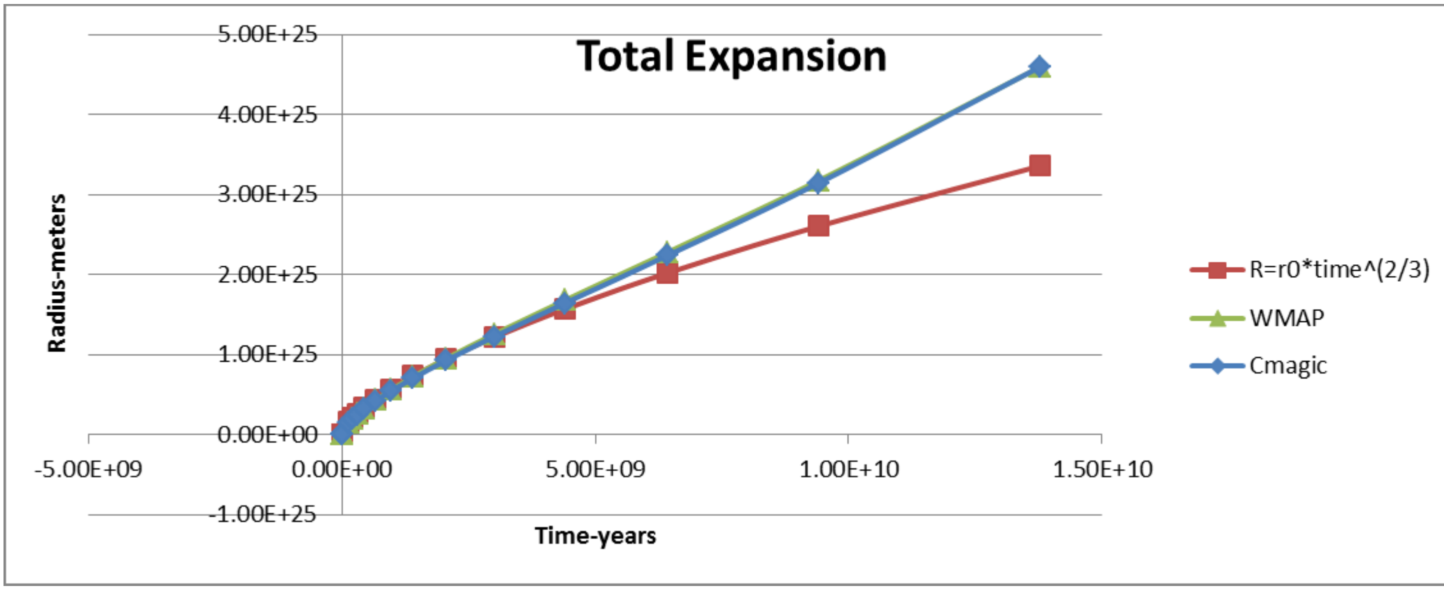
Abstract

Observations of the universe's expansion have created discussion regarding dark energy. Preliminary type 1a supernova data suggested that the universe might be accelerating although this is now unclear. There is consensus that expansion currently is more linear than the equations R=r*t^(1/2) and R=r*t^(2/3). Since the second equation represents conversion of kinetic energy to potential energy and is a curve, data proving that expansion is almost linear in the later period appears to violate energy conservation and require a dark (unknown) energy source.

This paper presents calculations indicating that energy produced by stars causes the linear expansion curve. The analysis draws on data regarding the relative abundance of elements to determine the number of stars and their energy radiation. Energy produced by stars is fusion energy and provides an alternate to dark energy. Current cosmology is based on mass with kinetic energy (with critical density that includes a dark component). A reduced critical density value is presented which subtracts the fusion source. Revised cosmological parameters are included. A full expansion curve is presented, including an analysis of limits on baryon/photon ratio.

Background

Expansion and cosmology parameters are currently based on radiometer projects known as COBE, WMAP [3][7], and Planck. They are compared to supernova data from Cmagic [5] that suggest an accelerating universe. Early expansion is radiation driven but after equality of mass density and photon density expansion follows R=r*t^(2/3). At equality perturbations grow and are observed at decoupling as temperature perturbations that subtend the angle 0.0106 radians (measured by WMAP). Analysis of perturbations provides good data for several cosmological parameters, including the ratio of light to dark matter. The equation R=r*t^(2/3) represents conversion of kinetic energy to potential energy but gives the wrong Hubble constant (slope of the expansion curve/divided by the radius). The measured value from WMAP year 9 is 2.26e-18/sec [12]. The graph below shows the problem.



Exploration

The dark sky temperature is 2.73K. However, recall that the WMAP and other radiometer projects blocked out light from the Milky Way stars since these photons originate from surfaces that are about 5780 K. The photons produced by stars are of interest because they may produce enough energy to explain "dark energy". Star formation (formally known as re-ionization) starts at about 200-500 million years after the beginning. There are potentially about 2e20 stars if their mass is 2e30 kg similar to our sun. The average star is about 5e29 Kg [4]. The sun emits 2.37e39 MeV/second and will burn for 7-8 billion years (Wiki). Since star formation a lot of atoms have moved through a well-documented solar burning cycle. Our sun is mainly hydrogen but a supernova in our vicinity produced the heavier elements that make up the earth and other planets. Heavier elements are measured throughout the universe and NIST publishes data regarding elemental abundance. The universe is mainly hydrogen but the abundance of Helium4 is uniformly 23%. It is widely accepted to be a result of primordial nucleosynthesis that occurred about 700 seconds after the beginning. He3, deuterium and Li7 were also produced by primordial nucleosynthesis and their abundance provides a marker for our understanding of this period [12]. Fusion energy was produced by each element involved in star evolution and their measured abundance [NIST] multiplied by their binding energy is of interest here. The table below shows the energy released by a few elements involved in star evolution.

		0.603	MeV from stars	
fractional	mev/nucleon			
abundanc		2.23E+00	Mev total	Mev/ 0.603
5.00E-07	2.490	1.24E-06	He3	
2.30E-01	7.075	1.63E+00	He prim	
	7.075	4.36E-01	He star	7.24E-01
6.00E-09	5.644	3.39E-08	Li7	
2.00E-09	6.492	1.30E-08	Be	
0.00E+00	6.476	0.00E+00	B10	
2.00E-09	6.952	1.39E-08	B11	
5.00E-03	7.681	3.84E-02	C12	6.37E-02
0.00E+00	7.491	0.00E+00	C13	
0.00E+00	7.558	0.00E+00	C14	
1.00E-03	7.477	7.48E-03	N14	1.24E-02
0.00E+00	7.717	0.00E+00	N15	
1.00E-02	7.977	7.98E-02	O16	1.32E-01
0.00E+00	7.767		O17	
0.00E+00	7.796		O18	
4.00E-07	7.861	5.97E-05	F	
1.30E-03	8.098	1.05E-02	Ne20	1.75E-02
0.00E+00	7.985		Ne21	
0.00E+00	8.105		Ne22	
2.00E-05	8.123	1.62E-04	Na	
6.00E-04	8.262	4.96E-03	Mg	8.22E-03

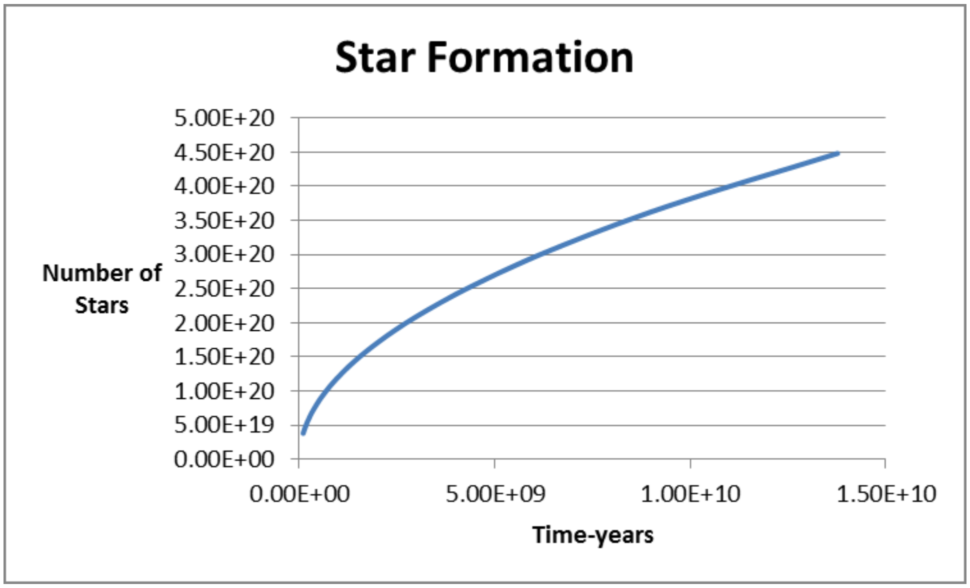
Early Helium4 fusion released 1.63 MeV but the stars have produced an additional 0.6 MeV/proton (subtract 1.63 from the total 2.23 MeV above). This 1.63 MeV has been highly reduced by expansion (energy later=energy release/expansion ratio because kinetic energy is being converted to potential energy) but makes up a significant part of the Cosmic Background Radiation. The other 0.6 MeV was released after stars formed and less reduced because the expansion ratio is only about 20. About 0.436 MeV/proton of the 0.6 total (73%) is first stage $H2 \rightarrow He4$ solar fusion as shown in the following calculation. The calculation is based on Wiki data solar output (2.37e39 MeV/sec) and 7e9 years of solar burn time. The other "burns" during the life cycle of stars ($He \rightarrow C \rightarrow O \rightarrow Fe$) [Wiki][11] are short lived and contribute the remaining 27% of the energy produced by stars.

0.436	He4 stars Mev=7e9*2.37E+39*365*24*60*60*2.05e20/(0.165*EXP(180))

Our goal is to determine the energy available to expand the universe. We will base our estimate on stars that are similar to our sun. The first step is to determine the number of this size stars that have contributed to the 0.6 MeV total as a function of time. We know there are 0.165*exp(180) protons (see section entitled "Recalculating parameters with a new critical density" below) so the average number of stars is 2.05e20. This is a maximum number since not all protons in the universe are tied up in stars.

2.05E+20	Number stars at 2e30 kg=0.165*EXP(180)*1.67E-27/(2E+30)

Since star formation rate was not uniform, we will distribute stars over the period 200 million years until the present. The graph below provides an estimate. Sensitivity to other possibilities was examined but results indicated the exact curve was not important to the final result.



To understand how energy drives expansion, one must know the forces produced by energy. We will use an approach that gives the force on each proton. The energy however will be an average over the universe that can be reduced to a small uniform value for each proton. I used this approach successfully to understand gravity [6][13] and call it cellular cosmology.

Review of cellular cosmology [2][6][10][13]

Consider large mass M (for our purposes the mass of the universe although the term universe seems a little presumptive) broken into exp(180) small cells, each with the mass of a proton labelled lower case m below. The mass (m) of a proton is 1.67e-27 kg. Fill a large spherical volume with exp(180) small spheres we will call cells. Consider the surface area of many small cells as a model of the surface of one large sphere with the same surface area. For laws of nature to be uniform throughout the universe there can be no preferred position. A surface offers this property but the equivalent surfaces of many small spheres also offer this property as long as we do not distinguish an edge. As such a surface model equivalent to the surface of many small cells is useful if the fundamentals of each cell are known.

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

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

For gravitation and large space, we consider velocity V, radius R and mass M as the variables (capital letters for large space) that determine the geodesic. With G constant, M=m*exp(180) and the surface area substitution R=r*exp(90), the gravitational constant would be calculated for large space and cellular space as follows (lower case r,v and m below are for cellular space):

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

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

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

F=MV^2/R			
M=exp(180)*m		equal mass	
4 pi R^2= 4 pi r^2*exp(180)		equal area	
r=R/exp(90)			
V^2=v^2		Energy is energy	
Substitute relationship above in force equation			
F=MV^2/R=m*exp(180) V^2/(r*exp(90)			
F=mv^2/r*exp(90)			
F/exp(90)=mv^2/r			
where small m and r refer to a cell			
Force must be reduced by exp(90)			

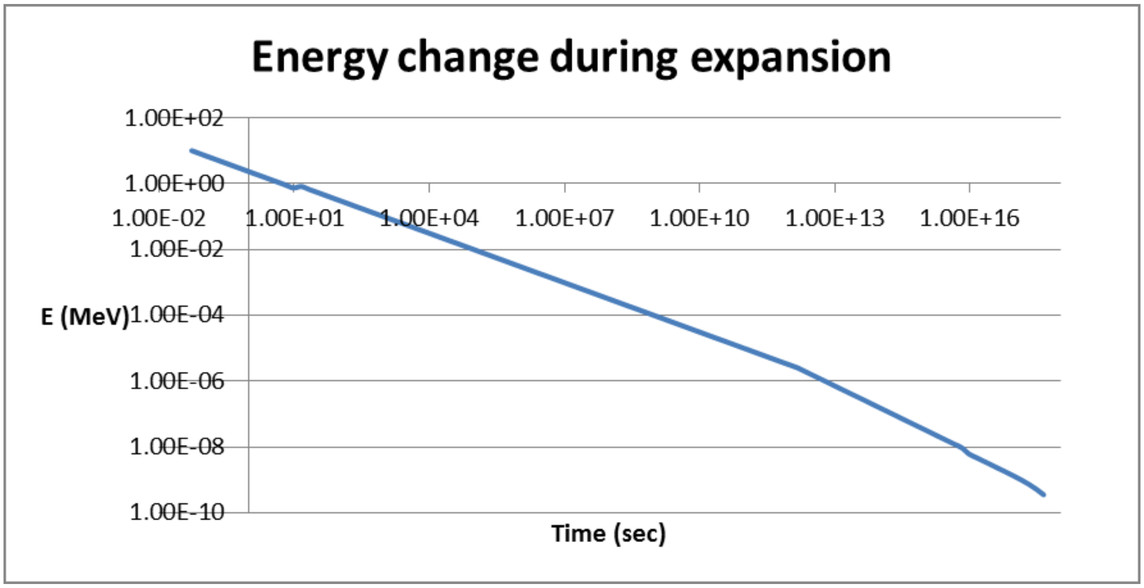
We can deal with parameters of one small cell if we deal with a force that has been reduced by exp(90).

We must also find the potential energy change on a cell by cell basis:

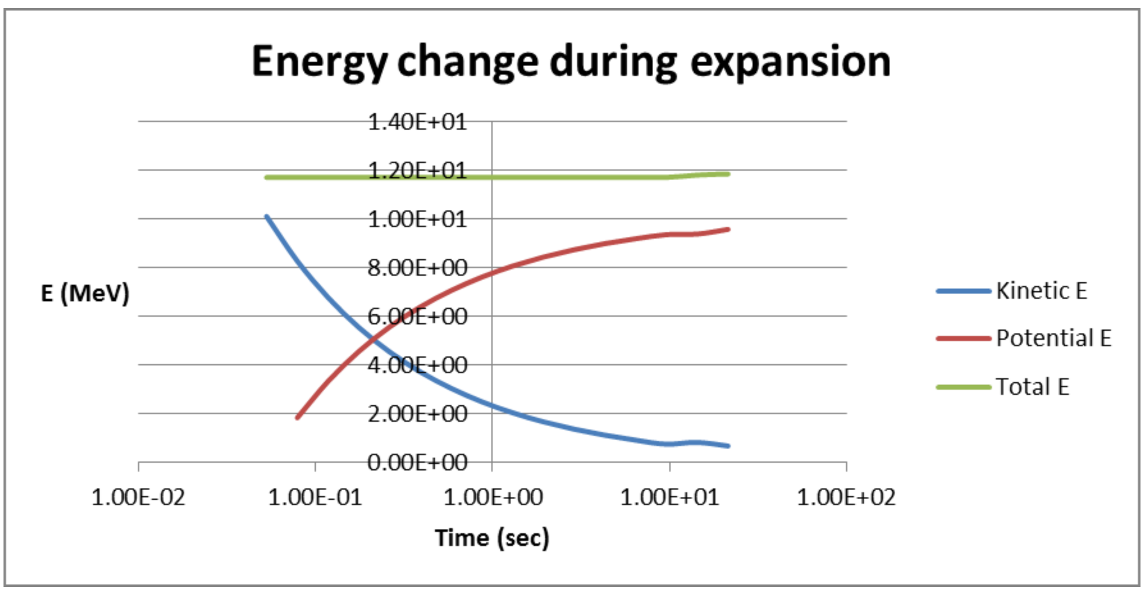
E=F dR/2.6e12			
where E is in MeV, R is meters and F is newtons			
2.6e12 nt-m/mev is a conversion constant			
M=exp(180)*m			
4/3 pi R^3= 4/3 pi r^3*exp(180)			equal mass
r=R/exp(60)			equal volume
Substitute relationship above in potential E equation			
E=(F/exp(90)*R/exp(60))/2.6e12			
E=(F*R/(2.6e12*exp(30))			

Energy relationships

The total energy produced by stars is a candidate for "dark energy" but we must understand the relationship between expansion energy and the energy we measure as the cosmic background radiation (CBR). The current energy can be calculated from the Boltzmann relationship; E=1.5*B*T, where B is 8.62e-11 MeV/K. Using this relationship, we can determine that the original 10.11 MeV has been reduced to E=1.5*8.62e-11*2.73=2.53e-10 MeV. Energy is added at the beginning and two additional places in the expansion curve. An initial kinetic energy of 10.11 MeV/proton comes from the proton mass model [1] [10](Appendix 1). This kinetic energy is converted to potential energy during expansion and has been reduced to a low value. Secondly 1.6 MeV/proton (plus some Neutron→Proton decay energy) is added when He4 forms. Lastly, energy is added by star formation after radius 1.2e24 meters (200 million years after the beginning). The temperature decreases to its present value 2.73 K as shown on the following chart.



The kinetic energy is converted into potential energy as expansion occurs with the total equaling 10.11 +1.6 MeV/proton. This calculation is made possible by the use of the equations developed above F=mV^2/R/exp(90) and Potential energy = integral F*dR/(2.6e12*exp(30)) that apply to each cell containing a proton.



Calculation of energy forces on late stage expansion

The principle to be applied here is that when we use a cell to describe the universe as a whole, we must use the constants 1/exp(90) and exp(30) to compensate for the geometric relationship between large and small. Furthermore to deal with one cell, every cell must represent a composite of all cells. The section entitled “Review of cellular cosmology” tell us that forces are produced by the equation F=mV^2/R/exp(90) with the coupling constant applied. The following example shows how expansion forces are calculated from the temperature during expansion.

g=(938.27/(938.27+MeV))	
v/C=(1-(g)^2)^0.5	
F=(1.67E-27*(v/C*3e8)^2/r/EXP(90)	

The energy marked **MeV** in the equation above is the cosmic background radiation (CBR) temperature because it is identically the remaining expansion kinetic energy. For example at the end of expansion, MeV= 2.73*1.5*8.62e-11 MeV/K=2.53e-11 MeV. Gamma (g) above is very close to 1 since g=938.27/(938.27+2.53e-10). This makes v/C=7.8e-7 and velocity v=231 meters/second. The proton (1.67e-27 kg) moving at this speed produces 1.76e-61 Newtons of force outward. This is the force on one proton that expands the cell radius. Once we know the expansion of one cell radius (r) we multiply by exp(60) to describe the universe radius R. One may also think of expansion as pressure driven with the force above divided by cell area to give the pressure. If you integrate pressure time the change in volume (PdV) over the expansion history, once again you have 11.7 MeV/proton at the end of expansion.

Below, we calculate expansion resulting from energy production by stars. Energy produced in stars will increase the temperature slightly and the force equation above will be used. Each star on average contributes 2.37e39 MeV/sec and there are an increasing number of stars. This method uses the Stephan Boltzmann number (S=3.54e5 MeV/m^2/K^4) and associated equation MeV/sec=S*area*T^4 to calculate the energy from stars.

First check that the star temperature 5778K (Wiki) produces the correct energy. The calculation below where S=3.54e5 MeV/m^2/K^4 verifies the output of the sun (Wiki).

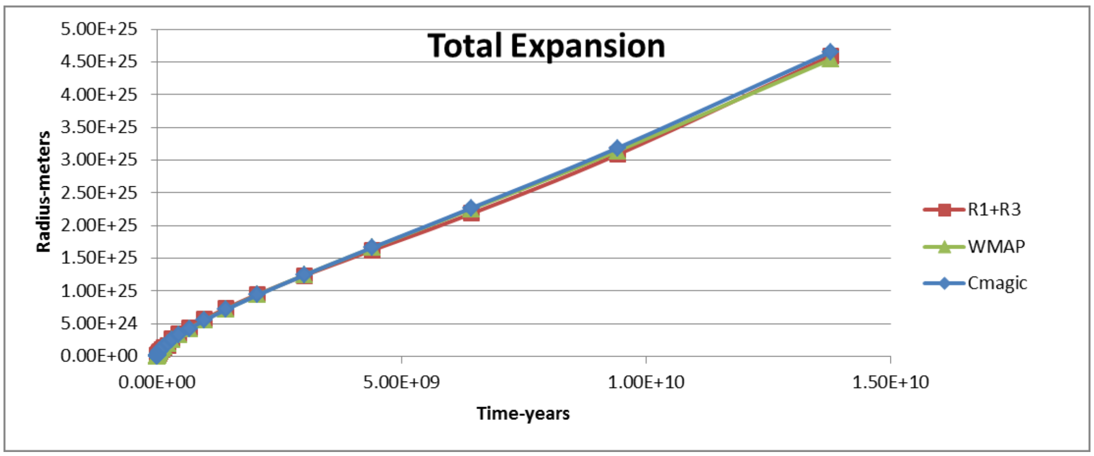
5778	Temp surface K
3.54E+05	mev/m^2/K^4
6.96E+08	radius of sun (meters)
6.08E+18	Surface area of sun
2.40E+39	mev/sec/star

Over time there are an increasing number of stars similar to our sun each with a surface temperature of 5778 K. The number of stars and their surface area give us the MeV/sec coming from this source. The sky also radiates energy. Its temperature is only 2.73 K but its area is the area associated with the radius of the universe. These two sources can be added together (MeV/sec total) and the increased sky temperature can be calculated by solving the Stephan Boltzmann equation for T. T=((MeV/sec total)/3.54e5/skyarea))^.25. Each temperature is associated with energy and the difference is the kinetic and potential energy change between the original sky temperature and the star augmented sky temperature. The next step in the calculation is to find the increase in radius possible with the difference in potential energy. We need to know the force to carry out the calculation dR=dE/Force. First the velocity of a proton is calculated from temperature and force is calculated with the equation above, i.e. F=1.67e-

27*V^2/(R1+R3)/exp(90). The table below contains calculation details and the vertical line after column 1 indicates cells are hidden to fit this document.

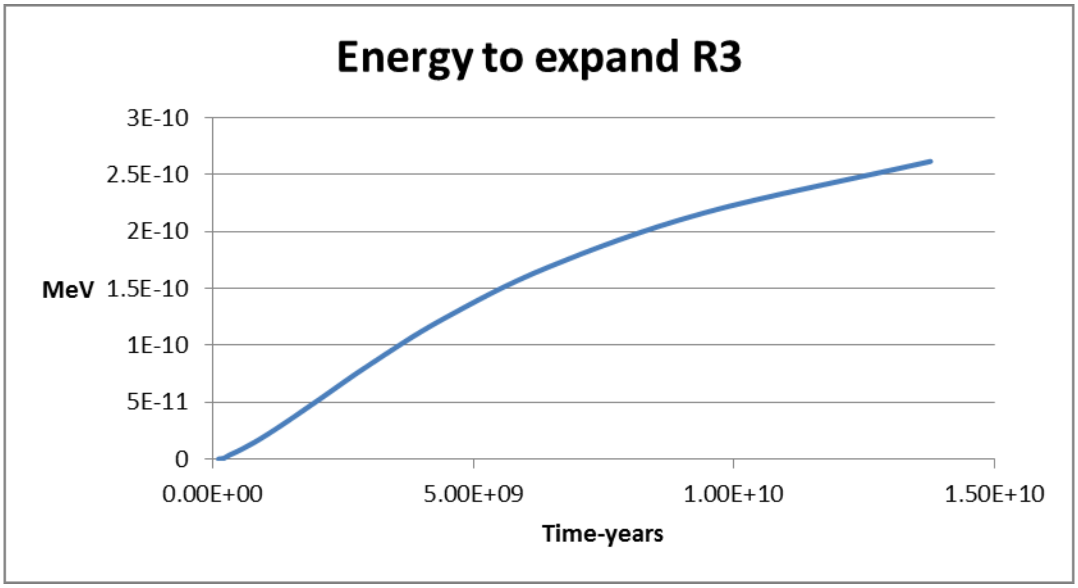
9.77E+07	4.40E+09	6.43E+09	9.41E+09	1.38E+10		Time from beginning (years)
122.16	7.15	5.29	3.84	2.73		Temperature without stars
2.78E+19	1.86E+20	2.25E+20	2.72E+20	3.30E+20		number of stars
6.65E+58	2.26E+60	2.80E+60	3.45E+60	4.24E+60		mev/sec=S*area stars*5778^4
1.93E+49	3.77E+51	7.12E+51	1.38E+52	2.63E+52		area sky
1.52E+63	3.49E+60	1.97E+60	1.06E+60	5.17E+59		mev/sec=S*area sky*2.73^4
1.52E+63	5.75E+60	4.77E+60	4.51E+60	4.76E+60		mev/sec total=stars+sky
122.17	8.10	6.60	5.52	4.75		T=((mev/sec total)/S/area sky)^.25
1.7262E-13	1.2287E-10	1.6889E-10	2.1636E-10	2.6183E-10		Energy difference between two temps
1.0000	**1.0000**	**1.0000**	**1.0000**	**1.0000**		**g=(938.27/(938.27+MeV))**
5.16E-06	**1.33E-06**	**1.20E-06**	**1.10E-06**	**1.02E-06**		**v/C=(1-(g)^2)^0.5**
3.02E-58	1.43E-60	8.50E-61	5.11E-61	3.19E-61		F=(1.67E-27*(v/C*3e8)^2/r/EXP(90)
1.240E+24	1.697E+25	2.319E+25	3.240E+25	4.590E+25		R1+delta R=E/(F*6.24e12*exp(90)/exp(60))
8.565E+18	1.284E+24	2.979E+24	6.345E+24	1.232E+25		delta R
2.61E-04	1.36E-01	2.38E-01	4.18E-01	7.38E-01		Integration of energy produced by stars

Delta R (call it R3) for the final column is 1.23e 25 meters. R1 was 3.36e25 meters and R1+R3=4.59e25 meters. The last four increments in the calculation above are enough to flatten the expansion curve and produce the measured Hubble constant of 2.26e-18/sec.

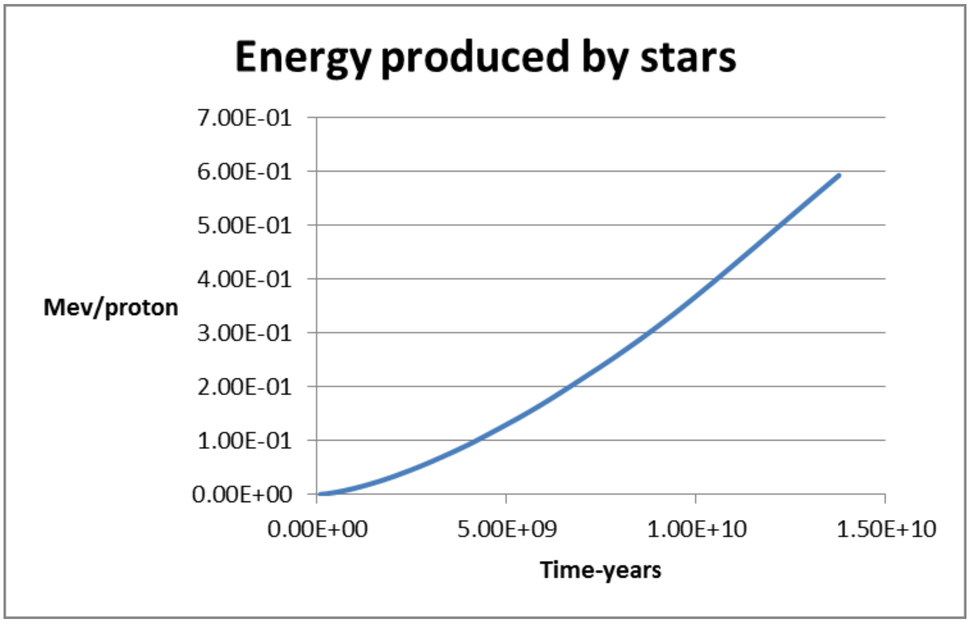


Note that the temperature increase is in the low single digits throughout the calculation.

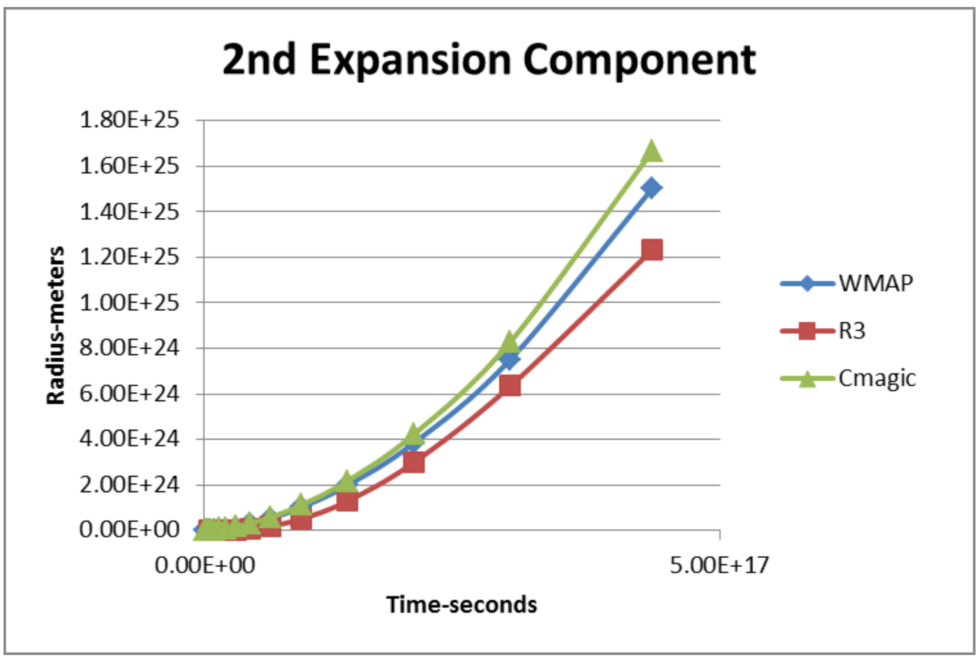
The calculation table above indicated that the force required to move particles apart is very low (on the order of 5e-61 Newtons). The energy/particle required to expand the universe by 1.2e25 meters is shown above in the row entitled “Energy difference between two temperatures”. It is approximately 3e-10 MeV/particle). This is ample evidence that dark energy should not be considered a large fraction (0.719) of all the mass in the universe.



To be accurate the above procedure must cross check against the total energy production. Abundance calculations cited above give 0.6 MeV/proton. Stars that form early have been burning a long time but there are not as many of these. Stars that form later haven't burned as long but the total energy for all the stars can be calculated. Here is the total MeV/proton produced as a function of time for the star formation curve above. The graph below is a column by column integration with energy from the previous step reduced by the expansion ratio. Details are in the last row of the table above. The values plotted are per proton. As required, it produces 0.6 MeV/proton. Most of this energy is used to raise the internal energy of stars but the Stephan Boltzmann approach using the star surface temperature takes this into account.



R3 is compared with Cmagic and WMAP second expansion components below. The source of R3 is the row labelled "delta R" in the table above. The WMAP and Cmagic results are simulations using the procedures described in references 2 and 5.



As indicated above R1 during this period of expansion is the equation R=R0*time^(2/3) but a more detailed expansion curve is presented in the section below entitled "Constructing the complete expansion curve". R3 is added to R1 expansion to reveal the total expansion. It compares favorably to WMAP [2] and Cmagic [5] and shows that the latter stage of expansion is flattened by energy from stars.

Revised critical density

The standard method of simulating expansion involves the equation:

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=(r/rf-1) where radius is the developing radius and rf is the final radius.

H0^2=8/3 pi G rhoC					
G		6.67480E-11			
Ho		2.26E-18			
rhoC	8/3 pi G/Ho^2	9.1237E-27	2.26E-18^2/(8/3*PI()*6.674e-11		

Energy from stars causes late stage expansion but the standard equation becomes very misleading because rhoC assumes that all expansion is density driven. Stars are powered by fusion and this energy is not part of the initial kinetic energy assumed by the critical density concept presented in the literature (density is a proxy for kinetic energy in the literature). We find that expansion is only partially density driven and we must separate the causes of expansion and treat them differently. Call H1 the Hubble constant for the R1 part that is density driven. H1^2 will be equal to 8/3 pi G rhonew for R1 (call the new critical density rhonew).

Rhonew can be calculated by removing the dark energy fraction from the old critical density (call it rhoold) because dark energy was previously thought to cause the flattened expansion curve. WMAP parameters are reviewed below:

WMAP [7]			
NOW			
published			
4.59E+25	Inferred Radius		
2.26E-18	H0 (1/sec)		
8809	Temperature at equality (K)		
	Photon mass density		
	Proton mass density		
2973	Temperature at decoupling (K)		
0.0106	Spot angle (radians)		
0.254	baryon number density n/m^3		
5.77E+08	Photon number density n/m^3		
4.400E-10	baryons/photon		
0.235	Dark matter fraction		
6.57E-27	dark matter density in kg/m^3		
4.2377E-28	baryon matter density in kg/m^3		
0.719	Dark energy fraction		
9.1351E-27	critical density		
0.0464	Baryon fraction		

Removing 0.719, we have only 0.235+0.0464=0.2814 for the mass fraction. This fraction is density driven and allows us to calculate rhonew, i.e.

0.281/rhonew=Omegaold/rhoold=1/rhoold
rhonew=0.281*rhoold=0.281*9.13e-27 kg/m^3
rhonew=2.57e-27 kg/m^3

Note the useful ratio:
rhonew/rhoold=0.281

Another way of calculating rhonew is:
rhonew=(rhoold-rhoold*0.719)
rhonew=rhoold*(1-0.719)=rhoold*(0.281)
rhonew=9.135e-27*0.281=2.57e-27 kg/m^3

Next, we can use the equation H1^2=8/3 pi G rhonew, to calculate H1, the Hubble constant for the density driven component of expansion (R1). The calculation follows:

rhonew (kg/m^3)	2.57E-27
(8/3 pi G rhonew)^.5 (1/sec)	1.198E-18

The equation for the first component of expansion should be replaced by the following equation:

R1=r0*t^(2/3) after the radiation dominated period ends at equality of mass and radiation.
Before that period the radius varies as time^(1/2).

R1=r0*t^(2/3) is the Friedmann [4] equation and can be derived from H^2=H0^2(fraction*(1-z)^3).

Hubble constant for the first component of expansion (H1=1.2e-18/sec) occurs for Radius=3.36e25 meters.

WMAP comparison

WMAP (year 9 results) [12] are important to cosmology. They support the existence of dark energy and are widely quoted for the discovery that most of the expected matter in the universe is missing. The updated year 9 parameters are shown in table below entitled WMAP published. The entry entitled Dark energy fraction is incorrect based on the work in this document (because the 0.719 fraction is not density driven). However, there are other parameters that require revision.

The current photon number density is well established by the Temperature 2.73 K. Photon mass number is given by the following equation [Wiki] with units kg/m^3.

Photon number density=8*pi/(H*C)^3*(1.5*B*T)^3   number/m^3
B is the Boltzmann constant 8.62e-11 MeV/K.

The baryon number fraction can be calculated with the following relationships:

5.8e8 photon number*4.4e-10 baryons/photon=0.254 baryon number density

This leads directly to the Baryon fraction:

0.254*1.67e-27/9.14e-27=0.046 baryon fraction

Summarizing:

5.77E+08	Photon number density n/m^3		
4.40E-10	baryons/photon		
0.254	baryon number density n/m^3		
4.2377E-28	baryon mass density kg/m^3		
2.58E-27	rhonew		
0.165	Baryon fraction		

Some have called the value 0.0464 the "missing matter (Baryon)" problem.

Note: WMAP derived the ratio 0.0464/0.254 from the ratio of two peaks in the Fourier analysis of cosmic background radiation [3]. This is consistent with the inferred ratio 4.4e-10 baryons/photons and similar to a value required to fit data with primordial nucleosynthesis calculations dating back to A. Sakharov and D.N. Schramm. This work is reviewed in reference 4, 8 and 12.

Recalculating parameters with a new critical density

The summary table above now gives the new Baryon fraction, 0.165 (about 1/6).

5.77E+08	Photon number density n/m^3
4.400E-10	baryons/photon
0.254	baryon number density n/m^3
4.2377E-28	baryon mass density kg/m^3
9.14E-27	rhoold
0.0464	Baryon fraction

We can now compare the R1+R3 model with WMAP. The dark matter fraction is 0.834 and the baryon fraction is 0.165. Some details of the WMAP parameters are compared below with the revised parameters presented in the rightmost column.

WMAP [7]		WMAP	R1+R3	R1+R3
NOW		Simulation		NOW
published				
4.59E+25	Inferred Radius	3.46E+21	3.62E+21	4.59E+25
			R1 only	3.36E+25
2.26E-18	H0 (1/sec)		H1 R1 only	1.20E-18
8809	Temperature at equality (K)			
	Photon mass density			
	Proton mass density			
2973	Temperature at decoupling (K)	3683.0	3529	
0.0106	Spot angle (radians)	0.0109	0.0110	
0.254	baryon number density n/m^3			0.254
5.77E+08	Photon number density n/m^3			5.77E+08
4.400E-10	baryons/photon			4.40E-10
0.235	Dark matter fraction			0.834
6.57E-27	dark matter density in kg/m^3			2.15E-27
4.238E-28	baryon matter density in kg/m^3			4.24E-28
7.190E-01	Dark energy fraction			0
9.135E-27	critical density	0.282		2.575E-27
0.0464	Baryon fraction			0.165
4.05E+77	Overall volume (m^3)	1.73E+65	1.98E+65	4.05E+77
2.814E-01	overall mass density		Vol R1(m^3)	1.59E+77

Number of proton like masses in the universe

We can now calculate the number of proton like masses in the universe. The critical density 2.57e-27 kg/m^3 is baryons plus dark matter. The table calculates the number of proton masses there are in the universe.

2.5755E-27	new critical density kg/m^3	
1.67E-27	mass of proton kg/m^3	
1.54E+00	rhonew/proton mass	
4.05E+77	volume for R=4.59e25	
2.45E+77	number of proton like masses	
1.49E+78	exp(180)	
0.164	proton fraction of exp(180)	

The new critical density is baryons plus dark matter. We divide by the proton mass and multiply by the total volume to determine the number of proton like masses. This number is compared to exp(180) and we find out that baryons are 0.165*exp(180). 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][2].

Limits on baryon/photon ratio established by residual deuterium, He3 and Li7

Photons in the first 731 seconds easily photo-disintegrate delicate deuterium atoms until the equilibrium reaction favors capture of deuterium into Helium4. Approximately 23% of all atoms are Helium4 originating from this period. Equilibrium is described by the SAHA equation, as follows [4][8]:

```
SAHA=LN(4/3*((1*0.8)/((1.94E+65)/(0.044*EXP(180))))^(3/2))+LN((0.044*0.738^2)*(T/1e10)^(3/2))-(2.58/(T/1e10))
```

This equation is dependent of the baryon fraction (0.046 above) and temperature T. Equilibrium occurs at 8e8 K. At this point the exp(SAHA)=1, where 1 represents the ratio (np nn/(nd*N))=1. Since np (number of protons), nn (number of neutrons) and N (number of total nucleons) are known, nd (number of nucleons in deuterium) is established. Nd becomes N-nn-np. nd/(4N)=0.23, the helium fraction.

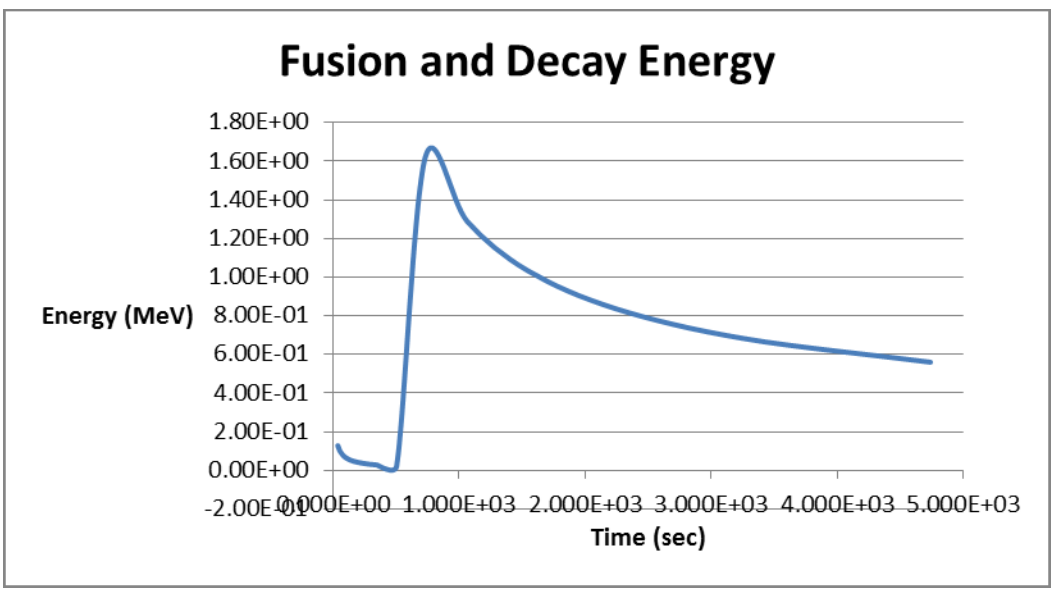
However, residual fractions of H2, H3 and Li must match measured values since these elements are uniformly found throughout space and must have originated in the big bang. Work by N.D Schramm and summarized below [13] establish limits on the baryon/photon ratio.

http://cds.cern.ch/record/262880/files/9405010.pdf

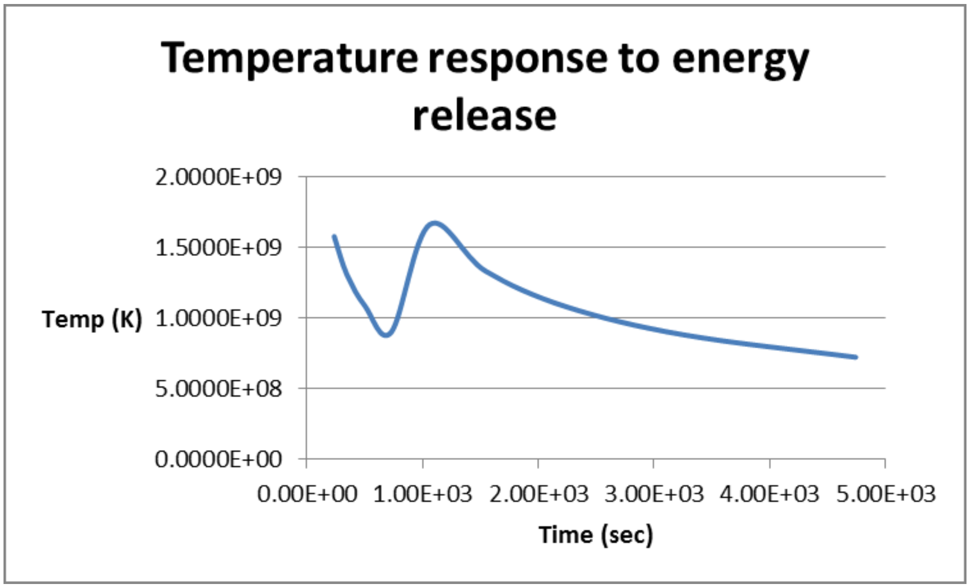
nb=eta ngam=6.6e-8/cm^3
rhob=nbmp=1.11e-31 g/cm^3
rhoc=3H0/(8piG)=1.88e-29 h^2 g/cm^3
omega=rhob/rhoc=.0059 h^-2

eta=bary/phot	1.10E-10			
ngam (1/m^3)	5.77E+08		(8*PI()/(4.14E-21*3e8)^3*(1.5*8.62e-11*2.725)^3)	
nb (1/m^3)	6.34E-02		eta*ngam	
rhob (kg/m^3)	1.06E-28		nb*1.67e-27	
rhoch^2	1.88E-27		ref paper	9.13E-27
h(9 yr wmap)	0.697		2.26e-18/sec	
rhoc (kg/m^3)	9.14316E-27		(2.261E-18)^2/(8/3*PI()*6.67e-11)	
rhoC R1 only	2.57548E-27	0.2817	ratio	
Omegab	0.0116			
Omega R1 b	0.04113		.0116/.2817	

Note that the reference Omegab=0.0116 is restated for known h=.697 [12] and the ratio of rhonew/rhoold=.281. The revised value labelled Omega R1 b=0.041 is slightly different that the WMAP result 0.046. The limits above apply to the time that He4 was formed. Slightly after that time, there was approximately 1.6 MeV of energy released from He4 fusion (based on its measured abundance fraction of 23%). The following graph shows the decrease in energy (starting at 10.11 MeV at near zero time) followed by the release of fusion energy. The graph includes the release of energy due to neutron decay.



Only baryons release energy into the total larger mass (because dark matter does not fuse). The effect on temperature of the dark plus light matter is dampened by the factor 0.165=1/6. A graph of the temperature during this period is shown below.

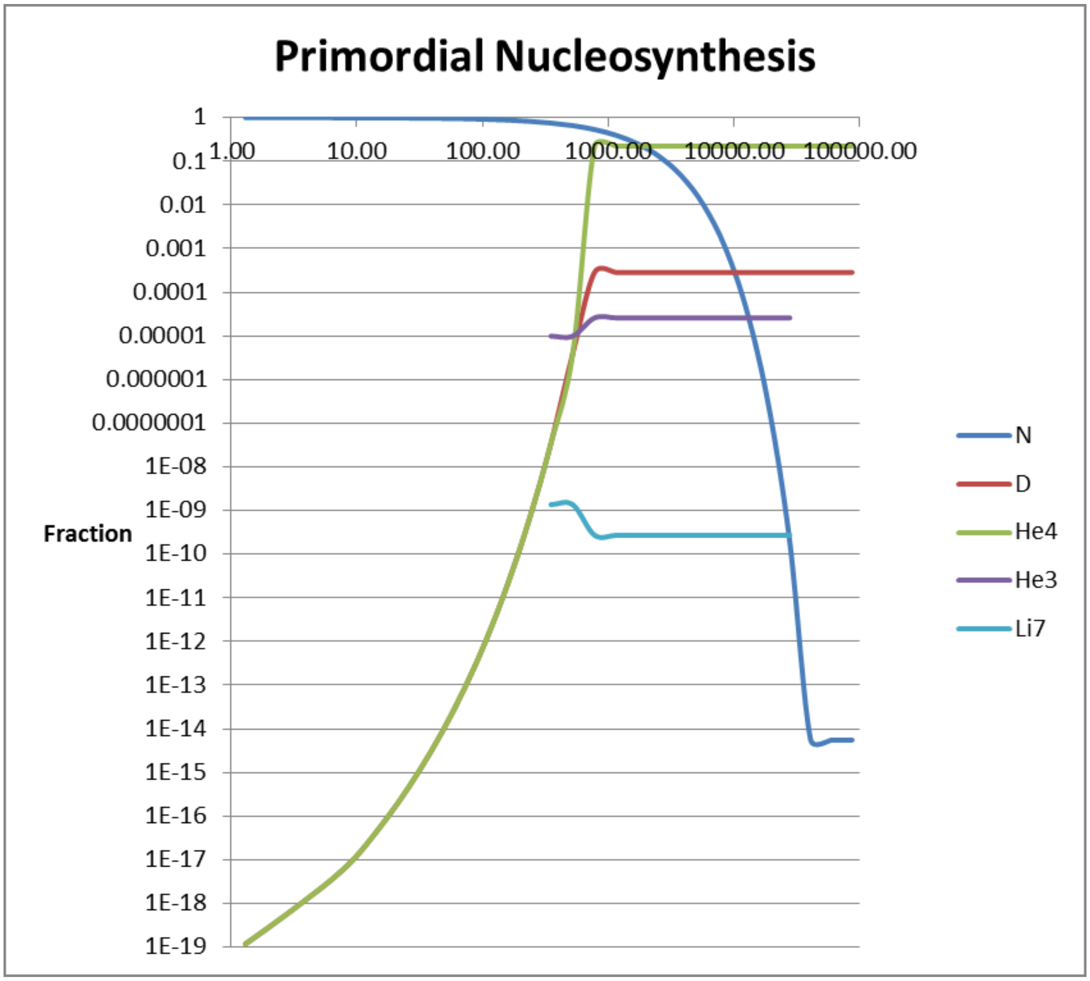


According to the SAHA equation, equilibrium occurs at 8e8 K. In the author's analysis this occurs at 731 seconds after the beginning. Over the next few seconds, the temperature increases to 1.5e9K, releasing photons and changing the important photon/baryon ratio. At equilibrium if the baryon fraction is 0.04 the baryon/photon ratio is 2.1e-10, higher than the required literature value. However, we now know that the baryon fraction is 0.165. The higher temperature and higher baryon ratio together give the required baryon/photon ratio in the range of 1.1e-10.

R (meters)	T (K)	baryons/photons before fusion		
9.73E+16	1.2875E+09	2.5362E-10	SAHA=(0.04*EXP(180)/(4/3*PI()*9.73e16^3))/(8*PI()/(4.31e-21*3e8)^3*(1.5*8.62e-11*1.28e9)^3)	
1.45E+17	1.7167E+09		1.3293E-10	SAHA=(0.165*EXP(180)/(4/3*PI()*1.45e17^3))/(8*PI()/(4.13e-21*3e8)^3*(1.5*8.62e-11*1.72e9)^3)
			baryons/photon after fusion	

Temperature (K)				1.1E+09	8.6E+08	7.1E+08	5.8E+08	4.7E+08
baryon/photon	2.5362E-10	2.5362E-10	2.5362E-10	1.05E-09	1.33E-10	1.33E-10	1.33E-10	1.33E-10
Time (seconds)				523	781	1165	1738	2593
D	4.6e-4*n10^-1.67		9.72E-05	9.12E-06	2.86E-04	2.86E-04	2.86E-04	2.86E-04
He3	3e-5*n10^-.5		1.88E-05	9.28E-06	2.60E-05	2.60E-05	2.60E-05	2.60E-05
Li7	5.2e-10*n^-2.43+6.3e-12*n10		1.15E-10	1.89E-09	2.73E-10	2.73E-10	2.73E-10	2.73E-10
http://cds.cern.ch/record/262880/files/9405010.pdf				equilibrium				

The resulting graph of Helium and Deuterium (D) fractions (the vertical axis) as a function of time in seconds (the horizontal axis) follows:



Neutrons decay and are shown in blue. Deuterium, shown in red, is photo-disintegrated early but increases to combine into He4 when the SAHA equation shows that reaction equilibrium has been reached. This occurs at exp(SAHA)=1.0 where the He4 abundance becomes 0.24. Fusion temporarily decreases the SAHA value but it recovers and establishes the D fraction measured throughout the universe. The residual He3 and Li7 calculations also agree with measured values at the higher baryon fraction 0.165.

Measurement	
2.10E-04	D
3.3e-5 to 1e-4	He3
1.58E-10	Li7

Constructing the complete expansion curve

The expansion curve has several stages summarized below:

Stage 1: Duplication increases the radius from 7.22e-14 meters to 8.24e12 meters

The author uses a model [1][2][Appendix 1 below] that starts with an initial radius of 7.22e-14m based on quantum gravity fundamentals. At time zero duplication by exp(180) occurs. In a three dimensional universe exp(180/3) is the radius multiplier. The radius at the end of the duplication process is 7.22e-14 *exp(60)=8.24e12 meters [10].

Stage 2: Rapid Expansion increases the radius from 8.24e12 to 1.6e16 meters

The proton model yields the initial kinetic energy of 10.11 MeV which corresponds to 7.82e10 K. However, conventional nucleosynthesis literature [7] begins at time near zero with about 1e16 (depending on literature source) meters and 5e10 K. To construct the expansion curve starting with quantum gravity fundamentals [13] we must understand how the universe expands from 8.24e12 meters to 1e16 meters. It is known that this period is radiation dominated. Radiation transfers momentum to matter and expands the universe rapidly. Temperature and energy fall as time^0.5. Potential energy increase is equal to kinetic energy decrease. Knowing the energy change and the force, the radius change is calculated from dr=dE/F. This uses the fact that potential energy must increase by integral Fdr during this 14 seconds. The force on matter is induced by photon impact and momentum transfer. The equations that apply are summarized below:

Conservation of momentum	
m(fract)C=Mv	
m is photon mass	
M is proton mass	
fract=protons/photons	
m fract C=M*v	
v=(m fract C)/M	
M =1.67e-27*decay n	
Force=M v^2/R	
dE=energy change	
dr=dE/Force	

Calculations are shown below (several columns were hidden to fit this document).

Time (sec)			0.053	0.079	0.391	0.583	0.870	2.888	9.588	14.303
Temperature (K)			7.82E+10	6.40E+10	2.88E+10	2.36E+10	1.93E+10	1.06E+10	5.81E+09	4.75E+09
Energy associated with Temperature			10.11	8.28	3.72	3.05	2.49	1.37	0.75	0.61
dE=Energy change for radius increment				1.83	0.82	0.67	0.55	0.30	0.17	0.14
phndens=8*PI()/(4.14e-21*3e8)^3*(1.5*8.62e-11*T)^3				7.48E+39	6.78E+38	3.72E+38	2.04E+38	3.38E+37	5.58E+36	3.06E+36
(4/3*PI()*(R1/EXP(60))^3)				1.74E-39	3.23E-36	2.12E-35	1.39E-34	3.93E-32	1.11E-29	7.30E-29
photon mass=phndens*vol*8.62e-11*1.5*T*1.78e-30				1.92E-28	1.45E-26	4.28E-26	1.26E-25	3.24E-24	8.30E-23	2.45E-22
fract=number baryons/number phc	1.26E-27	2.20E+01	1.69E+00	1.00E-02	2.79E-03	7.74E-04	1.66E-05	3.54E-07	9.83E-08	
delta time (seconds)			1	2.60E-02	1.29E-01	1.92E-01	2.87E-01	9.52E-01	3.16E+00	4.72E+00
v=(np*photon mass*3e8)/(np M)			1	5.82E+07	2.62E+07	2.14E+07	1.75E+07	9.62E+06	5.28E+06	4.32E+06
Force=Mv^2/(R*exp(90)) (newtons)			1	6.22E-38	1.02E-39	3.66E-40	1.31E-40	6.01E-42	2.76E-43	9.87E-44
R=r+dE/(F*6.24e12*exp(90)/exp(6	1.608E+16	8.25E+12	8.687E+12	2.939E+13	5.704E+13	1.203E+14	1.352E+15	1.608E+16	3.677E+16	

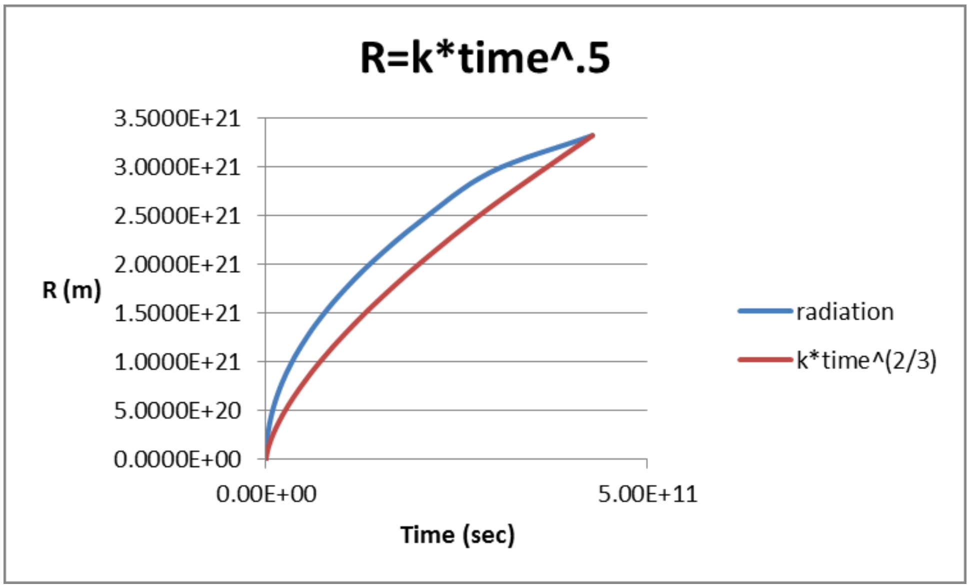
At 14 seconds, this period of rapid expansion ends and expansion follows the more conventional radiation dominated relationship R=3.7e16*(time/14.3)^0.5.

Stage 2: Expansion from 1.6e16 meters to 1.19e17 meters

He4 fusion and release of 1.6 MeV at 1.19e17 meters detailed in the section entitled “Limits on baryon/photon ratio”.

Stage 3: Radiation driven expansion from 1.19e17 meters to 3.6e21 meters where equality of radiation and matter occurs.

A comparison of Stage 3 and 4 are shown below: Expansion follows the relationship r=constant*time^(1/2) during the stage 3 but r=constant*time^(2/3) during stage4.



Stage 5: Conventional constant*time^(2/3) expansion increases the radius from 3.6e21 meters to 1.24e24 meters where star energy becomes important. R1 continues to the present time with R1=constant*time^(2/3).

Stage 6: Energy from stars increases the radius beginning at 1.24e24 meters and continuing to the current radius at 4.59e25 meters.

WMAP year 9 gives a Hubble constant of 2.6e-18/sec. The integration to 4.59e25 meters stops at this point because it yields the measured 2.6e-18/sec. The universe would expand only to 3.36e25 meters without radiation from the stars. The base R1 contribution is density driven and would produce a Hubble constant of 1.2e-18/sec associated with rhonew. Expansion during this Stage was detailed above under the heading “The effect of star energy on expansion”.

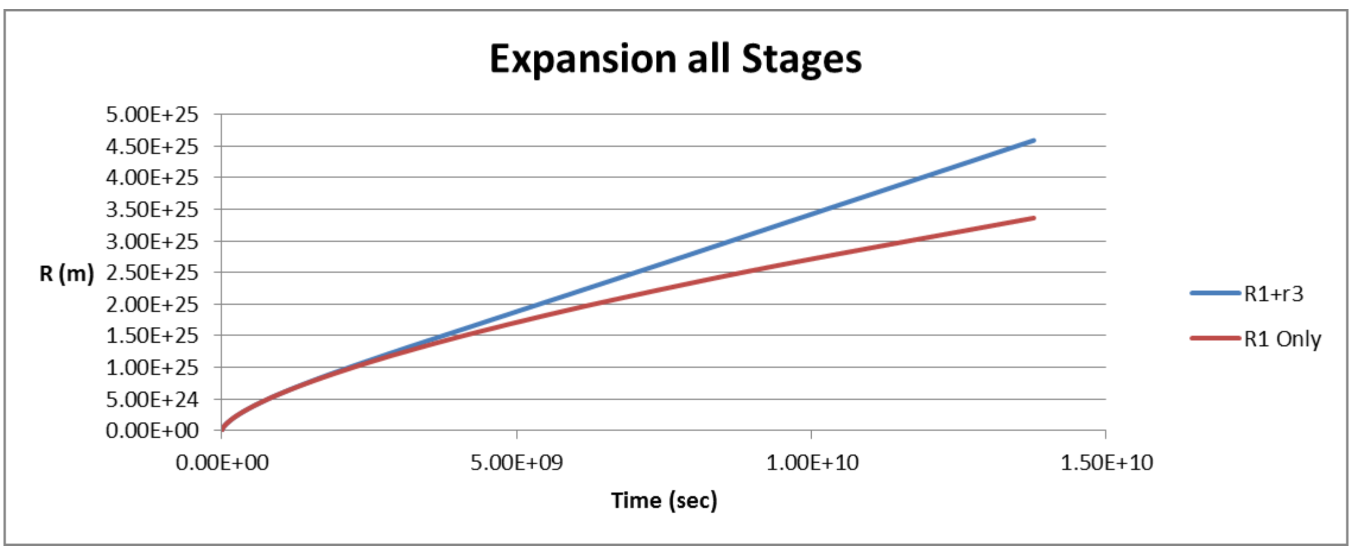
Expansion energy summary for Stages 1 through 6

A summary of the energy releases is shown below:

	Release R	Release R	Release R	Expanded Energy	
	Stage 1	stage 3	Stage 4	Now	Temperature (K)
meters	8.25E+12	1.19E+17	1.20E+24	4.59E+25	
			to 4.6e25		
MeV/proton	10.11	0.0007	reduced	1.82E-12	reduced
MeV/proton		1.6000			
MeV/proton		0.1379		3.57E-10	reduced
MeV/proton				3.55E-10	2.73
MeV/proton			0.60	6.20E-10	4.79

The original 10.11 MeV/proton has been reduced by expansion (kinetic energy being converted to potential energy) to 0.0007 MeV/proton at 1.2e17 meters. The SAHA equation predicts equilibrium at 8e8 K [8] and 1.2e17 meters. At this point deuterium combines into He4. The energy released is 0.23*7.07=1.6 MeV, where 7.07 is the binding energy for He4 but it is diluted to E*(1/6) by dark matter. As mentioned above this is most of the energy we see in the current CBR. The new energy is reduced by expansion to 3.55e-10 MEV where it is measured by WMAP as the current temperature 2.73 K. Stars produce 0.6 MeV late in expansion but most of this energy is stored in the star's temperature. The radiation release is calculated by using the Stephan Boltzmann equation and a surface temperature of 5780K. Overall the 0.6 MeV is responsible for late state expansion the author labels R3 but this only increases the average "sky temperature" to about 4.7K, only slightly higher than the dark sky measurement 2.73K.

Overall there at 6 stages to expansion blended together into the curve shown below. Of interest here is stage 6 (star energy) that flattens the expansion curve and replaces the concept of "dark energy" with a physical process.



Detailed equality to decoupling simulation

WMAP [3][7] 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 (CBR) as the plasma clears at decoupling. Results for the WMAP expansion simulation are shown with a light background. Below the WMAP block, the author's R1+R3 results are shown (yellow background). Although the expansion curves end at the same radius, there are small differences. The WMAP simulation is very close to the R1+R3 calculation through the period from equality to coupling because this is well before the R3 component of expansion becomes significant.

Equality and decoupling values are shown in red. The mass densities are based on total mass density = exp(180)*1.67e-27/volume for the WMAP and R1+R3 equality ratios.

		WMAP		1.37E-08	1.38E-04	2.24E+01	SAHA WMAP
2.35E-05	3.03E-05	9841.73	7635.71	1741.02	1350.57	1047.64	Expansion ratio
4.67E+04	3.62E+04	2.81E+04	2.18E+04	4.75E+03	3683	2.9E+03	T WMAP (K)
2.90E+21	1.35E+21	6.30E+20	2.94E+20	3.05E+18	1.42E+18	6.65E+17	Photon density n/m^3
3.37E-14	1.57E-14	7.35E-15	3.43E-15	3.56E-17	1.66E-17	7.77E-18	proton mass density
3.12E-14	1.13E-14	4.07E-15	1.47E-15	3.33E-18	1.21E-18	4.37E-19	photon mass density
9.25E-01	7.15E-01	5.54E-01	4.29E-01	9.35E-02	7.26E-02	5.63E-02	photon/proton density ratio
0.00E+00	0.00E+00	3.90E+19	9.60E+19	1.50E+21	2.32E+21	3.52E+21	Wave progression (m)
0.0000	0.0000	0.0014	0.0027	0.0091	0.0109	0.0128	Angle radians
4.43E+20	2.07E+20	9.67E+19	4.52E+19	4.69E+17	2.19E+17	1.02E+17	
2.81E+21	3.62E+21	4.66E+21	6.01E+21	2.76E+22	3.55E+22	4.58E+22	R1+R2 Radius (meters)
		R1+R3		5.46E-08	8.40E-04	2.34E+02	SAHA R1+R3
4.46E+04	3.46E+04	26870.66	2.08E+04	4.55E+03	3529	2.74E+03	T R1+R3 (K)
2.53E+21	1.18E+21	5.53E+20	2.58E+20	2.68E+18	1.25E+18	5.85E+17	Photon density n/m^3
2.68E-14	1.25E-14	5.86E-15	2.73E-15	2.84E-17	1.33E-17	6.19E-18	proton mass density
2.60E-14	**9.44E-15**	**3.42E-15**	**1.24E-15**	**2.81E-18**	**1.02E-18**	**3.68E-19**	photon mass density
9.70E-01	7.53E-01	5.84E-01	4.53E-01	9.88E-02	7.67E-02	5.95E-02	photon/proton density ratio
0.00E+00	2.66E+19		5.70E+19	1.65E+21	2.46E+21	3.66E+21	Wave progression
0.00	0.001	0.0000	0.0015	0.0095	0.0110	0.0127	Angle radians

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 3.61e21 meters for the R1+R3 model. From this point waves progress until the temperature reaches 3529 K. At this point the SAHA equation indicates that decoupling occurs. The R1+R3 radius is 3.55e22 meters at decoupling. The wave has enlarged to 2.46e21 meters and this value divided by 2*pi*3.5e22=0.011 radians. Both simulations satisfy the WMAP data requirement that the wave enlarges to 0.0106 radians between equality and de-coupling. This matches the observed peak CBR anisotropy.

Conclusions

There are several areas that need reconsideration if we can agree that energy produced by stars is the cause of late stage expansion. Calculations indicate that the later part of the expansion curve is flattened by this energy and agrees with simulated expansion curves reported in the literature. The concepts of "dark energy" and missing matter were a concern. The source for star energy caused expansion is fusion and on this basis we believe that "dark energy" has been identified. But this energy is not the kinetic energy of protons and as such critical density is lower than previously thought. It is 0.28*9.13e-27=2.57e-27 kg/m^3. The revised baryon concept of the universe is 0.165 of the total, not 0.046 as reported by WMAP.

Possible objections to revised cosmological parameters were addressed. New calculations were carried out regarding the abundance of He4, He3, Deuterium and Li7. The calculated values match the measurements if two changes in the calculations are made. One change is the increased temperature due to fusion of He4 and the second change is the revised baryon content 0.165.

The author found an energy value in a model of the proton that is pertinent to cosmology. The initial kinetic energy is 10.11 MeV. Combined with new concepts for quantum gravity a complete expansion curve was constructed. The expansion curve has several Stages and agrees with data available. Specifically, Hubble constant 2.26e-18/sec is satisfied by a final radius (including all components) of 4.59e25 meters. The expansion radius calculated from the revised critical density 2.57e-27 kg/m^3 is 3.36e25 meters. Late stage star energy caused expansion adds approximately 4.59e25-3.36e25=1.23e25 meters at the current time in expansion.

WMAP measurement of temperature "spot" size increase from equality to decoupling agrees with the expansion curve calculations.

The proton mass model proposed by the author starts with exp(180) particles of proton like mass. The model is strongly supported by the analysis presented.

References

1. Barbee, Gene. H., *A Top-Down Approach to Fundamental Interactions*, FQXi essay June 2012, viXra:1307.0082, Nov 2014

2. Barbee, Gene. H., *Unification*, viXra:1410.0028, Oct 2014.
3. Bennett, C.L. et al. *First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Data*, Astrophysical Journal, 2001
4. Peebles, P.J.E., *Principles of Physical Cosmology*, Princeton University Press, 1993.
5. A. Conley, et al, (*THE SUPERNOVA COSMOLOGY PROJECT), Measurement of Omega mass and Omega lambda from a blind analysis of Type1a supernovae with CMAGIC*.
6. Barbee, Gene H., *On the Source of the Gravitational Constant*, Prespacetime Journal, Volume 5 No 3, April, 2014. Originally viXra:1307.0085.
7. Hinshaw, G. et.al, Nine Year WMAP Observations, draft June 5,2013 http://arxiv.org/pdf/1212.5226v3.pdf Table 2.
8. Bergstom, L. and Goobar, A., *Cosmology and Particle Astrophysics*, 2nd Edition, Springer-Praxis Books in Astrophysics and Astronomy, 2004.
9. Barbee, Gene H., *The Effect of He4 Fusion on Primordial Deuterium*, viXra:1404.0465, May 2014.
10. Barbee, Gene H., *Application of Proton Mass model to Cosmology*, viXra:1307.0090, Jan 2015.
11. Barbee, Gene H., *Semi-Fundamental Abundance of the Elements*, viXra:1308.0009
12. http://cds.cern.ch/record/262880/files/940501.pdf Review of work by N. D. Schramm.
13. Barbee, Gene H., *Discovery of Quantum Gravity*, viXra:1508.0120, Aug 15 2015.

Appendix 1: Proton mass model

Reference 2 starts with an information based model based on exp(180) that anchor the following masses and kinetic energies for three quarks. Together they model the measured proton mass 938.272 MeV. It is simplified below but the value of interest here is the kinetic energy 10.11 MeV.

Simple neutron model					
r20 uc2					
	Mass and Kinetic Energy			Field energy	
	Mass	KE	Strong	Strong	Gravitation
	Quarks		Residual	field energ	Energy
	MeV	MeV	Field	MeV	MeV
Strong	130.16	799.25		-957.18	-2.73
Strong Residual KE		10.15			
Neutron		939.57	(-20.30)		-959.92
neutrino		0.05			
Gravitational ke		10.15			
Gravitational pe		10.15			
Total		959.92			

Simplified Proton mass Model

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

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

Appendix 2: Calculation of Gravitational Constant from the Proton Mass Model

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

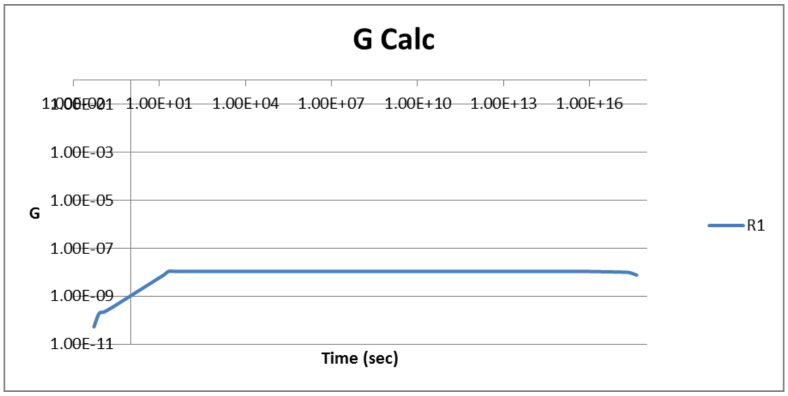
The following table follows a format that organizes input values, intermediate results and the final result in a column of calculations. The goal is to use the fundamental radius 7.224e-14 meters to calculate the gravitational inertial force. The inputs listed at the top of the table originate in the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

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

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

The Geodesic during expansion

We deal with the variables (r, v and m) to calculate expansion forces. In fact, if we calculate Force with the equation F=mV^2/r/exp(90), with V determined by the expansion kinetic energy and r=R/exp(60) we can calculate the gravitational constant with the equation G=Fr^2/m^2. The value is the gravitational constant G at the beginning 6.67e-11 Nt m^2/kg^2. In fact, if r=r0*t^(2/3) T=r/rfinal*2.73 K, G is maintained exactly at the value 6.67e-11 throughout expansion. It is different than G but constant through the remaining expansion stages since radiation driven expansion increases the radius.



Why is light matter 1/6 of the total?

Based on the author's work, one would expect the mass of the universe to be the mass of a proton*exp(180) but this assumes that all the mass is light matter. Dark matter is known to exist. It flattens the shape of the velocity curve in the outer portion of galaxies and causes bending of light around massive objects. It was shown that light matter is 1/6 of the total and 5/6 is cold dark matter.

Here is an excerpt from Reference 2:

Figure 0:1 Information Operations

> *The numbers are natural logarithms, abbreviated* ***ln***. *Addition of natural logarithms means that Probability=1/exp(N)are multiplied". Conserving the value 90 means that the probability of the components multiplied together is 1/exp(90).*

1) Start with the number 180. Appendix 1 topic 8.7 reduces data from WMAP [11] and shows that exp(180) is the number of particles in the universe (the whole). Use N=90 to define two opposite types of energy; mass energy and field energy. Represent positive mass by the number Nmass= 90. Balance to zero by representing fields with the value Nfields=-90.
2) Operation 1: Separate N=90 into four N value=90/4=22.5. Operation 2 and 3: Further divide 3 values of 22.5 into 10.167 and 10.333. The fourth 22.5 divides into 11.5 and 10 but the 11.5 becomes 5.167+3.167+3.167 in operation 4 and is added back to form the values 15.33, 13.33 and 13.33. Operation 5: Divide the number 1 into 6 segments of ln(3/e)= ln(3)-1=0.0986 each and a remainder 0.075.
3) Add 0.0986 to each creating the right-most column of numbers called Fundamental N values.
4) The 10.333 at the bottom of the table will become an electron.

The total N for each column is conserved to the value 90.

The N values above represent energy through the relationship E=2.02e-5*exp(N). For example, the Higgs particle is approximately 2.02e-5*exp(22.5).

A goal might be to understand why nature separates the total exp(180) into 5/6*exp(180) representing dark matte and 1/6*exp(180) protons. Nature seems use the concept of dividing segments into 6 parts several times and this could be a clue.