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Dark Energy

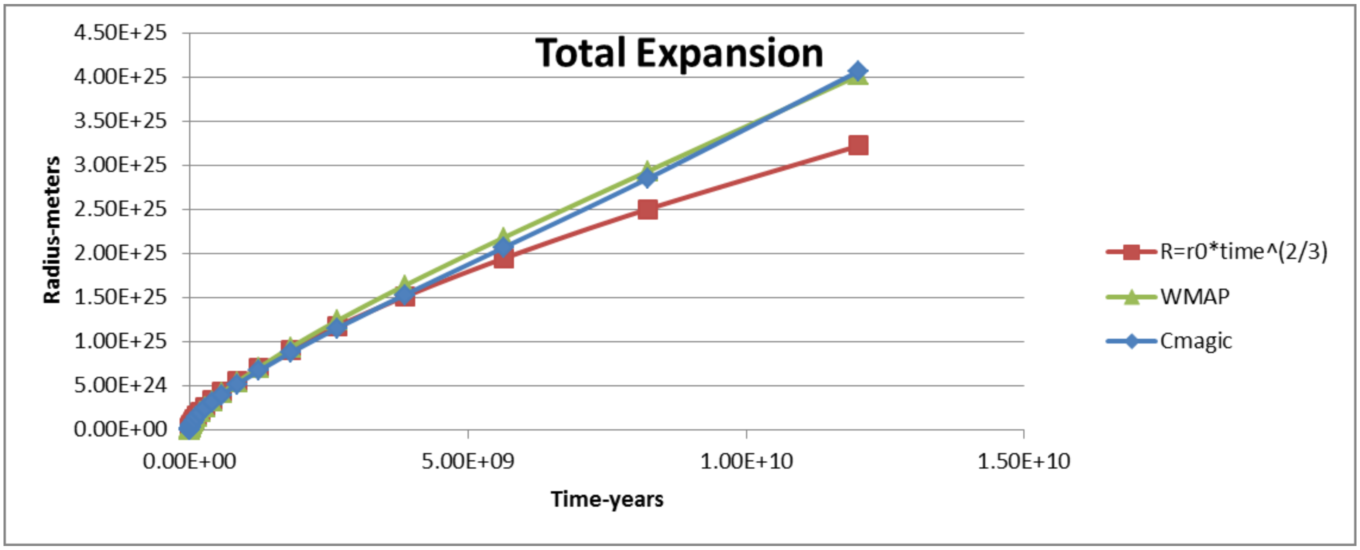
Abstract

Observations of the universe's expansion have created discussion regarding dark energy. There is consensus that late stage expansion currently is more linear than the equation R=r*t^(2/3). Since this equation represents conversion of kinetic energy to potential energy and is a curve, Hubble data showing that late stage expansion is almost linear appears to violate energy conservation and require a dark (unknown) energy source. Two proposals (cosmological constant and quintessence) attempt to account for this unknown energy source. The author feels these proposals are non-physical.

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 output. Energy produced by stars is fusion energy and provides a physical alternate to dark energy. Current cosmology is based on mass with kinetic energy but includes a large fraction (0.719) of dark energy. Analysis shows that although the critical density is correct, the mass fraction should be near 1.0. Current literature does not take into account the spike in temperature following primordial fusion of He4. When this is included Deuterium abundance calculations agree with measurements and changes the allowed baryon/photon ratio. Revised cosmological parameters are presented which show that the total number of particles in the universe equals the natural number e to power 180, i.e. exp(180). A full expansion curve is also presented.

Background

Expansion and cosmology parameters are currently based on differential 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 and radiation density, expansion follows R=r*t^(2/3). After equality waves grow and are observed at decoupling (temperature at which the electron can orbit the proton) 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 accepted equation R=r*t^(2/3) gives the wrong Hubble constant (slope of the expansion curve/divided by the radius) and a second expansion component must be added. The question is what is causing the second component. The measured value from WMAP year 9 is 2.26e-18/sec [12]. The graph below shows the problem. Data suggests the upper curve but this requires an unknown energy source. The concept "dark energy" is a placeholder and the author explored the possibility that energy produced by stars is the unknown energy source.



Exploration

The dark sky temperature is 2.725K. However, recall that the WMAP and other radiometer projects blocked out light from stars since these photons originate from surfaces that are about 5780 K. Energy produced by stars is of interest because it may produce enough late stage expansion 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. 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 also mainly hydrogen but the abundance of Helium4 is uniformly 23%. It is widely accepted to be a result of primordial nucleosynthesis that occurred (in my analysis) about 200 seconds after the beginning. Deuterium, He3 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 multiplied by their binding energy give us the total energy produced by stars. 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

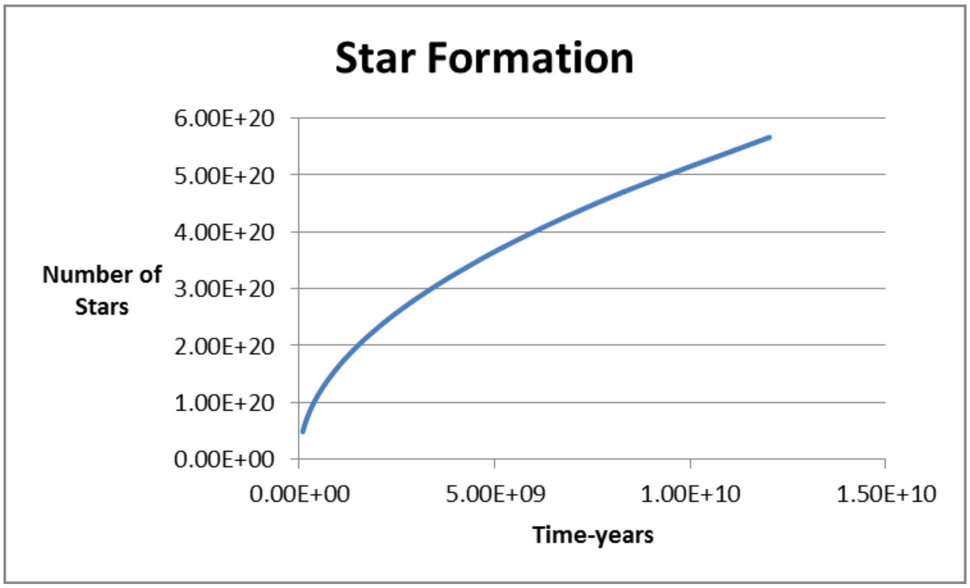
Primordial Helium4 fusion released 1.63 MeV/proton but the stars have produced an additional 0.6 MeV/proton (subtract 1.63 from the total 2.23 MeV above). This 1.63 MeV/proton has been reduced to about 3e-10 MeV/proton by expansion (energy later=energy release/expansion ratio because kinetic energy is being converted to potential energy). Primordial fusion makes up most of the Cosmic Background Radiation (CBR). The other 0.6 MeV/proton was released after stars formed and is less reduced now because the expansion ratio was only about 20. About 73% (0.436 MeV/proton) of the 0.6 total is first stage H2→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→C→O→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 expansion energy available after stars form. We will base our estimate on stars that are similar to our sun. The first step is to determine the number of stars that have contributed to the 0.6 MeV/proton total as a function of time. There are 0.165*exp(180) protons (see section entitled "Recalculating parameters with a new critical density" below) each releasing 0.6 MeV. This large amount of energy is more than the total energy of the dark sky at 2.73K and cannot be ignored.

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 involved. We will use an approach that gives the force on each proton. The energy will be an overall value reduced to a small representative 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. The value exp(180) comes from the section below entitled "Number of proton like masses in the universe". Consider the surface area of many small cells as a model of the surface of one large sphere with the same surface area. For laws of nature to be uniform throughout the universe there can be no preferred position. A surface offers this property but the equivalent surfaces of many small spheres also offer this property as long as we do not distinguish an edge. As such a surface model equivalent to the surface of many small cells is useful if the fundamentals of each cell are known.

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

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

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

At any time during expansion		
<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.

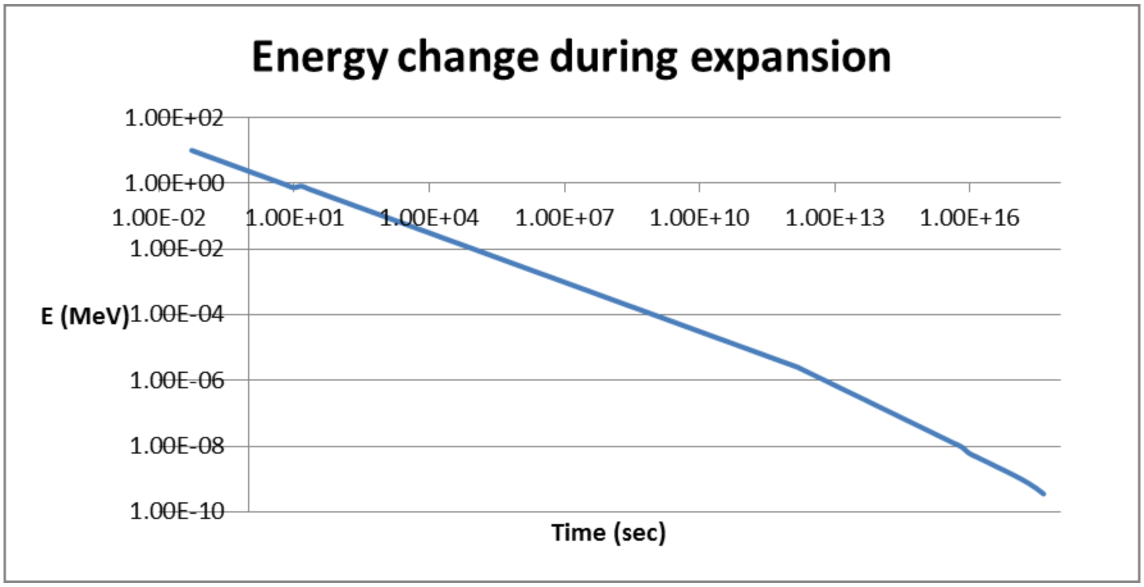
F=MV^2/R			
M=exp(180)*m		equal mass	
4 pi R^2= 4 pi r^2*exp(180)		equal area	
r=R/exp(90)			
V^2=v^2		Energy is energy	
Substitute relationship above in force equation			
F=MV^2/R=m*exp(180) V^2/(r*exp(90)			
F=mv^2/r*exp(90)			
F/exp(90)=mv^2/r			
where small m and r refer to a cell			
Force must be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

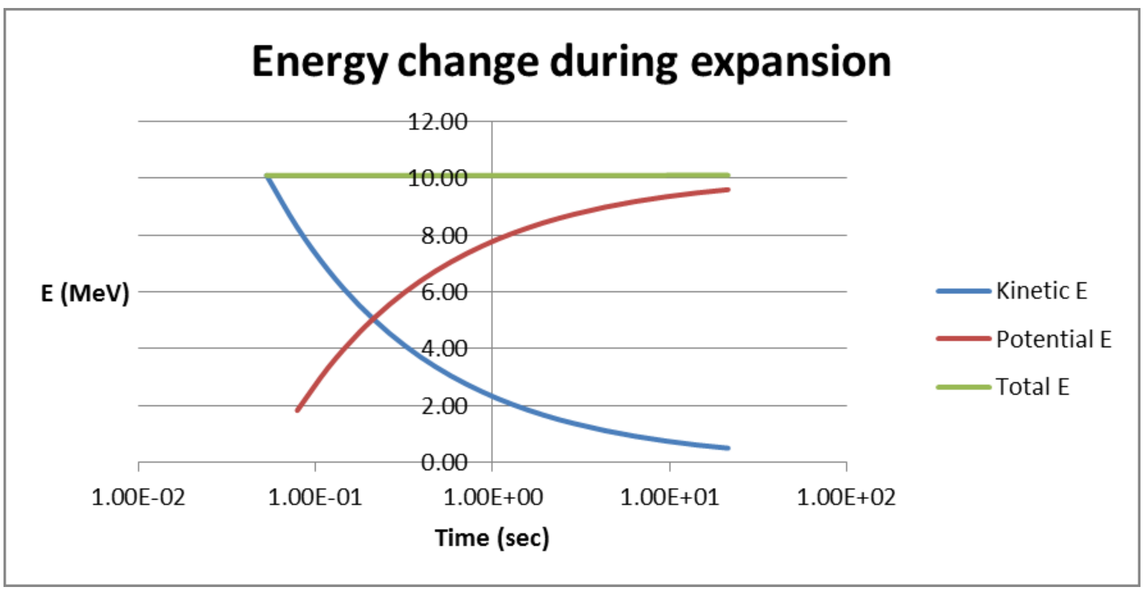
E=F dR/2.6e12			
where E is in MeV, R is meters and F is newtons			
2.6e12 nt-m/mev is a conversion constant			
M=exp(180)*m			
4/3 pi R^3= 4/3 pi r^3*exp(180)			equal mass
r=R/exp(60)			equal volume
Substitute relationship above in potential E equation			
E=(F/exp(90)*R/exp(60))/2.6e12			
E=(F*R/(2.6e12*exp(30))			

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/proton has been reduced to E=1.5*8.62e-11*2.73=2.53e-10 MeV/proton. Energy is available at the beginning and added in 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 some Neutron→Proton decay energy and 1.6 MeV/proton is added early in expansion. The temperature decreases to its present value 2.73 K as shown on the following chart. Lastly, energy is added by star formation after radius 1.2e24 meters (200 million years after the beginning).



The kinetic energy is converted into potential energy as expansion occurs with the total equaling 10.3 MeV/particle (not all particles are protons). 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 particle.



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 temperature if a particle of mass 1.67e-27 kg (938.27 MeV) is expanded against gravity.

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, E=1.5BT= 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 particle (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 times the change in volume (PdV) over the expansion history, once again you have 10.3 MeV/particle at the end of expansion but it has been converted to potential energy.

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.

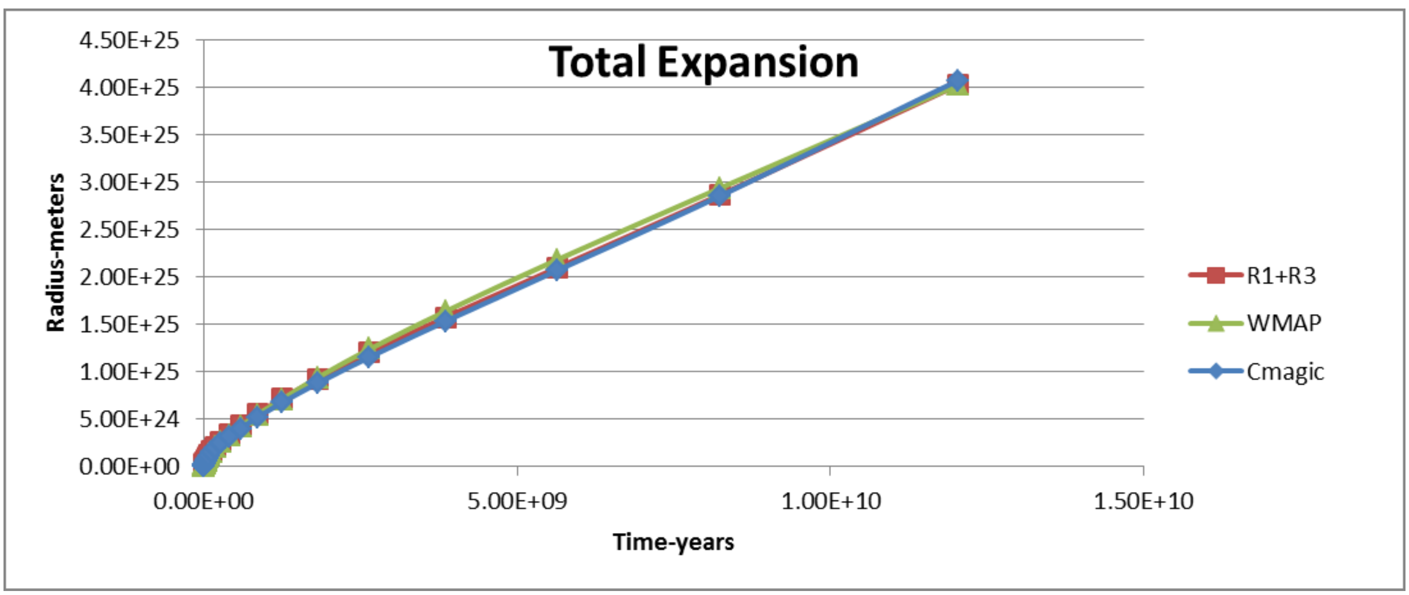
First check that the star temperature 5778K (Wiki) produces the correct energy. The calculation below where MeV/sec=3.54e5 MeV/m^2/K^4 verifies the output of the sun (Wiki).

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 energy/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=MeV/sec stars+MeV/sec sky) 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=mass*V^2/(R1+R3)/exp(90). (Mass is 0.156*1.67e-27 kg and R3 is the radius increase) The table below contains calculation details and the vertical line after column 1 indicates columns are hidden to fit this document.

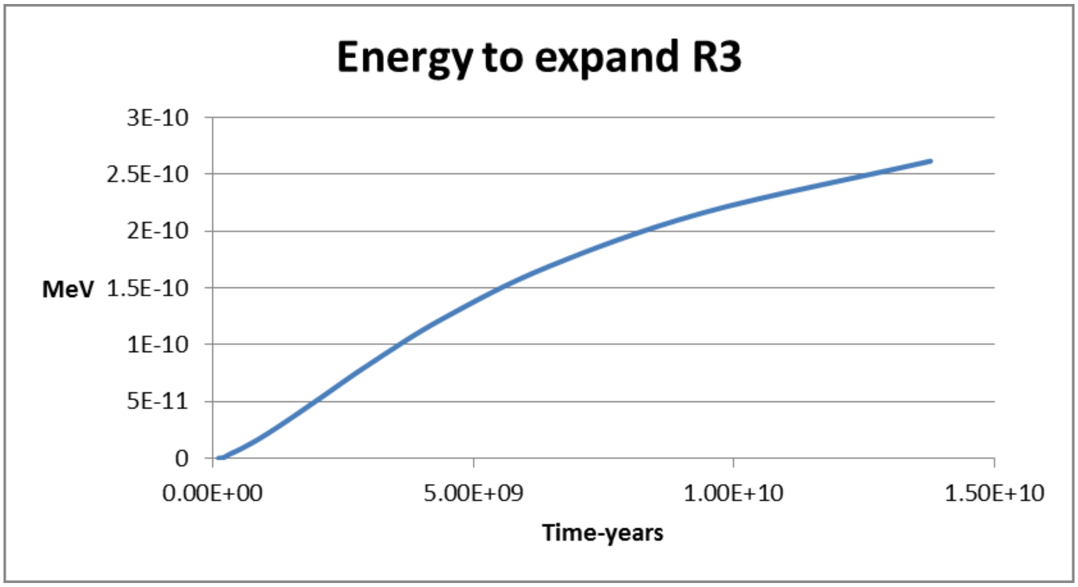
z=19							
1.86E+08	2.72E+08	3.97E+08	3.86E+09	5.64E+09	8.24E+09	1.20E+10	Time from beginning (years)
54.29	42.16	32.74	7.03	5.31	3.87	2.73	Temperature without stars
7.05E+19	8.52E+19	1.03E+20	3.21E+20	3.88E+20	4.69E+20	5.67E+20	number of stars
3.18E+59	3.62E+59	3.86E+59	8.25E+59	9.80E+59	1.17E+60	1.40E+60	mev/sec=S*area stars*5778^4
5.53E+49	9.17E+49	1.52E+50	3.53E+51	6.08E+51	1.08E+52	2.02E+52	area sky
1.70E+62	1.03E+62	6.18E+61	3.06E+60	1.70E+60	8.58E+59	3.96E+59	mev/sec=S*area sky*2.73^4
1.70E+62	1.03E+62	6.22E+61	3.88E+60	2.68E+60	2.03E+60	1.79E+60	mev/sec total=stars+sky
54.32	42.20	32.79	7.46	5.94	4.80	3.98	T=((mev/sec total)/S/area sky)^.25
3.2824E-12	4.7996E-12	6.5863E-12	5.5958E-11	8.2496E-11	1.2001E-10	1.6192E-10	Energy difference between two temps
1.0000	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**g=(M/(M+MeV))**
8.47E-06	**7.47E-06**	**6.58E-06**	**3.14E-06**	**2.80E-06**	**2.52E-06**	**2.29E-06**	**V/C=(1-(g)^2)^0.5**
7.94E-59	4.79E-59	2.89E-59	1.36E-60	8.29E-61	5.02E-61	3.05E-61	F=(M*(V/C*3e8)^2/r/EXP(90)
2.001E+24	2.577E+24	3.319E+24	1.571E+25	2.093E+25	2.861E+25	4.018E+25	R1+delta R=E/(F*6.24e12*exp(90)/exp(60))
6.200E+20	1.503E+21	3.417E+21	6.148E+23	1.493E+24	3.582E+24	7.962E+24	delta R (R3)
z=19	2.25E-03	3.97E-03	0.120	0.212	0.375	0.661	Integration of energy produced by stars

Delta R (call it R3) for the final column is 7.9e24 meters. R1 was 3.22e25 meters and R1+R3=4.02e25 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.

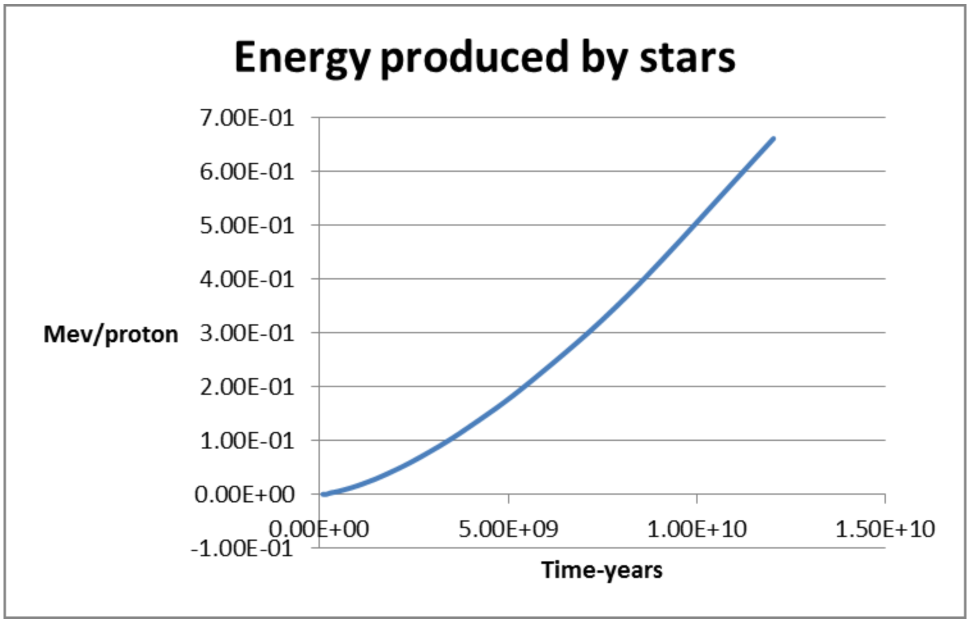


Note that the temperature increase is in the low single digits. It appears to the author that WMAP measurements masked this energy source. Since microwave radiation is long wavelength, radiometers are not well suited to measure the energy from stars. Apparently they miss this energy because they subtend a very small angle (associated with a very small wavelength).

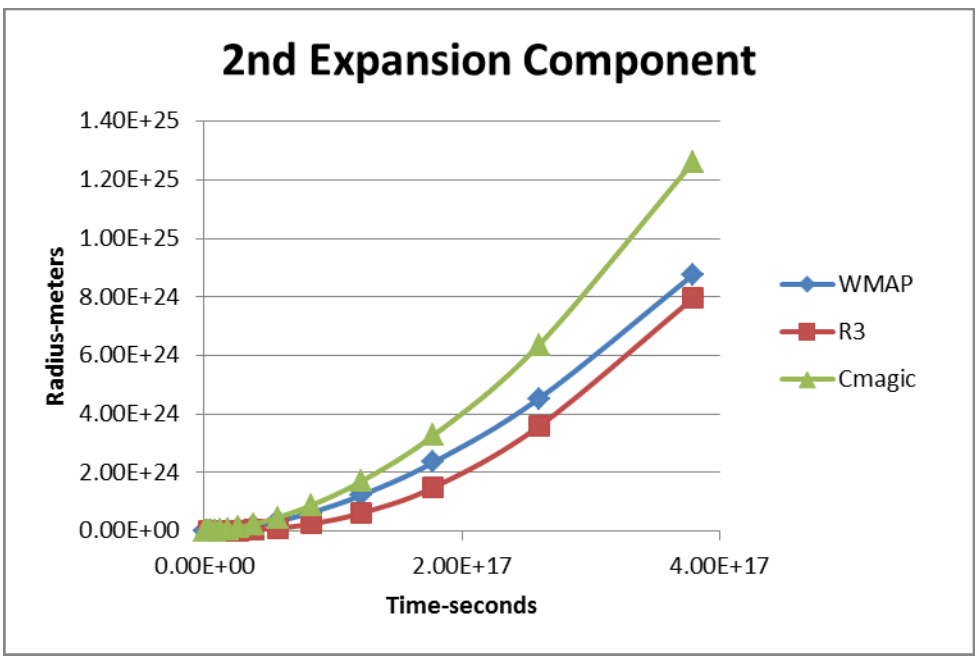
The calculation table above indicated that the force required to move particles apart against gravity is very low (on the order of 5e-61 Newtons). The energy/particle required to expand the universe by 7.9e24 meters is shown above in the row entitled "Energy difference between two temperatures". It is 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. Energy accumulates over time because there is no place for it to go but it is reduced by expansion. 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.

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.

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)		

WMAP Review:

WMAP 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 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, H is Heisman's constant and C is the speed of light

The baryon number fraction can be calculated with the following relationships. The value 4.4e-10 is a key value from WMAP and is established by the measurement of residual deuterium in the universe (2.37e-5). The relationship is:

1.37E+17	R (Meters)
8.00E+08	T (K)
4.40E-10	Baryon/photon=(0.046*EXP(180)/(4/3*PI()*4.04e25^3))/(8*PI()/(4.31e-21*3e8)^3*(1.5*8.62e-11*2.73)^3
3.88E-05	D=0.00046*(4.4e-10*10000000000)^(-1.67)

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

This leads directly to the Baryon fraction where 9.14e-27 kg/m^3 is critical density

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

Summarizing:

5.77E+08	Photon number density
4.400E-10	baryons/photon
0.254	baryon number density
4.2377E-28	baryon mass densty
9.14E-27	rhoC
0.0464	Baryon fraction

The updated year 9 parameters are shown in table below entitled WMAP published.

WMAP [7]	
NOW	
published	
4.02E+25	Inferred Radius
2.26E-18	H0
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
5.77E+08	Photon number density
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

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

Note: WMAP derived 0.0464 from the ratio of two peaks in the Fourier analysis of cosmic background radiation [3]. This is consistent with 4.4e-10 baryons/photons ratio 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 0.719 dark energy removed

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 related to kinetic energy using the Friedmann derivation). We find that expansion is only partially density driven and we must separate the causes of expansion and treat them differently. Density related to mass can be calculated by removing the dark energy fraction from critical density.

Below we are not treating critical density (rhoC) as an incorrect value. Critical density is related to the accepted finding that the universe is "flat" and can be related to the Hubble constant with the equation rhoC=H^2/(8/3 pi G). However we need to separate matter density from the component of expansion called dark energy. Removing 0.719, we have only 0.235+0.0464=0.2814 for the mass fraction and we will scale this up so two mass components make up the critical density. There is a second expansion component but it requires very little energy (on the order of 2e-10 mev/proton). As indicated above WMAP measured the ratio between light and dark matter. This ratio is unchanged by the scaling operation below.

old	multiplier	new		ratio l/d
0.235	3.55	0.835	dark matter	
0.046	3.56	0.165	light matter	0.197
0.281		1		

Note the useful ratio:
Old/new=1/3.56=0.281

There are other parameters that require revision. We can now compare the R1+R3 model with WMAP. The dark matter fraction is 0.834 and the baryon fraction is 0.165. The new mass fractions allow us to calculate density by multiplying the number of particles by 1.67e-27 kg and dividing by the volume associated with 4.02e25 meter radius. To carry out the calculation we need to know the number of particles in the universe.

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][2][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	

The baryon/photon ratio is discussed later but the summary table above separates exp(180) into baryons and dark matter. Baryons are 0.165 and dark matter is 1-0.165=0.835. Baryon densities is 0.165*exp(180)*1.67e-27kg/2.72e77m^3=1.51e-27 kg/m^3.

baryons/photon				4.43E-10
Dark matter fraction				0.835
dark matter density in kg/m^3				7.63E-27
baryon matter density in kg/m^3				1.51E-27
Dark energy fraction				0
critical density		2.81E-01		9.14E-27
Baryon fraction				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				decoupling	decoupling	NOW
published						
4.02E+25	Inferred Radius				1.69E+21	4.02E+25
					R1	3.22E+25
2.26E-18	H0					
8809	Temperature at equality (K)					
2.73	Temperature now (K)					4.15
2973	Temperature at decoupling (K)			3115.8	3123	
0.0106	Spot angle (radians)			0.0106	0.0105	
0.254	baryon number density					0.902
5.77E+08	Photon number density					2.04E+09
4.400E-10	baryons/photon					4.43E-10
0.235	Dark matter fraction					0.835
6.57E-27	dark matter density in kg/m^3					7.63E-27
4.2377E-28	baryon matter density in kg/m^3					1.51E-27
0.719	Dark energy fraction					0
9.1351E-27	critical density			2.81E-01		9.14E-27
0.0464	Baryon fraction					0.165
2.72E+77	Overall volume (m^3)				2.04E+64	2.72E+77

Baryon number density is simply 1.51e-27/1.67e-27=0.903 shown below. Photon number density is calculated as follows:

photon number density=(8*PI()/(4.13e-21*3e8)^3*(1.5*8.62e-11*4.15)^3)	2.04E+09	number/m^3

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

Photons in the first 158 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 value, 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 (0.044 in the equation above) and temperature T. Equilibrium occurs at 8e8 K. At this point the SAHA fraction=1/exp(SAHA value)=1, where the SAHA fraction= (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. The deuterium dn=N-nn-np. The helium fraction =(N-nn)/4N=(np+nd)/(4N)=0.24. This is the point that neutrons and protons convert to He4.

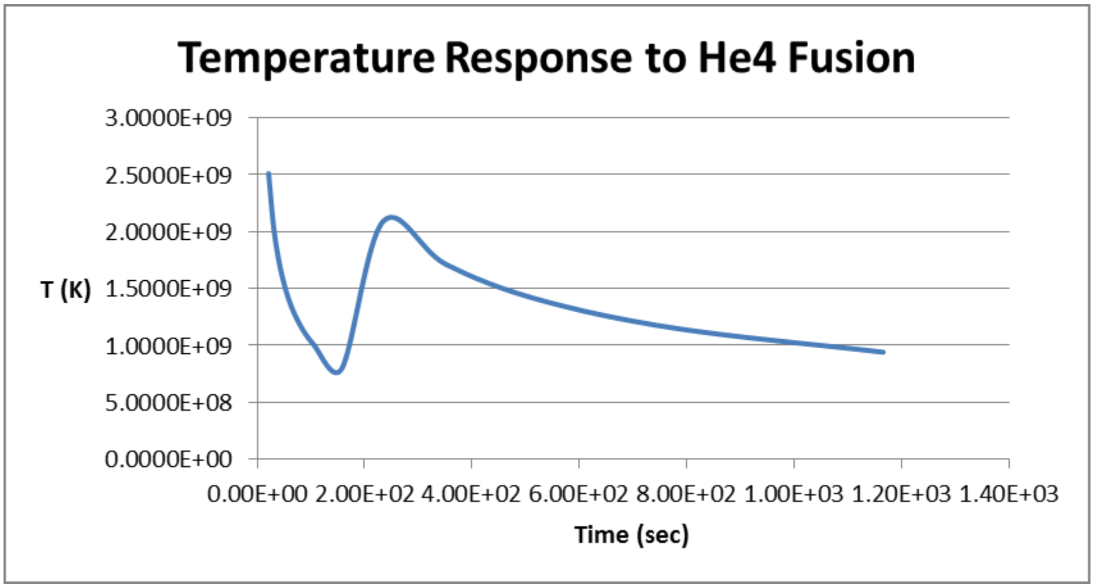
However, residual fractions of H2, H3 and Li must match measured values since these elements are uniformly found throughout space and must have originated in the big bang. Work by N.D Schramm and summarized below [12] help establish limits on the baryon/photon ratio.

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

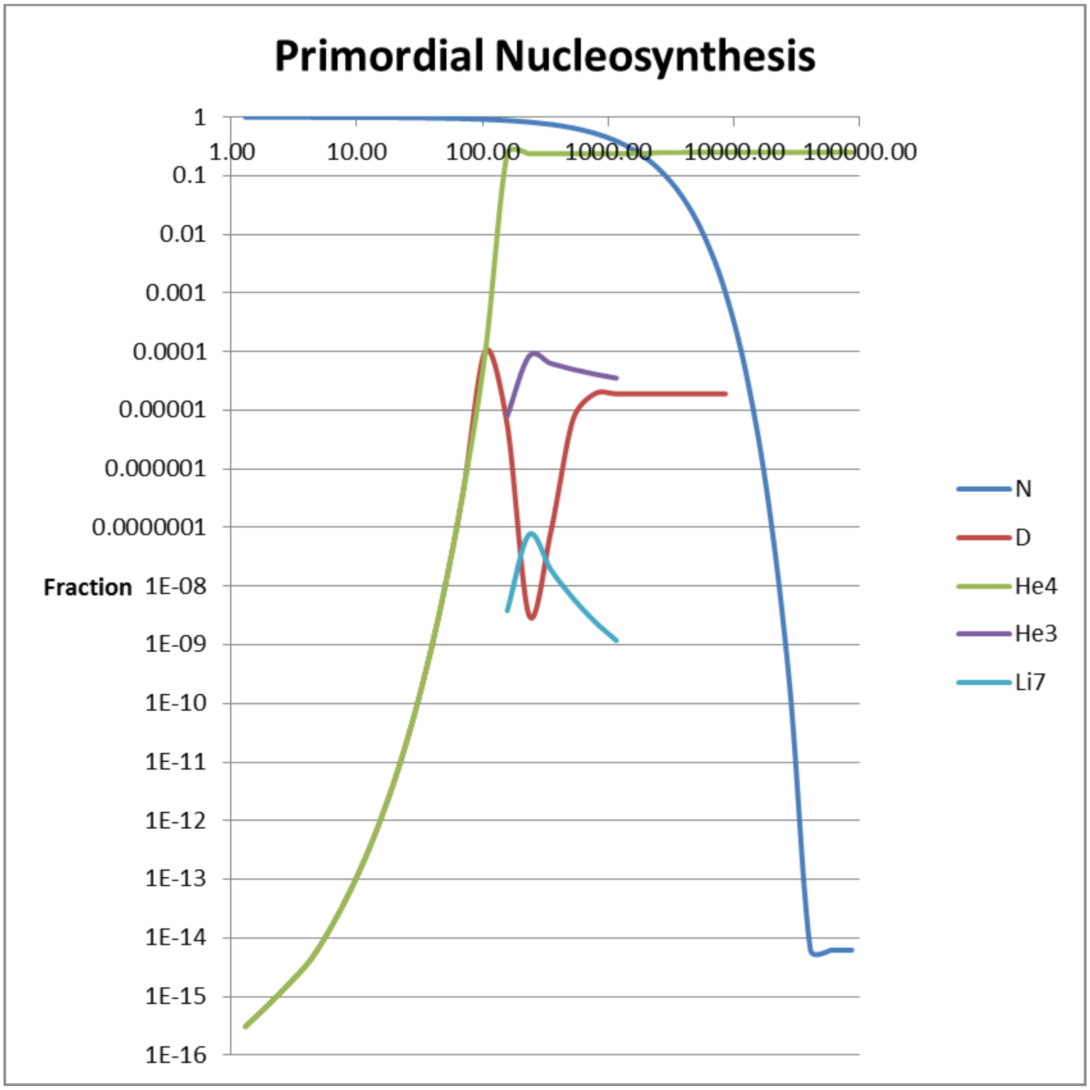
nb=eta ngam=6.6e-8/cm^3
rhob=nbmp=1.11e-31 g/cm^3
rhoc=3H0/(8piG)=1.88e-29 h^2 g/cm^3
omega=rhob/rhoc=.0059 h^-2

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)	
Omegab	0.0116		

The reference Omegab=0.0116 is restated for known Hubble h=.697 [12] but this is different than the WMAP result 0.046. The limits above apply to the time that He4 was formed but neither appear to consider the He4 temperature spike. Slightly after that time, there was approximately 1.6 MeV of energy released from He4 fusion (based on its measured abundance fraction of 24%). The following graph shows the decrease in energy (starting at 10.11 MeV at near zero time) followed by the release of fusion energy. 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 value (and the literature), equilibrium occurs at 8e8 K. In the author's analysis this occurs at 158 seconds after the beginning. Over the next few seconds, the temperature increases to 1.5e9K, releasing photons and changing the important photon/baryon ratio. Literature does not include the effect of He4 fusion on residual deuterium, He3 and Li7. These elements are formed during primordial nucleosynthesis but the deuterium residual is formed after the equilibrium point where He4 Fuses. As the fusion related temperature increases (spikes) the residual of deuterium decreases because deuterium easily photo disintegrates. When the temperature again decreases, deuterium rises and establishes the measured value [7]. The following chart shows the fraction of important elements as a function of time. He3, and Li7 have higher binding energy values and are not fragile, like deuterium. Like He4, their abundance is established at equilibrium (SAHA=1).



Helium4 abundance is shown in green and increases to 0.24. Neutrons decay and are shown in blue. Deuterium, shown in red, is photo-disintegrated when the temperature spikes due to He4 fusion. However, when the temperature spike decreases following fusion, the D fraction recovers somewhat. After the SAHA value becomes zero (fraction = 1.0), the D fraction becomes fixed. Measured values are in column 1 below and calculated values for He3 and Lithium7 depend on the baryon/photon ratio. The actual mass fraction is used in the baryon/photon ratio since at this point neutrons are still decaying to protons and the full Omega value 0.165 is only partially available. The reference 12 equations are detailed below. The deuterium residual agrees with measured values toward the end of the temperature spike. There are several factors considered in this calculation. The SAHA fraction (1/exp(SAHA value) decreases and the reference 12 equation values are multiplied by the fraction until it returns to 1 at the end of the spike. At this point, the equilibrium residual is calculated with the Boltzmann ratio=(exp(-1.115/MeV)=1.9e-5) where MeV is the energy associated with 8e8K and 1.115 is the binding energy for deuterium. After that point the residual value is frozen at a value close to the measured value 2.3e-5.

Actual mass fraction =(p)/N*.165		1.58E-02	1.58E-03	2.78E-03	4.39E-03	6.41E-03
baryon/photon ratio		1.3936E-09	1.2844E-11	2.2695E-11	3.5796E-11	5.2267E-11
Temperature (K)	1.00E+09	7.99E+08	1.45E+09	1.18E+09	9.69E+08	7.94E+08
R (meters)		6.52E+16	7.97E+16	9.73E+16	1.19E+17	1.45E+17
Time (seconds)		158	235	351	523	781
1/EXP(SAHA)		1.00E+00	2.25E-07	1.58E-05	2.65E-03	1.00E+00
D=4.6e-4*(B/P*1e10)^(-1.67)	Measured	5.65E-06	1.42E-02	5.47E-03	2.56E-03	1.36E-03
D=4.6e-4*(B/P*1e10)^(-1.67)*1/exp(SAHA)	2.37E-05	5.65E-06	3.19E-09	8.63E-08	6.77E-06	1.91E-05
He3=3e-5*(B/P*1e10)^-0.5	3.3e-5 to 1e-4	8.04E-06	8.37E-05	6.30E-05	5.01E-05	4.15E-05
Li7=5.2e-10*(B/P*1e10)^-2.43+6.3e-12*(B/P*1e10)^2.43	6.00E-09	3.80E-09	7.62E-08	1.91E-08	6.31E-09	2.52E-09
http://cds.cern.ch/record/262880/files/9405010.pdf	SAHA value	0 (equilibrium)	1.53E+01	1.11E+01	5.93E+00	-2.58E-01

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 7e16 meters

The proton model yields the initial kinetic energy of 10.11 MeV which corresponds to 7.82e10 K. However, conventional nucleosynthesis literature [8] 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 7e16 meters. It is known that this period is radiation dominated. 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 158 second period. The force on matter is MV^2/R where V is the kinetic energy related to temperature.

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

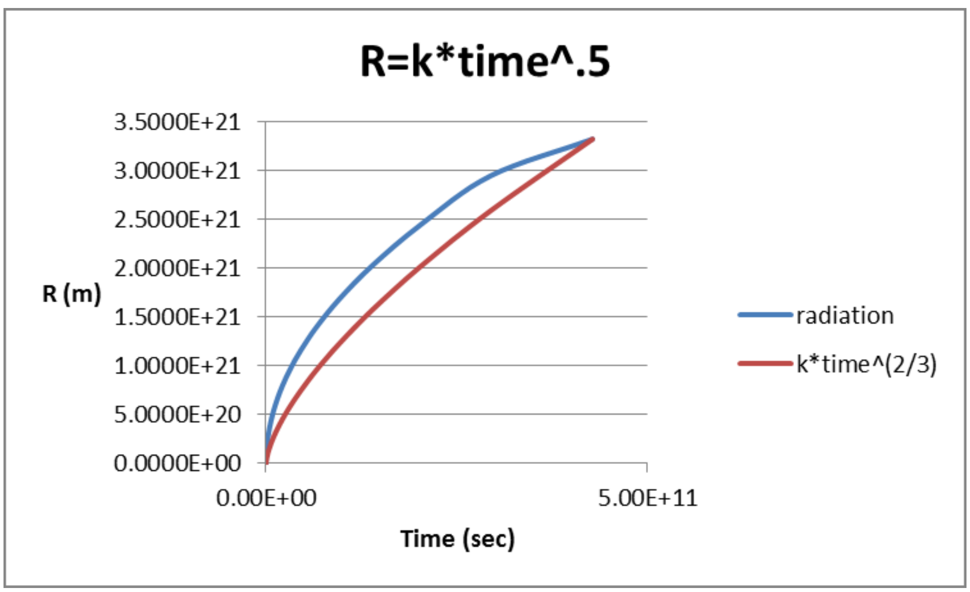
Time (sec)		0.053	0.079	0.118	70.843	105.686	157.664
Temperature (K)		7.82E+10	6.22E+10	4.94E+10	1.26E+09	1.00E+09	7.99E+08
Energy associated with Temperature		10.11	8.04E+00	6.39E+00	1.63E-01	1.30E-01	1.03E-01
dE=Energy change for radius increment			2.071	1.647	0.04	0.03	0.03
phndens=8*PI()/(4.14e-21*3e8)^3*(1.5*8.62e-11*T		4.52E-28	2.071	1.647			
F=Gmm/R^2		3.61614E-38	1.74E-38	1.26E-39	1.97E-45	9.29E-46	4.39E-46
M=Mass (Kg)	1	1.67E-27	1.67E-27	1.67E-27	1.67E-27	1.67E-27	1.67E-27
Mass/(Mass+KE)		**0.9893**	**0.9915**	**0.9932**	**0.9998**	**0.9999**	**0.9999**
Velocity (V)=(1-(M/(M+KE))^2)^0.5*3e8	1.00E+00	**4.3658E+07**	**3.8994E+07**	**3.4817E+07**	**5.5928E+06**	**4.9873E+06**	**4.4474E+06**
Force=MV^2/(R*exp(90)) (newtons	1.46	3.89E-41	1.97E-38	2.96E-39	9.54E-44	5.21E-44	2.85E-44
	2	8.66E+12	1.13E+13	1.48E+13	1.05E+15	1.37E+15	1.79E+15
R=r+dE/(F*6.24e12*exp(90)/exp(6	8.25E+12	8.25E+12	1.72E+13	6.40E+13	5.12E+16	7.46E+16	1.09E+17
	8.25E+12	8.25E+12	1.179E+13	4.386E+13	3.508E+16	5.110E+16	7.438E+16
Comparison R=Const*(time/0.0529)^0.5		1.19E+15	1.46E+15	1.78E+15	4.37E+16	5.34E+16	6.52E+16

At 158 seconds, this period of rapid expansion ends and expansion follows the radiation dominated relationship R (meters)=1.2e15*(time/158)^0.5.

The radius 1.09e17 meter is the radius and temperature where He4 fusion occurs. This releases 1.6 MeV/proton. See details in the section entitled “Limits on baryon/photon ratio”.

Stage 3: Radiation driven expansion from 1.09e17 meters to 3.6e21 meters where equality of radiation and matter occurs.

A comparison of two expansion rates are compared below: Expansion follows the relationship r=constant*time^(1/2) during the stage 3 but r=constant*time^(2/3) during stage 4.



Stage 4: Expansion increases the radius from 3.6e21 meters to 1.24e24 meters where star energy becomes important. R1=r0*t^(2/3) is the Friedmann [4] equation and can be derived from H^2=H0^2(fraction*(1-z)^3). R1 continues to the present time with R1=constant*time^(2/3).

Stage 5: Energy from stars increases the radius beginning at 1.24e24 meters and continuing to the current radius at 4.02e25 meters.

WMAP year 9 gives a Hubble constant of 2.6e-18/sec. The integration to 4.02e25 meters stops at this point because it yields the measured 2.6e-18/sec. The universe would expand only to 3.21e25 meters without radiation from the stars. Total expansion for this stage is R1+R3. Details are under the heading "The effect of star energy on expansion".

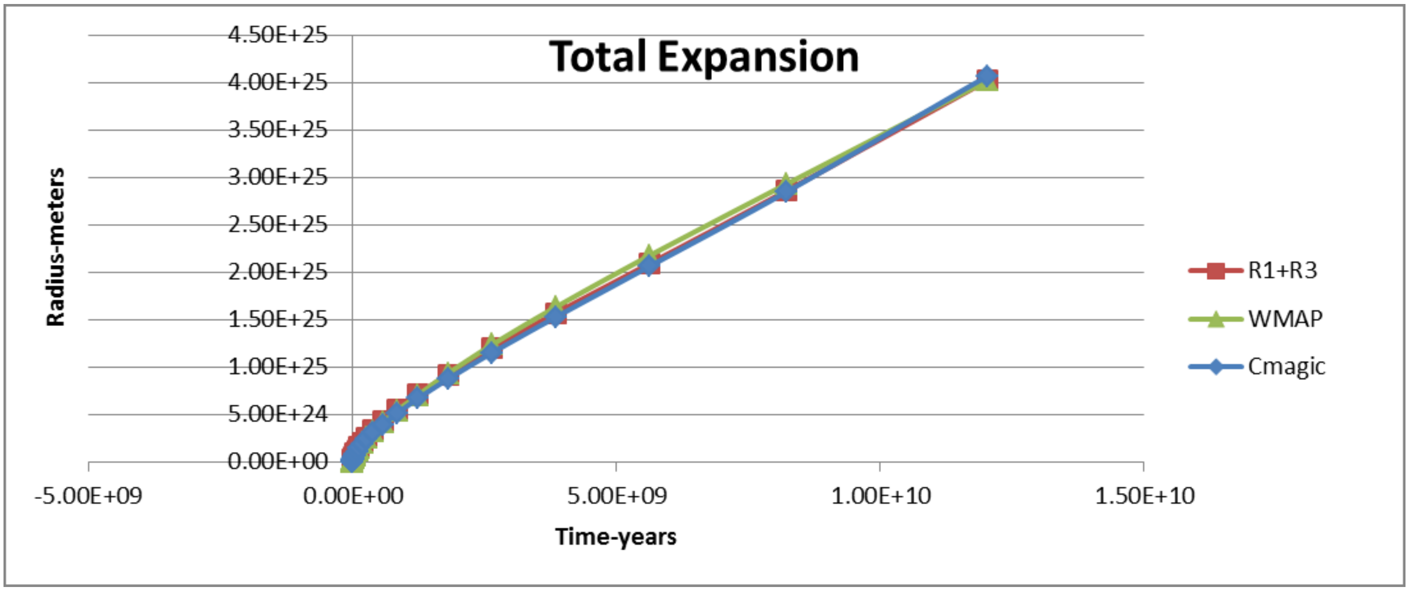
Expansion energy summary for Stages 1 through 5

A summary of the energy releases is shown below. The arrows labelled reduced show the change in the energy value/proton due to expansion.

	Summary of energy releases during expanson				
	Release 1	Release 2	Release 3	Expanded Energy	
	Stage 1	stage 2	Stage 5	Now	Temperature
	Initial energy	He4 fusion	Star energy	MeV/proton	Now
					(K)
R meters	8.25E+12	1.45E+17	1.20E+24	4.02E+25	
		reduced	to 4.6e25		
MeV/proton	10.11	→ 0.0006		2.08E-12	
MeV/proton		1.6000			
MeV/proton		0.1379	reduced →	4.97E-10	
MeV/proton				3.53E-10	2.73
				reduced	
MeV/proton			0.60	→ 5.15E-10	3.98

The original 10.11 MeV/proton has been reduced by expansion (kinetic energy being converted to potential energy) to 0.0006 MeV/proton at 1.4e17 meters. The SAHA equation for deuterium 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 (0.165)*1.6 MeV 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 3.53e-10 MEV where it is measured by WMAP as the current temperature 2.73 K. Stars produce 0.6 MeV/proton 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 3.98K, only slightly higher than the dark sky measurement 2.73K.

Overall there at 5 stages to expansion blended together into the curve shown below. Of interest here is stage 5 (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 matched and fell below mass density a condition known as equality had occurred. Acoustic oscillations were no longer dampened and wave propagation at velocity 3e8/3^.5 m/sec began. These waves enlarge and are visible in the cosmic background radiation (CBR) as the plasma cleared 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				5.39E-07	2.86E-02	3.79E+04	SAHA WMAP
			1889.45	1469.23	1142.42	888.26	Expansion ratio
8.25E+04	6.40E+04	4.97E+04	5.15E+03	4.01E+03	3116	2.4E+03	T WMAP (K)
1.60E+22	7.47E+21	3.49E+21	3.90E+18	1.83E+18	8.62E+17	4.06E+17	Photon density n/m^3
2.53E-13	1.18E-13	5.53E-14	6.17E-17	2.90E-17	1.37E-17	6.43E-18	proton mass density
3.03E-13	1.10E-13	3.99E-14	4.62E-18	1.69E-18	6.18E-19	2.26E-19	photon mass density
1.20E+00	9.30E-01	7.21E-01	7.48E-02	5.82E-02	4.53E-02	3.52E-02	photon/proton density ratio
0.00E+00	7.90E+18	1.95E+19	1.09E+21	1.60E+21	2.35E+21	3.44E+21	Wave progression (m)
0.0000	0.0007	0.0014	0.0082	0.0093	0.0106	0.0121	Angle radians
4.98E+21			1.19E+18	5.59E+17	2.62E+17	1.23E+17	
1.32E+21	1.69E+21	2.18E+21	2.12E+22	2.73E+22	3.51E+22	4.52E+22	R1+R2 Radius (meters)
R1+R3				1.00E-06	5.45E-02	7.56E+04	SAHA R1+R3
8.33E+04	6.47E+04	5.03E+04	5.18E+03	4.02E+03	3123	2.43E+03	T R1+R3 (K)
1.65E+22	7.73E+21	3.62E+21	3.95E+18	1.85E+18	8.68E+17	4.07E+17	Photon density n/m^3
2.61E-13	1.22E-13	5.72E-14	6.24E-17	2.92E-17	1.37E-17	6.42E-18	proton mass density
3.16E-13	**1.15E-13**	**4.19E-14**	**4.71E-18**	**1.71E-18**	**6.24E-19**	**2.27E-19**	photon mass density
1.21E+00	9.44E-01	7.33E-01	7.54E-02	5.86E-02	4.55E-02	3.54E-02	photon/proton density ratio
	7.90E+18	1.95E+19	1.06E+21	1.57E+21	2.31E+21	3.40E+21	Wave progression
0.00	0.00	0.00	0.0079	0.0091	0.0105	0.0120	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 occurred at radius 7.73e21 meters for the R1+R3 model (red). From this point waves progress until the temperature reaches 3123 K. At this point the SAHA equation indicates that decoupling occurs (shown in green). The R1+R3 radius is 3.51e22 meters at decoupling. The wave has enlarged to 2.31e21 meters and this value divided by 2*pi*3.5e22=0.0105 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 I believe that “dark energy” has been identified. But this energy is not the kinetic energy of protons and as such the reported densities must be revised. The revised baryon content 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 residual 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 important 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 4.02e25 meters. The expansion radius calculated for the main component (R1) of expansion is 3.21e25 meters. Late stage star energy caused expansion adds approximately 4.02e25-3.21e25=7.96e24 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.

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Appendix 1: Proton mass model

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 [2] 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 represent energy through the relationship E=2.02e-5*exp(N). For example, the Higgs particle is approximately 2.02e-5*exp(22.575).

Reference 2 describes how the N above interacts in pairs to create quantum orbits and the following energy values:

Unified.xls cell g191			
mass	Energy-mev	S field	Energy
ke		G field	mev
15.432	101.95	17.432	753.29
12.432	5.08	10.432	0.69
13.432	13.80	15.432	101.95
12.432	5.08	10.432	0.69
13.432	13.80	15.432	101.95
12.432	5.08	10.432	0.69
-10.333	-0.62	-10.333	-0.62
10.408	0.67	10.408	0.67
10.33	0.62	10.333	0.6224
0.000	0.0000	0	2.02E-05

The energy values above are arranged below to model the neutron mass 939.565 MeV.

Mass and Kinetic Energy						Field Energy
Mass	Difference KE	strong residual ke	Neutrino	Expansion	Strong field	Gravitational
mev	mev	mev	mev	KE	energy mev	Energy mev
101.947	641.880	10.15			-753.29	
						-0.69
13.797	78.685			10.151	-101.95	
						-0.69
13.797	78.685			10.151	-101.95	
						-0.69
0.000	0.000		0.048			-0.67
0.622	0.000					
130.163	799.251	**939.5653531**	0.048	20.303	-957.185	-2.732
		NEUTRON MASS		Total m+ke	Total fields	
				Total positive	Total negative	
				959.916	-959.916	0.000E+00

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.

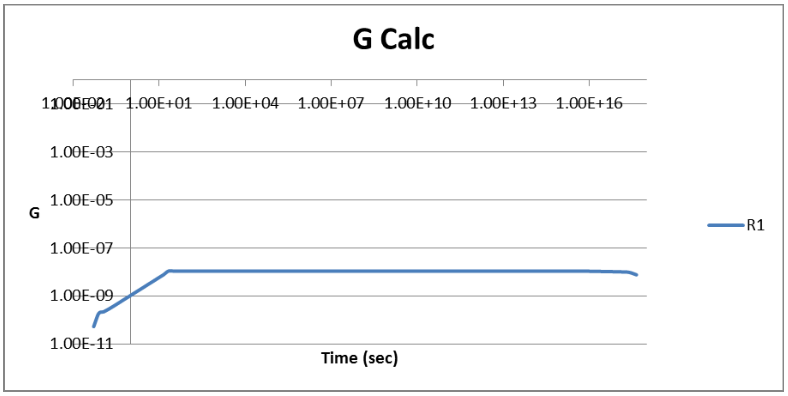
The following table follows a format that organizes input values, intermediate results and the final result in a column of calculations. The goal is to use the fundamental radius 7.224e-14 meters to calculate the gravitational inertial force. The inputs listed at the top of the table originate in the 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.

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