Application of proton mass model to cosmology

Author Gene H. Barbee
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Email: genebarbee@msn.com

Abstract

Historically, a culture's cosmology was an explanation of the origin and a justification for its most significant beliefs. Scientists are actively engaged in understanding new observations regarding our universe. There is agreement that achieving a new level of understanding may require an extension to what has been observed to date about fundamental interactions, matter and energy. This paper is a summary of work by the author building on the best measurements made by physicists, astronomers and cosmologists. Of specific interest are the topics of force unification, gravitational theory, definition of space and time, dark energy and cold dark matter. The following documents are summarized:

A Top-Down Approach to Fundamental Interactions **[1]**
Starting with data from WMAP [11] that allows an estimate of the number of protons in the universe (exp(180)), where exp stands for natural number 2.712^(180) the author explored how this number is used by nature to represent fundamental particles. This reference described models for the neutron and proton mass based on Shannon type information theory. In addition, it proposed a way of unifying the electromagnetic, weak, strong and gravitational forces.
On the Source of the Gravitational Constant at the Low Energy Scale **[18]**
This document summarizes arguments for a low energy gravitational scale and offered an understanding of the weak and long range character of gravitation. Physics has struggled with the reconciliation of general relativity with the other fundamental interactions (strong force, weak force and electromagnetic force). The reason for the difficulty is that general relativity and gravitation is the geometry of space and time and does not appear to originate at a reasonable energy at the quantum level. The accepted gravitational theory had the energy scale far above the energy of a proton. The author proposed a lower energy scale and offered a relationship between the quantum scale and the scale of the universe that appears to resolve this conflict.
On Expansion Energy, Dark Energy and Missing Mass **[2]**
This document summarizes and extends this theoretical groundwork to the field of cosmology. Information from the proton mass model is applied to the beginning, expansion of the universe and observables from the field of astronomy. The fundamentals of space and time are described including the relationships that accurately model expansion, temperature, gravitational history and helium abundance. Results from an expansion model are compared to values reported in WMAP analysis and CMAGIC studies [14]. Three models of expansion are compared and a proposal regarding dark matter is discussed. Reference 2 analyzed the kinetic and potential energy changes during expansion and showed that there is no dark energy (dark energy fraction is 0). Furthermore, information is presented that questions the WMAP conclusion that only 0.046 of the universe is normal protons. Based on work by the author, it appears that the baryon (proton) fraction is 0.5 and the cold dark matter fraction is 0.5.

A Simple Model of Atomic Binding Energy **[20]**
The purpose of this document is to support the value 10.15 MeV from the proton mass model. This is the value that changes and causes the atomic binding energy curve [9]. The model presented is a probabilistic model that follows the same fundamentals of reference 1.
Semi-Fundamental Abundance of the Elements **[19]**
This document again is offered as support for the proton mass model and the model of atomic binding energy. It provides a probabilistic model of fusion using barrier energy from the binding energy curve model. It models the abundance of the elements produced during the life cycle of stars [8][10].
Baryon and Meson Masses Based on Natural Frequency Components **[3]**
The purpose of this document is to extend the approach used to develop the proton mass model to data gathered for the hundreds of mesons and baryons observed at high energy labs [7]. Although the work is somewhat tentative most of the particles have "mirror" particles that allow nature to balance properties to zero (particles with properties can be created from zero only if there is a "mirror" particle).
The Effect of He4 Fusion on Primordial Deuterium **[22]**
Literature regarding primordial nucleosynthesis was reviewed that states that measured primordial deuterium is a sensitive test that limits the baryon mass fraction to 0.046. Surprisingly literature does not account for He4 fusion which releases approximately 0.5 MeV. When this energy is added to temperature curves for early expansion the temperature increases and deuterium photo-disintegrates. However, as the temperature finally falls due to expansion deuterium production recovers to the measured values. Calculations also show that the photon/baryon number ratio does not restrict the baryon fraction from reaching 0.5.

The proton mass model

The formal definition of information is attributed to Claude Shannon. Information (N) = -ln P (Inversely, P=1/exp(N) where exp(N) means the natural number 2.718 to the power N). Probabilities are the chance of one event divided by all possibilities. He used natural logarithmic relationships because probabilities (P) multiply but information is additive. The negative sign tells us that information is high when probabilities are low.

Can energy (E) be related to information? Using the right probability, the answer is yes. Probability P=e0/E where e0 is an energy constant that forms an energy ratio. Quantum mechanics deals with the square root of P (a complex number called psi). This is tied to wave/particle duality but the relationships of interest are described by probability P=e0/E=1/exp(N) and E=e0*exp(N).

N for fundamental energy values

The relationship E=e0*exp(N) will be used extensively. N is a logarithmic number. The key to N values for energy was correlation of data gathered by high energy labs [7][9]. Comparing N values for particles and knowing that the 0.511 Million Electron Volts (MeV) electron has a field equal to 2.72e-5 MeV, allowed the author to deduce that the electron N was 10.136 and its electromagnetic field energy N was 0.296=3*0.0986=3*ln(3/e) where e is the natural number 2.718. The energy constant e0=2.02e-5 MeV is calculated below from Particle Data Group [7] data for the electron mass. The universal equation for energy is E=2.02e-5*exp(N) MeV.

Electron N	**10.136**	**(10.3333-0.0986*2)**					
Electron mass (mev)		**mass of electron (MeV)**		**0.51100024**	**MeV**		
Find the value e0 by solving the above equation with E=.511						**e0=E/exp(N)**	
						e0= 0.511/exp(10.136)	
						2.025E-05	**mev**
Note that 3*.0986=.296				**E=eo*exp(.296)=2.72e-5 mev**		**2.722E-05**	**mev**
The electric field energy of the electron is known to be: (MeV)						**2.72E-05**	**mev**

Data showing an N value for fundamental energy observations is listed in Part 2 Topic 1. The data is from either from NIST, (National Institute of Standards and Technology), the Particle Data Group [7] maintained by UC Berkeley or other reported values [6]. There are three quarks confined in a neutron (and proton) but they are not observed individually. The higher energy bosons are variations of N=22.5 and the Higgs particle measured in July 2010 agrees well with the author's N value of 22.575. Time for fundamental particles is simply reciprocal time (1/time=frequency).

Neutron components

The author found N values for neutron components based on the way three quark masses and their kinetic energies add to the neutron mass. The related information components total N=90 for the neutron. They are listed in Table 1 below.

	Neutron particle and kinetic energy N			Neutron field energy N
Quad 1	**15.43**	quark 1	**17.43**	strong field 1
	12.43	kinetic energy	**10.43**	gravitational field component
Quad 2	**13.43**	quark 2	**15.43**	strong field 2
	12.43	kinetic energy	**10.43**	gravitational field component
Quad 3	**13.43**	quark 3	**15.43**	strong field 3
	12.43	kinetic energy	**10.43**	gravitational field component
Quad 4	**10.41**		**-10.33**	
	-10.33		**10.41**	gravitational field component
Quad 4'	**10.33**	pre-electron	**10.33**	
	0.00		**0.00**	
	90.00	Total	**90.00**	Total
	Table 1		Table 2	

Table 2 is similar to Table 1 except it contains N values for field energies of the neutron. Since the neutron does not carry charge, the electromagnetic field is absent but appears as a separation once the neutron decays to a proton (quads 4 and 4'). The strong residual field energy is part of a total energy balance. Sets of four N values labelled quads are involved in an information operation.

Table 1 represents mass plus kinetic energy and Table 2 represents field energy. Set 2 will be used as an example for a quad that contains four values. The N values 13.43+12.43 are separated into 15.43+10.43. This operation conserves N but energy is also conserved. After these operations mass is imbedded in field energy quantum orbits. Each N has a specific place and a specific energy described below. N1 always gives a mass, N2 always represents a kinetic energy value, N3 always specifies strong field energy and N4 always specifies a second field energy (associated with gravity).

E1 will be identified as a mass (a quark for the strong interaction)
E2 is identified as a kinetic energy (ke) addition to energy E1.
E3 is identified as strong field energy.
E4 is identified as a gravitational field energy component.

		mev			mev		
		E=e0*exp(N)			E=e0*exp(N)		
N1	13.432	13.797	E1 mass	N3	15.432	101.947	E3 field
N2	12.432	5.076	E2 ke	N4	10.432	0.687	E4 field

These above energy values are placed in a table below with mass plus kinetic energy (102.634 MeV) separated from field energy (102.634). The total energy across the interaction is conserved at zero with mass (E1) + ke (E2) +ke difference (E4+E3-E2-E1) balancing field energies (E3+E4 shown as negative).   This information separation followed by energy conservation has powerful implications. The operation involving E1 and E2 can be read E1 is given exp(2) of kinetic energy. Since the numbers (N) are exponents (E=e0*exp(N)), the number 2 can be associated with a divisor 1/exp(2)=0.135 that increases the kinetic energy of E1. The value 0.135 is identical to the concept of gamma in relativity. Gamma is the divisor that increases the kinetic energy of a moving mass involved in the Lorentz transformation.   The definition is: ke=m/gamma-m. These may be special case Lagrangians and the energy interaction is similar to a physics qauge transition.

Information (N) values from the neutron component table were used to a model the neutron's known mass, 939.56 MeV. Three quads of N values are associated with three quarks and the fourth set transitions to the electron. The values toward the left side of the box, labeled mass and kinetic energy are balanced by fields on the right hand side of the box. Fundamental N values (13.431, 12.431, 15.431 and 10.431) are shown to the left of the box. These values are the source of the energies (E=e0*exp(N)) inside the box. The kinetic energy operator N=12.431 gives mass kinetic energy. It's associated energy=2.025e-5*exp(12.431)=5.01 MeV. This creates a quark orbit with kinetic energy and associated field energies. The kinetic energy column has several components. Kinetic energy for each quad =E3+E4-E1-E2-E2. The extra E2's are added back to form the column weak kinetic energy (10.15 MeV) and gravitational expansion energy (20.3 MeV). These energies play crucial roles in cosmology. The bottom quad is for the electron after it has decayed from the neutron.

Tables 1 and 2 above each sum to the value N=90 but are separated opposites. This separates zero energy into two types of energy. Mass plus kinetic energy is positive and field energy is negative. The total energy for each neutron (939.56 MeV) plus the external kinetic energy that drives expansion is 960.54 MeV but the fields are negative 960.54 MeV. This conserves the other initial condition; zero energy.

Energy (MeV) = 960.54-960.54=0.

The values in the above table unify the four forces (interactions) of nature [1].

The Proton Mass Model

Next assemble the components into a model of the proton. Literature indicates that there are three quarks in the proton but the energies are thought to be lower. To use the above component energies, we guess that the quarks are at higher energy and have transitioned to lower values while preserving mass plus kinetic energy. The values toward the left side of the box, labeled mass and kinetic energy are balanced by fields on the right hand side of the box. Reference 1 N values (13.431, 12.431, 15.431 and 10.431) are shown to the left of the box. These values are the source of the energies inside the box. Four values like the ones described above make one "quad" that describes the quark orbit and its associated field energies. The kinetic energy column has several components. Kinetic energy for each quad =E3+E4-E1-E2-E2, using the nomenclature above labeled Operation 6. The extra E2's are added back to form the column weak kinetic energy (10.15 MeV) and gravitational expansion energy (20.3 MeV). The bottom quad is for the electron after it has decayed from the neutron. The balancing neutrinos and energies play crucial roles in cosmology.

Unified.xls cell g191				Mass and Kinetic Energy						Field Energy
mass	Energy-mev	S field	Energy	Mass	Difference KE	strong residual ke	Neutrino	Expansion	Strong field	Gravitational
ke		G field	mev	mev	mev	mev	mev	KE or PE	energy mev	Energy mev
15.432	101.95	17.432	753.29	101.95	641.88	10.15			-753.29	
12.432	5.08	10.432	0.69							-0.69
13.432	13.80	15.432	101.95	13.80	78.69			10.15	-101.95	
12.432	5.08	10.432	0.69							-0.69
13.432	13.80	15.432	101.95	13.80	78.69			10.15	-101.95	
12.432	5.08	10.432	0.69							-0.69
-10.333	0.00E+00	-10.333	0.00E+00	0.00	0.00		0.67	t neut ke	0.0E+00	-0.67
10.408	0.67	10.408	0.67				0.0	neut m		
10.33	0.62	10.333	0.62	0.00	0.62				-0.62	
0.000	0.000E+00	0	0.00E+00							0.00
				129.5409	799.873	**939.5653446**	0.67	20.30	-957.807	-2.73
90.000	sum	90.000	sum			**NEUTRON MASS**		Total m+ke	Total fields	
								Total positive	Total negative	
								960.539	-960.539	0.00E+00

Add the quarks together and simplify the neutron table:

	Mass and Kinetic Energy			Field energy	
	Mass	KE	Strong	Strong	Gravitational
	Quarks		Residual	field energ	Energy
	MeV	MeV	Field E	MeV	MeV
Strong	**130.16**	**799.25**		**-957.18**	-2.73
Strong Residual KE		**10.15**			
Neutron		**939.57**			
neutrino ke		0.67		**-0.62**	
Total		940.24	**(-20.30)**		-960.54
Expansion ke		**10.15**			
Expansion pe		**10.15**			
		960.54			

The neutron decays to a proton by emitting a neutrino energy 0.671 and separating the electron quad of value 0.622 MeV. The proton has 957.59 MeV minus 1.293 (0.671+0.622) MeV and has energy 938.272 MeV. The three quark masses total 129.5 MeV and together have 799.2 MeV plus 10.15 MeV of kinetic energy minus one neutrino of energy 0.671 MeV. These components give the proton mass (938.27 MeV).

	129.541	**799.251**	**-0.671**	
		10.151		
Proton		**938.272**	**Mev**	

	Mass and Kinetic Energy			Field energy	
	Mass	KE	Strong	Strong	Gravitational
			Residual	field energy	Energy
	MeV	MeV	MeV	MeV	MeV
Strong	**130.16**	**799.25**		**-957.18**	-2.73
Strong Residual		**10.15**			
Neutron		**939.57**			-960.54
neutrino ke		0.67		**-0.62**	
below, the Neutron decays to a proton, electron and neutrino					
Proton		**938.27**		**2.72E-05**	
ejected neutrino l		**0.67**		**E/M charge splits**	
Electron	**0.51**	**0.11**		**-2.72E-05**	
Expansion ke		**10.15**			
Expansion pe		**10.15**	**(-20.3)**		
Total		**960.54**			

The proton is thought to be a primary manifestation of the underlying laws and as such contains information that determines many aspects of nature. The proton model above is the source of constants for unification of forces, the subject of reference 1. This table gives the mass, kinetic energy and fields for fundamental constants. Gamma is g=m/(m+Ke) and R=hC/(field energy*mass/g)^.5 (small h sometimes called hbar is H/(2*pi)). The important values for gravity are the mass of the proton with 10.15 MeV of kinetic energy imbedded in a field energy of 2.732 MeV. The residual strong force (related to the weak interaction) is determined by a mass of 928.792 MeV, a kinetic energy of 10.15 and field energy 20.3 MeV. This field energy is the missing energy required to balance 960.54 MeV with balancing field energies totaling 960.54 MeV. (Overall the energy is zero by being balanced since there are no negative energies). An orbit is formed by a "bundle of quarks" with kinetic energy 10.15 MeV orbiting in field energy 20.3 MeV. .

	Mass (m)	Ke	gamma (g	R	Field (E
	(mev)	(mev)		meters	(mev)
Gravity	**938.272**	**10.110**	**0.9893**	**7.2238E-14**	**-2.732**
Electromagn	**0.511**	**1.36E-05**	**0.99997**	**5.2911E-11**	**-2.72E-05**
Strong	**129.541**	**798.580**	**0.1396**	**2.0936E-16**	**-957.18**
Strong residu	**928.121**	**10.151**	**0.9892**	**1.4297E-15**	**-20.303**

Before considering gravitation more thoroughly, it is instructive to review other interactions supported by information extracted from the proton mass model. An updated table from [1] is reproduced below:

Unification Table		**cell ax74**		**Strong**		**Electromagn**	**Gravity**
Higgs energy (mev)				**Combined**	**Strong Residual**		**proton**
*****Field coupling to Higgs field Energy**							
	Potential energy of proton falling into gravitational field (mev)						**20.115**
Field Energy E (mev)				**957.18**	**20.303**	**2.72173E-05**	**2.732**
Mass Coupling to Higgs field energy							
Particle Mass (mev)				**130.16**	**928.121**	**0.511**	**938.272**
Mass M (kg)				**2.32E-28**	**1.65E-27**	**9.11E-31**	**1.6726E-27**
Kinetic Energy (mev)				**798.58**	**10.151**	**1.361E-05**	**10.111**
	Rydberg energy from PDG					**1.361E-05**	
Gamma (g)=m/(m+ke)				**0.1401**	**0.9892**	**0.99997**	**0.9893**
Velocity Ratio		**v/C=(1-(g)^2)^.5**		**0.9901**	**0.1467**	**7.298E-03**	**0.1456**
R (meters) =((HC/(2pi)/(E*M/g)^0.5)				**2.0929E-16**	**1.4297E-15**	**5.291E-11**	**7.2238E-14**
Electromagnetic R minus proton R=5.291627e-11-1.4297e-15						**5.291E-11**	
Force	**Newtons**	**F=E/R*1.6022e-13**		**732765.9**	**2275.2**	**8.242E-08**	**3.6556E-38**
						7.250E-09	**7.2238E-14**
Inertial F	**Newtons**	**F=M/g*V^2/R**		**710992.321**	**2262.86246**	**8.241E-08**	**3.6556E-38**
Force=HC/(2pi)/R^2=3.16e-26/Range^2 (n				**721797.0**	**15466.9**	**1.129E-05**	
HC/(2pi)	**3.16E-26**	**(4.13e-21*3e8*6.24e12/(2*pi())**					
	F=(5.907e-39)*hC/R^2 (nt)						**3.5786E-38**
	F=6.67428*m^2/R^2						**3.5782E-38**
Coupling constant derived from this work				**1.0152**	**0.147099**	**137.03047**	**1/exp(90)**
Derived c^2 (E*R) mev m				**2.00E-13**	**2.90E-14**	**1.44E-15**	**1.19E-51**
Derived c^2 joule m				**3.21E-26**	**4.65E-27**	**2.31E-28**	**1.91E-64**
Derived exchange boson (mev)				**942.856**	**138.02**	**0.0037**	**2.732E+00**
***published c^2 mev m**					**1.56E-14**	**1.44E-15**	**1.17E-51**
***published c^2 joule m**					**2.5E-27**	**2.31E-28**	**1.87E-64**
***Range**						**5.29E-11**	**8.82E+25**
***http://www.lbl.gov/abc/wallchart/chapters/04/1.html**						**5.29177E-11**	
Published coupling constant (PDG)				**Rydberg data from PDG**		**137.03599**	

The field energies for three strong (color) interactions and their associated particles are from the proton mass table. They are referenced to the Higgs energy since it is considered by many to be the source of field energies and particle masses. A force coupling constant is calculated to be 1.00 and derived c^2 (E*R) values are presented in MeV-m and joule-m. The author did not find published values for comparison (quarks are not independently observable). The lower hierarchy electromagnetic coupling constant is well known and the author's calculations substantially agree.

The traditional relationship F=hC/R^2 is too simple to characterize gravity since gravity involves defining a radius and a proton with potential energy falling to that radius. Justification for replacing the coupling constant with the value 1/exp(90) is presented below.

The atomic binding energy curve is considered to be a result of the strong residual interaction. Again, the proton mass model provides information. The key value is the kinetic energy 10.15

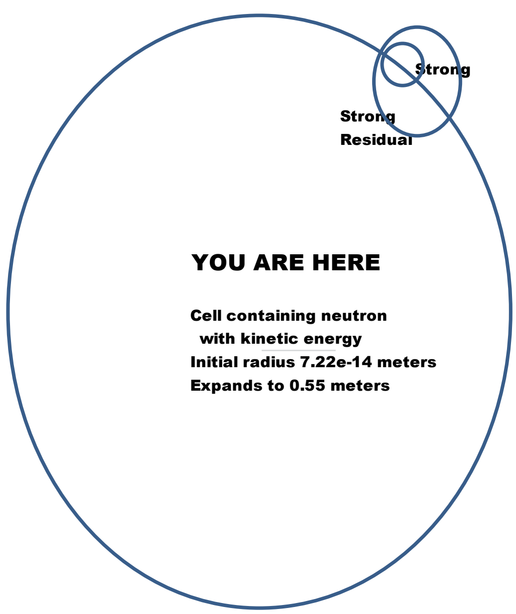
MeV associated with the proton. The strong residual force F=hC/R^2= 15467 NT requires the coupling constant 0.147 and the derived c^2= 2.9e-14 MeV m is similar to the published value 1.56e-14 MeV m. Also the radius of the proton appears to be credible. Reference 9 describes a simple model using the value 10.15 MeV as the basis for binding energy. In this model 10.15 MeV is the kinetic energy that changes as atoms fuse. (928.121 MeV+10.151 MeV =938.272 MeV).

Fundamental gravitational radius

Identify the radius and time for the gravitational orbit described above			
Fundamental radius=1.93e-13/(2.732*2.732)^.5=7.224e-14 meters			
Fundamental time=7.224e-14*2*PI()/(3e8)=h/E=4.13e-21/2.732			
Fundamental time	**1.514E-21**	**seconds**	

The equations above are basic to quantum mechanics. Of particular interest is the equation R=const/(E*E)^.5. In most cases one of the E's in the equation takes on the value mass/gamma. Gamma=(1-(v/C)^2)^0.5 where v is the velocity of the particle over the speed of light C). The author will refer to this equation as the R equation with the constant HC/(2*pi)=1.973e-13 MeV-m. The R equation is central to fundamental forces with different inputs, all derived from the model of the proton above.

The specific R=7.22e-14 meters calculated above is of extreme interest. It is fundamental to space and the starting point for expansion. The author believes that the space we walk around in is expanded from exp(180) cells of radius r=7.22e-14 meters.



Proposed Model for Expansion of the Universe

For gravity and cosmology take into account the large number of particles in the universe. (exp(180) particles consisting of neutrons decaying to protons, and dark matter). For purposes of our discussion on cosmology it is preferable to consider a filled sphere since it what we observation. Rather than the surface of one large sphere, consider the equivalent cumulative volume of exp(180) small spheres each of radius 7.22e-14 meters. The radius of the large sphere R is small r*exp(60) by the following math:

4/3*pi*7.22e-14^3*exp(180)=4/3*pi*R^3
R=r*exp(60)

In general relativity the metric tensor is based on (ds^2). The surface area of a 2-sphere may be broken into many small spheres with an equal surface area. Let r represent the radius of a many small spheres (we will call these cells) and R represent the same surface area of one large sphere containing exp(180) cells. Position a proton on the surface of each cell. The total mass is m*exp(180). The total energy will be that of one protons/cell plus a small amount of kinetic energy.

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

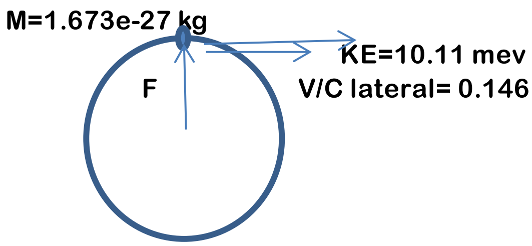
At any time during expansion		
Large space		**Cellular Space**
		With substitutions:
		R=r*exp(90) and M=m*exp(180)
R*V^2/M=	**G=G**	**r*exp(90)*V^2/(m*exp(180))**
R*V^2/M=	**G=G**	**(r*v^2/m)/exp(90)**

For cells, G=r v^2/m/exp(90).
Reference 1 shows that the value 1/exp(90) is actually the gravitational coupling constant. Appendix 3 provides an example time dilation calculation for cells using exp(90) to make time dilation equivalent for general relativity and special relativity.

Gravitational constant fundamentals for cell size space

A fundamental gravitational radius r= 7.22e-14 meters. This equation and maintaining geodesics that give the gravitational constant G=6.674e-11 nt m^2/kg^2 define the geometry of space time.

Mass follows and defines the geodesic by establishing an inertial force F=mV^2/R. For gravity the inputs are the mass of the proton (938.27 MeV) and kinetic energy slightly lower than the available 10.15 MeV. An "orbit" is established when the above kinetic energy of 10.11 MeV imparts a velocity of 0.146 C to the mass 938.27 MeV. The gravitational constant is calculated with the inertial force and the radius 7.22e-14 meters. The diagram below shows the fundamentals:



		GRAVITY
		mass only
GRAVITY		
		neutron
Neutron Mass (mev)		**939.565**
Neutron Mass M (kg)		**1.675E-27**
Field Energy E (mev)		**2.732**
Kinetic Energy ke (mev)		**10.140**
Gamma (g)=M/(M+ke)		**0.9893**
Velocity Ratio v/C=(1-g^2)^0.5		**0.1457**
R (meters) =(HC/(2pi)/(E*E)^0.5		**7.224E-14**
Inertial Force (F)=(M/g*V^2/R)*1/l		**3.666E-38**
HC/(2pi)=1.97e-13 mev-m		**3.2319E-12**
Calculation of gravitational constant G		
G=F*(M/g)^2/R^2=NT m^2/kg^2		**6.6743E-11**
Published by Partical Data Group		**6.6743E-11**

Published value of G (PDG)=6.6743e-11 nt m^2/kg^2. More details including examples for gravitation are included in references 1 and 2.

Expansion

Inflation in the author's models is represented by duplication of one particle by a factor of exp(180). As duplication occurs, the lowest meaningful gravitational radius at the "edge" would be an initial radius of 7.22e-14 multiplied by exp(60)=8.24e12 meter.   (exp(60) is exp(180)^.333 for three dimensions).

The following derivation uses the concept that kinetic energy is converted to potential energy during expansion. The reason to show this derivation is to justify the use of time to the power 2/3 as the basis for expansion. Time will be expressed as a ratio, g=time/alpha time.

Nomenclature

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

Radiation driven expansion:
R=constant*(time)^.5

Matter driven expansion:
(r/r0)^3 increases as (t/alpha)^2 (kinetic energy requirement)

r=r0*g^(2/3)
r0=1.93e-13/2.73=7.22e-14

Kinetic energy during expansion

Temperature is inversely proportional to expansion in most expansion models. This includes red shift. However, the author's proposal starts with quantum gravity and analyzes what happens to energy based on gravity. The following analysis shows what happens to orbital kinetic energy as G=rV^2/M remains constant and r expands to R. Lateral velocity (because we are dealing with surfaces) of the "orbiting" proton V falls to v as r becomes R. Orbiting is in quotes because this is also a model. The beginning involves high temperature associated with this kinetic energy and since plasma exists, one should not expect a neat orbit.

G remains constant G=rv^2/(M)		
RV^2/(M/g)=rv^2/(M/g0)	RV^2/M=rv^2	10.11 ke
RV^2*g=rv^2*g0	RV^2=rv^2	
(v/V)^2=(r/R)*g0/g	(v/V)^2=(r/R)	
(v/V)=(r/R)^.5*(g0/g)^.5		
ke=ke0*(r/R)	Ke decreases with r	

The expansion equations and the above analysis are put into action below to predict expansion and show that the gravitational constant remains almost constant during expansion.

This expansion history will be compared with other models in the section entitled "Comparison of Expansion Models" below.

The Concordance Model
Results from WMAP support incremental expansion equations that have become known as the concordance model. There are three parts to the equations, starting with an incremental calculation that updates the radius as a function of the distance increased over a certain velocity and time. The velocity is the second part of the equation and contains parameters such as 0.235 mass fraction and "critical" density 9.14e-27 MeV/m^3. The third part of the equation is an accelerating velocity addition to accommodate a universe containing an unknown dark energy that allows the expansion curve to increase linearly rather than follow a curve depending on time^(2/3). The radius "now" (4.02e25 meters) agrees with a measured Hubble constant of 69.7 [11] m/sec/mega parsec (2.26e-18/sec).

Constructing the 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.

Stage 2: Rapid Expansion increases the radius from 8.24e12 to 7e16 meters

The proton model yields the initial kinetic energy of 10.14 MeV which corresponds to 7.86e10 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 5.8e16 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 400 second period. The force on matter is MV^2/R where V is the kinetic energy related to temperature. Details are shown in appendix 4.

At 400 seconds, this period of rapid expansion ends and expansion follows the radiation dominated relationship R (meters)=1.2e15*(time/400)^0.5.

The radius 2e17e17 meter is the radius and temperature where He4 fusion occurs. This releases 0.55 MeV/proton. See details in the section entitled "Limits on baryon/photon ratio".

Stage 3: Radiation driven expansion from 2e17 meters to 3.06e21 meters where equality of radiation and matter occurs.

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 3.1e21 meters to 1.24e24 meters where star energy becomes important. R1=r0*t^(2/3) is the FLRW [12] 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. Details are shown in Appendix 1.

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 expansion

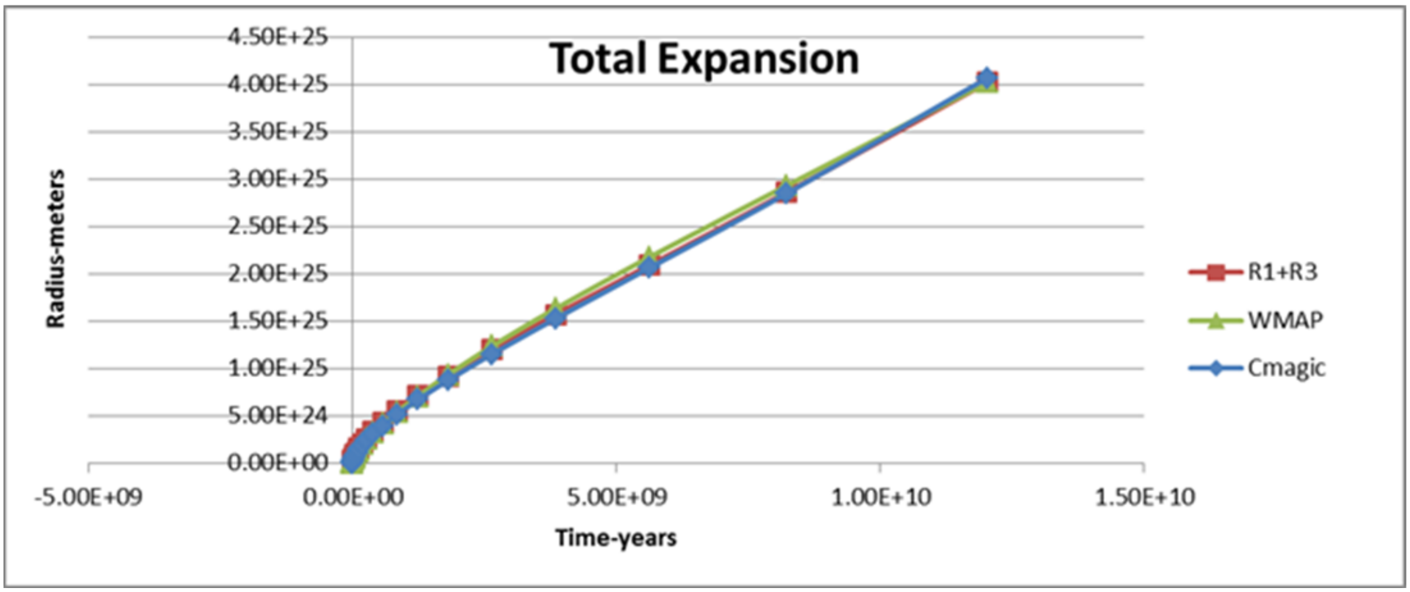
	Stage 1 start Initial Energy	Stage 2 start He4 fusion	Stage 3 start r=r*t^(2/3)	Stage 4 start Star energy	Expanded Energy now (MeV/proton)
R meters	8.25E+12	2.00E+17	2.03E+21	6.70E+24	3.12E+25 no stars
		reduced			
MeV/proton	10.15 ⟶	0.11			
MeV/proton		0.555	reduced ⟶	⟶	1.82E-10
MeV/proton				e addition ⟶	1.71E-10
R delta (meters)					8.70E+24
					4.02E+25 stars

The original 10.14 MeV/proton has been reduced by expansion (kinetic energy being converted to potential energy) to 0.0006 MeV/proton at 5.8e16 meters. The SAHA equation for deuterium predicts equilibrium at 8e8 K [8] and 5.8e16 meters. At this point deuterium combines into He4. The energy released is 0.23*7.07/4=0.55 MeV, where 7.07 is the binding energy for He4. 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" by only 0.011K.

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.

R1+R3, concordance, and Cmagic expansion history.

A graph of expansion radius for the author’s model (referred to as R1+R3) as a function of time is compared below to the model resulting from WMAP data and the Cmagic model [14] resulting from supernova data. The time scales at the bottom of the graph are the same for all expansion histories.



Comparison of Expansion Models

The author’s cellular model is the only model that does not involve velocities larger than the speed of light but of course as all cells expand they are carried away from each other at superluminal speeds. In three dimensions the cells that fill the volume repeat exp(60) times out to the edge of the overall radius for both the light and dark matter expansion. Each small cell contains one particle on its surface and has a small expansion velocity (currently 2.26e-18 m/sec) determined by the base and expanded states presented above for gravity. The author’s proposal is based on the inflation phase being identical to duplication of the particles by exp(180**).**
Energy conservation and the source of the cosmic background radiation will be addressed in later sections.
Conventional expansion models create space rather than move particles within space and represent space on a large surface rather than space between particles. Since all particles expand, the additive velocity is quite dramatic at the “edge” of the radius that contains the particles. As a

point of reference, studies regarding the distribution of mass throughout observable space document remarkable overall uniformity. A principle called the "cosmological principle" states that the initial condition was uniform. Theories exist regarding uniformity (inflation theories) that attempt to explain the initial uniformity [12]. Each light matter model suggests that "space is expanding and carrying light along with it", especially during an inflation phase and early expansion.
Cosmological parameters determined by the WMAP and Cmagic projects are summarized in Table 3 [11] and Figure 8 Cmagic [14] with rho critical=9.14e-27 kg/M^3. Important parameters updated by 9 year data are Omega total=1, consisting of 0.718 dark mass, 0.235 mass and 0.0464 baryons. Hubble's constant was updated to 2.26e-18/sec. Surprisingly the Cmagic model suggested that the universe is expanding more rapidly than the WMAP model although this is now being questioned. Many have concluded that the source of late stage expansion appears to be a cosmological constant. Since supernova data is based on luminosity of its "standard candle", the interpretation is mainly based on the final slope of the expansion. Both of these models are partially supported by the "cosmological constant" historical discussions involving Einstein, Friedmann, Mach and others [12].

The table below compares overall characteristics of the two models.

Comparison of Expansion Models

Criteria	**Proposal (R1+R3)**	**Concordance**
Expansion history	Current radius 4.02e25 meters Current H=2.26e-18/sec (WMAF	Current radius 4.02e25 meters Current H=2.26e-18/sec (WMAP)
Initial kinetic energy	Proton model gives 10.14 MeV	source unidentified (several hundred mev)
Temperature at beginnin	7.6e10 (10.14 MeV)	>1e11 degrees
Initial expansion kinetic equal potential energy	& ke 10.15 MeV	
Inflation	Identified as particle duplication	Planck scale exponential
Radiation driven	r=const*time^.5 until 3.1e21 meters	Unstated in Wmap documents
Helium formation	Sakharov He4 Fusion is accounted for Deuterium abundance OK if temperature bump included	Sakharov? no no accounting for dark matter
matter driven	r=const*time^(2/3) after 3.6e21 meters	r=const*time^(2/3)
dark energy	star energy caused	0.719 dark
Dark matter	0.5 proton 0.5 dark @ 1.67e-27 kg	0.046 baryons 0.235 dark
Final State of Universe	"flat" about 4e26 meters Time ratio =90 Expansion kinetic energy is depleted	"flat" expansion continues indefinately
CMB temperature K	2.73*(z-1) star energy increases by 0.011K	2.73*(z-1)
Conservation of energy	yes kinetic energy converted to potential energy	no
V/C in early Universe	Subluminal within cells (Space is expanded gravity r)	Superluminal space is being created
Mass Accumulation	accoustically initiated accoustic variation at decoupling power spectrum variations Accumulation of dark matter in cluster augments gravitation redshift	same

WMAP

The Wilkinson Microwave Anisotropy Probe (WMAP) [11] [21] was launched into orbit in 2001 and produced data for many years. Its purpose was to map the radiation coming from the entire sky called the cosmic microwave background (CMB). The temperature of this radiation is on average 2.725 degrees K but there are hot and cold areas (on the order of 70 micro degrees K) that are of interest. Theory emanating from Princeton's Peebles [12] and other important papers (Bahall) suggested that the hot and cold spots are the results of acoustic waves that have well defined origins and progress at know speeds. They begin to propagate at a condition called equality of mass and radiation density. As the universe expands and matter density starts to dominate, waves travel in the matter at a speed of C/3^.5=1.73e8 meters/sec. They travel outward from their origin and a temperature spot develops related to compression within the wave. As expansion continues another transition occurs. Electrons initially have too much energy to fall into orbits around protons (a state known as plasma where electrons are ionized and absorb light). As expansion decreased the temperature, plasma cleared and the universe became transparent. Radiation from temperature variations on the surface of last scattering traveled through space and was measured by sensors on WMAP. Temperature decreased in direct proportion to the expansion ratio (Rfinal/R), and knowing the temperature at which ionization falls to approximately 0.5 is was extremely important. This transition is known as the decoupling point. The period between equality and decoupling has been the subject of intense interest. Anisotropy in the radiation is related to mass accumulation and theorists have attempted to develop mechanisms for mass accumulation in the early hot universe. There is a critical period when mass accumulation needs to begin to agree with observations regarding early development of galaxies and stars (this occurs at about 200 million years into expansion according to some sources. Decoupling is predicted by an equation known by the acronym SAHA. At decoupling WMAP measured the temperature anisotropy of a sphere when the light matter plasma cleared and it was possible for radiation to escape (the surface of last scattering). The interpretation of the cool spots is that early gravitational accumulation has red shifted the radiation, somewhat offset by density compression that would also change the temperature slightly. The spot size data (0.0107 radians) and the magnitude of the temperature perturbations (70 microdegrees K) are of extreme interest.

WMAP data analysis using the proposed expansion model

Spot size (anisotropy in the CMB) is a measurement of decoupling radius. According to literature acoustic waves start at equality and are visible at decoupling. The time between these two transitions allow waves to travel 3.18e21 meters at velocity of 3e8/3^.5=1.73e8 meters/second. The highest temperature peak was observed by WMAP against the full sky and the angle the spot subtended was 0.598 degrees or 0.0105 radians. (there are pi radians per 180 degrees). The author utilized the R1+R3 model and showed that the model reproduces the results. This data allowed an estimate of the size of the universe now 4.02e25 meters. Results are compared in Appendix 3.

The above values can be compared with WMAP reported results below:

WMAP Reported and derived values				
3196	z equality			
1090	z decoupling			
302.4	acoustic scale			
14.116	da angular size dia gigapc			
6.920E+22	radius at decoupling meters=14.116*3.08e19/pi			
146.6	sound horizon mpc (3.08e19 meters/megaparsec)			
4.515E+21	sound horizon (spot size) meters=146.6*3.08e19			
4.922E+24	Wmap spot size now=1090*4.5e21			
0.0104	spot size in radians=4.5e21/(6.9e22*pi())			
7.542E+25	Universe radius now=4.9e24/.0104/(2*pi())			
2.301E-18	Hubble's constant =71/3.08e19			
13.75	Age of Universe Billion years			

WMAP results [11][21] 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 [21] 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 6, 12 and 13.

Constructing the temperature history from He4 fusion to present

If we are to calculate an accurate baryon/photon ratio, we need the temperature history earlier than the present values 2.725K and 4.02e25 meters. Important values can be calculated at Rh where primordial helium4 forms. The temperature throughout the entire curve from that point to the end is due to heat addition from primordial fusion to He4. Helum4 formation occurs when the SAHA equation for deuterium indicates that its probability is one. This is known to occur at 8e8K but the exact radius where this temperature occurs is critical. The SAHA equation is unity at 373 seconds and 5.82e16 meters radius. Details are included in the appendix topic entitled

“Details of primordial nucleosynthesis”. We can calculate the fusion energy added at that point. The value 0.25 in the figure below represents the fraction of normal matter fused to He4 and the value 4 represents the number of nucleons required to form He4 atoms. The value 7.07 MeV is He4 binding energy [7].

Binding Energy			
MeV	Number	dq MeV	
7.07	4.65E+76	3.29E+77	He4 binding energy*0.5*exp(180)*.25/4
0.11	7.45E+77	8.19E+76	Energy remaining from 10.15 MeV initial energy
		4.11E+77	sum dq MeV
		0.552	MeV/proton

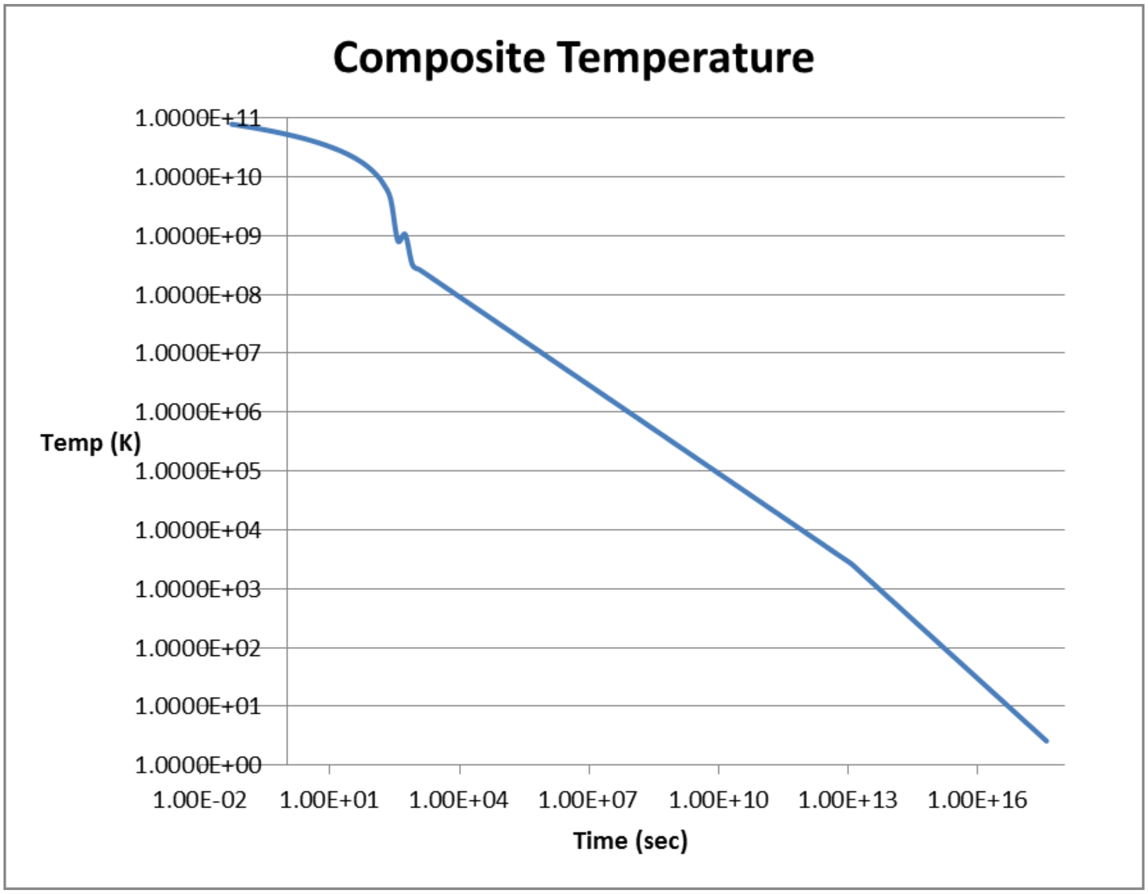
In addition to fusion energy there is a small amount of energy still available from the original 10.15 MeV. Kinetic energy 10.04 MeV was converted into potential energy to expand the initial radius and only 0.11 MeV remains at 2e17 meters.

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

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

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

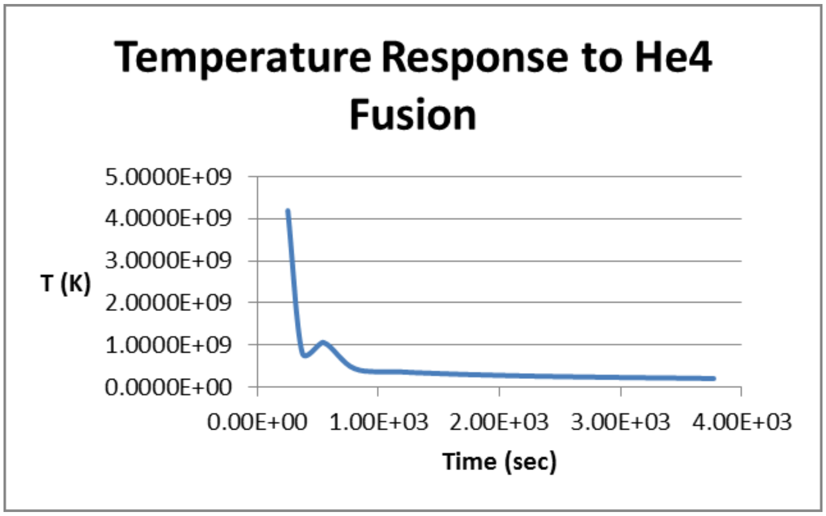
The total energy for the plasma components compares with the He4 energy release above (0.551 MeV/proton). The temperature 1.06e9K is one temperature we need to define the temperature curve and 2.725K is the other temperature. Dark matter saps 0.116 MeV from the total at 2.07e17 meters and continues to take smaller amounts as expansion progresses. As expansion occurs the temperature falls as Rh/R and yields 2.73K as the current value. Photon KE (MeV) determines the temperature (T=KE/(1.5B) where B is Boltzmann’s constant 8.6e-11 MeV/K. The curve is interesting.



The beginning temperature (3.92e10 K at 10.15 MeV) starts to fall and dives when the kinetic energy is nearly depleted. When the temperature hits 8e8 K the SAHA equation for deuterium initiates He4 fusion. This causes a spike in temperature to 1.06e9 K but then continues to fall according to Rh/R. The break in the curve at 3e13 seconds is decoupling where expansion follows a 2/3 power rather than the earlier ½ power.

Temperature spike from He4 fusion

The temperature history decreases initially but as He4 fusion occurs, the temperature increases before finally decreasing to the Cosmic Background Temperature (CBR) due to expansion. The temperature spike caused by the release of 0.55 MeV/proton is shown below.



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

Review of historical baryon fraction limitations

We are now in a position to calculate the important baryon/photon ratio and from the ratio calculate deuterium residual, He3 residual and Li7 residuals. The baryon/photon ratio equation is below; all one has to do is put in the radius and temperature at that radius (R&T). The point where He4 forms is 1.06e9K and 2.07e17 meters.

Baryon/photon=(0.5*EXP(180)/(4/3*PI()*R^3))/(8*PI()/(4.31e-21*3e8)^3*(1.5*8.62e-11*T)^3)

	1.0971E-09	7.7371E-10	7.3656E-10	1.3646E-09	5.8370E-08	5.8755E-10	1.1803E-08	1.1803E-08
Radius (meters)			1.0212E+00	1.0000E+00	5.82E+16	2.07E+17	2.51E+17	3.05E+17
Temperature (K)				1.35E+17	8.16E+08	1.06E+09	3.22E+08	2.65E+08
baryon/photon ratio				1.0400E+09	5.84E-08	5.88E-10	1.18E-08	1.18E-08
Time (seconds)				Measured	373	549	807	1186
D=4.6e-4*(B/P*1e10)^(-1.67)*1/exp(SAHA)				2.37E-05	1.10E-08	2.39E-05	2.39E-05	2.39E-05
He3=3e-5*(B/P*1e10)^-0.5				3.3e-5 to 1e-4	1.24E-06	1.24E-05	1.24E-05	1.24E-05
Li7=5.2e-10*(B/P*1e10)^-2.43+6.3e-12*(B/P*1e10)^2.43				6.00E-09	3.32E-05	4.73E-10	4.73E-10	4.73E-10
http://cds.cern.ch/record/262880/files/9405010.pdf				SAHA	1 (equilibrium)	3.01E+00	-5.47E+01	-7.20E+01

With 0.5*exp(180) protons, the baryon/photon ratio is 6e-10 but continues to change after He4 formation. We cannot use present day values for this critical calculation as literature suggests. Several isotopes are part of the primordial spectrum but once established they can't change at the lower temperatures. The literature equations for predicting deuterium, helium3 and lithium7 are on the left. At the calculated baryon/photon ratio the deuterium residual is in the range and the other two measurements are close to the measured values. The Planck mission's baryon/photon ratio result was 6e-10. A review of the reaction rates in reference 22 indicates that the density at

the temperature for He4 formation is critical. Rh above is 2e17 meters. The reason this Rh has to be larger than the equivalent Planck mission radius 9.06e16 meters is that a larger radius is required to enclose the required reactions [25] to match data because dark matter is part of the density and it does not react. This is shown by a ratio of the densities (3/2 because there are three species). Both sets of data below give 6e-10 baryon/photon but the set labelled Planck are for a lower radius and a compensating decrease to 0.046 baryons fraction of critical density. The line labelled "with dark matter" below is for 0.5 baryon fraction of critical density.

T (K)	8.16E+08	1.06E+09	3.22E+08	2.65E+08	2.19E+08	1.80E+08	1.49E+08	1.23E+08
		Baryon/photon=(0.5*EXP(180)/(4/3*PI()*R^3))/(8*PI()/(4.31e-21*3e8)^3*(1.5*8.62e-11*T)^3)						
		baryon/photon	number densit	radius (m)				
			.5*exp(180)/vol					
	1.685	6.1985E-10	2.9797E+25	9.0686E+16		n+p	Planck	
		5.8755E-10	1.9941E+25	2.0736E+17	1.49E+00	n+p+d	with dark matter	

Result of deuterium abundance possible limitation

The baryon/photon ratio and deuterium abundance should not cause baryons to be severely limited like WMAP [11] and other documents suggest (0.046 fraction of critical density). The number of baryons associated with 0.5 fraction of critical density is okay with respect to this possible limitation.

Dark Energy

Forces that determine expansion

Conventional cosmology uses time ratios for expansion but what are the actual forces that cause particles to expand away from each other? I used cellular cosmology to calculate forces. The derivation below shows a different way to write equations that obey Newtonian gravity. The coupling constant for gravity is a published value 1.16e-51 Mev M (Wiki). The equation G=F r^/M^2 can also be written in terms of kinetic energy. That equation would be:

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

The coupling constant is scaled down to one proton orbiting a central mass of one proton at KE by applying exp(90)/2. The 2 makes it kinetic energy and exp(90) scales the calculation to one proton orbiting another proton. Kinetic energy (MeV) for a known radius r is 7.08e-13/r with r in meters (lower case r is for cellular cosmology).

R (meters)	5.43E+17	6.59E+17	7.99E+17	9.68E+17	1.17E+18
Temp (K)	8.12E+07	6.70E+07	5.52E+07	4.55E+07	3.76E+07
r=R/exp(60) m	4.76E-09	5.77E-09	6.99E-09	8.48E-09	1.03E-08
coup*ph/pr	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13
ke=coup/r	1.06E-02	8.78E-03	7.24E-03	5.97E-03	4.93E-03
g=(939/(939+ke))	**9.9999E-01**	**9.9999E-01**	**9.9999E-01**	**9.9999E-01**	**9.9999E-01**
V=(1-(g)^2)^0.5*C (n	**1.4282E+06**	**1.2971E+06**	**1.1780E+06**	**1.0698E+06**	**9.7154E+05**
F=mV^2/r (Nt)	5.8671E-46	3.9911E-46	2.7149E-46	1.8468E-46	1.2563E-46
E=Fdr (MeV)	0.03	4.52E-03	3.73E-03	3.08E-03	2.54E-03
de from Rh	0.04	7.77E-03	6.41E-03	5.29E-03	4.36E-03

Each column of calculations is a radius increment. R is the expansion curve and T is the temperature curve reported in the section above entitled “Constructing the expansion radius”. The radius r is R/exp(60), again to scale the calculation down to the proton-proton level. Next we determine the orbital kinetic energy related to gravity (keg) by the definition of coupling constant above, i.e. Coup=keg*r. We know r and can determine keg. For radiation driven expansion we know that ke cannot fall below the energy contributed by photons because inertial forces *and* impact by photons drive expansion. The photon energy is kep=T*1.5*B where Boltzmann’s constant B=8.6e-11 MeV/K. With this we put (keg+kep) in the equation for gamma and then determine orbital velocity. From here we can calculate the force F=mV^2/r. Above it is 5.86e-46 Nt for the first increment. We can now actually calculate the next radius in incremental calculations from fundamental forces and do not have to rely on the equation r=r0*(time/time0)^.5. The equation is r=rprior+E/F*1.6e-13/exp(90). From here we can take the scaling out and calculate R=r*exp(60).

Energy added by stellar photons

Each star on average contributes 2.37e39 MeV/sec and there are an increasing number of stars after z=16. 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.

Fraction of star energy delivered

We calculated that there would be about 0.5 MeV/proton considering the fusion energy of all the stars. We now show the fraction of that energy actually available to expand free protons. At this point most matter is in galaxies, etc. that are in orbit. Classically, it is not available to expand any longer because it is gravitationally bound. I assumed that free protons make up about 10% of all matter at the present time but this can be refined. The model for the following calculation is a target proton that expands when it is impacted by photon energy. The entire sky is the source of the photon energy and it contains 6e20 stars each with an area (1.52e18 m^2). The number of photons in the source area equal protons divided by the baryon/photon ratio. There are 1.47e77 target protons (10% of all matter) each with a cross-section to photons of 2e-31 meters^2 (PDG). When all of this estimated, the fraction of the star energy that is actually delivered to their targets is on the order of 1e-10.

1.48E+21	nstars=number of stars/sky area
1.52E+18	source area/star (pi^r^2, where r is star radius) meters^2
4.13E+51	sky area= surface area of the universe modelled as sphere (4pi^Runiverse^2) (meters)^2
9.32E+90	source of photons=nstars/sky area*star area*sky area
2.72E+98	number of photons in source area=source of photons/(nprotons/nphotons) (np/nb=3.4e-8)
1.49E+77	target =number of free protons (about 0.1 of all protons)
2.00E-31	cs=cross section of target proton=2e-31 m^2
3.65E-10	fraction delived to expanding protons (numb photons/target*cs)

Late stage expansion

We are in a position to predict late stage expansion with the energy addition (e). We are interested in its effect on radius and temperature. For example we want to answer the question "how large does e have to be to explain the second component of expansion?" We will focus on the column on the right (the present time).

We can carry the above incremental calculations to the present time. After 3e22 meters, expansion is no longer radiation driven. The forces involved are gravitational forces only. The columns of calculations above are carried through to the current time below. But we can add a small energy e to the calculation and find out its effect on radius. We will focus on the column on the right (the present time).

8.69E+24	1.12E+25	1.45E+25	1.88E+25	2.43E+25	3.14E+25	R (meters)	
7.61E-02	9.84E-02	1.27E-01	1.65E-01	2.13E-01	2.75E-01	r=R/exp(60) m	1.27E+00
7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	7.09E-13	coup*ph/pr	
9.31E-12	7.20E-12	5.57E-12	4.31E-12	3.33E-12	2.58E-12	ke=coup/r	
1.9858E-14	**1.5360E-14**	**1.1880E-14**	**9.1891E-15**	**7.1075E-15**	**5.4975E-15**	**g=(939/(939+ke))**	
4.2247E+01	**3.7155E+01**	**3.2677E+01**	**2.8738E+01**	**2.5274E+01**	**2.2228E+01**	**V=(1-(g)^2)^0.5*C (m/sec)**	
3.2082E-62	1.9193E-62	1.1483E-62	6.8696E-63	4.1098E-63	2.4587E-63	F=mV^2/r (Nt)	
4.22E-12	3.26E-12	2.52E-12	1.95E-12	1.51E-12	1.17E-12	E=fdr (MeV)	
7.61E-02	9.84E-02	1.27E-01	1.65E-01	2.13E-01	2.75E-01	predicted r (m)	
2.137E-14	5.376E-14	1.273E-13	2.916E-13	6.543E-13	1.449E-12	e addition	2.84E-12
1.26E+01	9.74E+00	7.52E+00	5.77E+00	4.30E+00	2.73E+00	Temp w/o star	0.354
1.66E-04	4.17E-04	9.87E-04	2.26E-03	5.07E-03	1.12E-02	delta T stars	1.045
1.260E+01	9.739E+00	7.521E+00	5.774E+00	4.303E+00	2.743E+00	Temp with Stars	
7.62E-02	9.88E-02	1.29E-01	1.70E-01	2.34E-01	3.52E-01	r=rp+(E+de)/F*1.6e-13/EXP(90)	
8.70E+24	1.13E+25	1.47E+25	1.94E+25	2.67E+25	4.02E+25	R=r*EXP(60)	with star de
9.97E+21	4.19E+22	1.66E+23	6.36E+23	2.38E+24	8.83E+24	delta R stars	
	8.48E-18	5.87E-18	4.18E-18	3.18E-18	2.68E-18	V=dR/dt/R	

The predicted cell radius r=0.275*exp(60) to match the full radius 3.14e25 meters. The calculated gravitational kinetic energy is only 2.6e-12 MeV from inertia. The value E=Fdr=1.51e-12 MeV checks as the energy required to calculate the next radius.

r=rp+E/F*1.6e-13/EXP(90)			
0.275=(0.213+1.17e-12/2.46e-63*1.6e-13/exp(90))			
0.275354438			
3.14E+25	R=0.275*exp(60) m		

Now look at the e addition line. Adding 1.45e-12 MeV increases the radius of the universe to 4.02e25 from 3.14e25 meters (delta=8.83e24 meters). This is equivalent to the expansion component associated with lambda and dark energy.

The effect of 1.5e-12 MeV on the temperature is a delta of 0.011 degrees K.

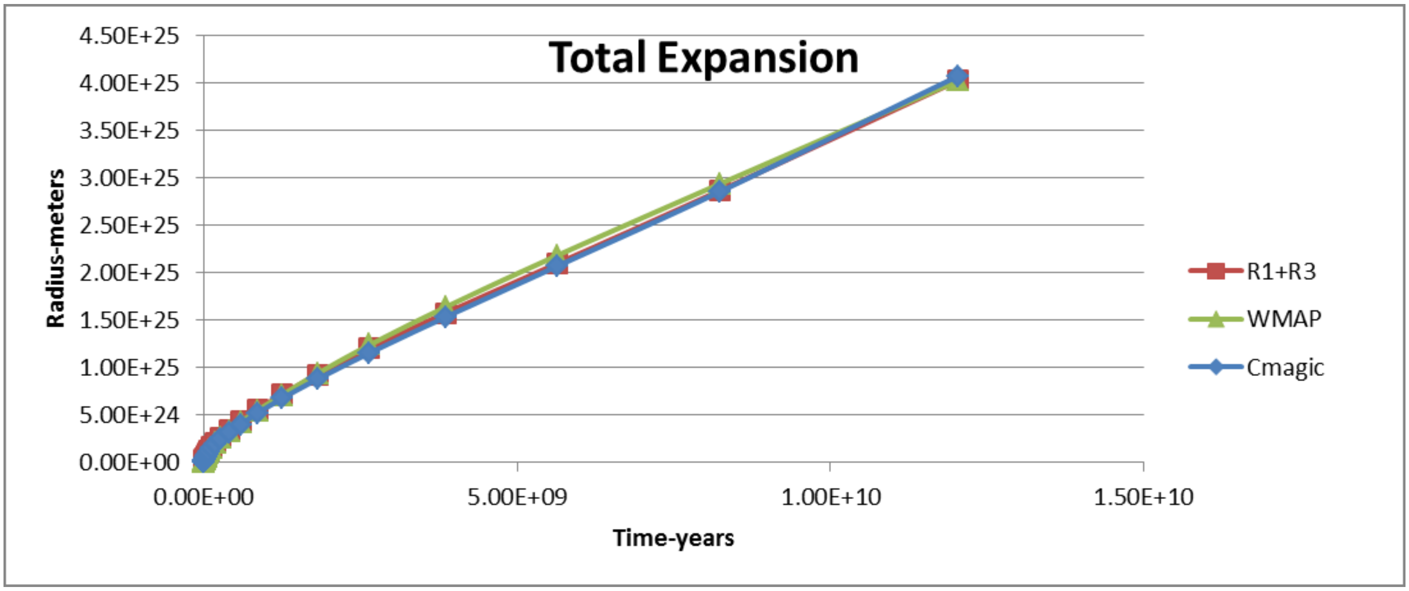
Above we took the lambda component out but added 1.5e-12 MeV to replace it. It is proposed that late stage expansion is related to energy released by stars [18]. Late in expansion stars are lighting up and the overall fusion energy produced is on the order of 0.5 MeV/proton. Only a tiny fraction of this energy (on the order of 3e-12) actually expands free protons (protons not tied up in orbits).

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 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.



Comparison with Hubble constant measurements

Several missions have refined the Hubble constant. It is 2.26e-18/sec or 69.7 km/mpc/sec, sometimes written h=69.7/100=0.697. Concordance equations use two expansion components but we didn't include the second component (about 7e24 meters) in the expansion curves developed above. Hubble constant measurements are the slope of the expansion curve/divided by Rnow including both components of expansion. We added back a component related to photon energy and now recalculate the Hubble constant.

1.13E+25	1.47E+25	1.94E+25	2.67E+25	4.02E+25	R=r*EXP(60)	with star de
4.19E+22	1.66E+23	6.36E+23	2.38E+24	8.83E+24	delta R stars	
8.48E-18	5.87E-18	4.18E-18	3.18E-18	2.68E-18	V=dR/dt/R	

The calculation table above indicated that the force required to move particles apart against gravity is very low (on the order of 3e-63 Newtons). The energy/particle required to expand the universe from z=15 to the present is on the order of 1.5e-12 MeV. This value is 13 orders of magnitude lower than the kinetic energy associated with 0.72 critical density calculated below on the order of 0.72*43 MeV.

Critical density

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

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

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

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

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

The equations below appear to define critical density RhoC.

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

The equation is useful to relate the Hubble constant 2.26e-18/sec to rho but it only works because the present density is 9.14e-27 kg/m^3. This is rhoC but the considerations below indicate that it cannot be used to characterize other possible components of expansion.

Kinetic energy and critical density

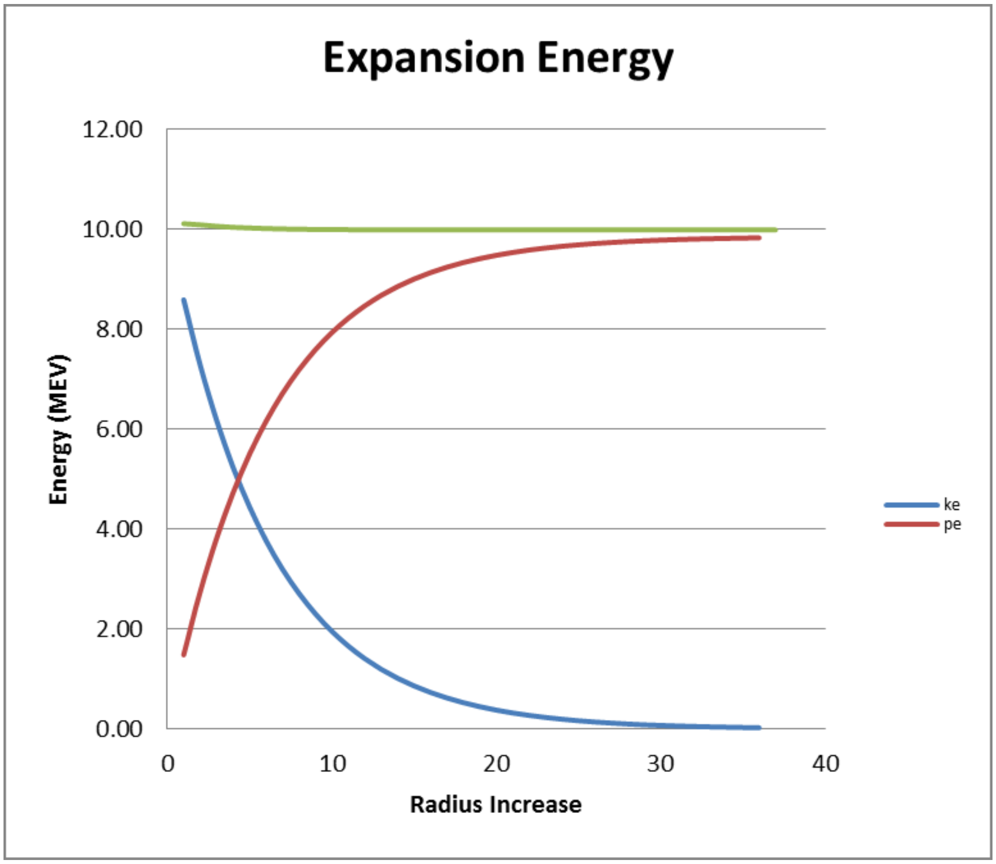
We can see problems with critical density when we relate it to kinetic energy. The velocity can be found by multiplying V/R*R. From here, we can find kinetic energy at the current time ½*m*V^2.

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

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

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

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



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

Cosmological Parameter Comparison

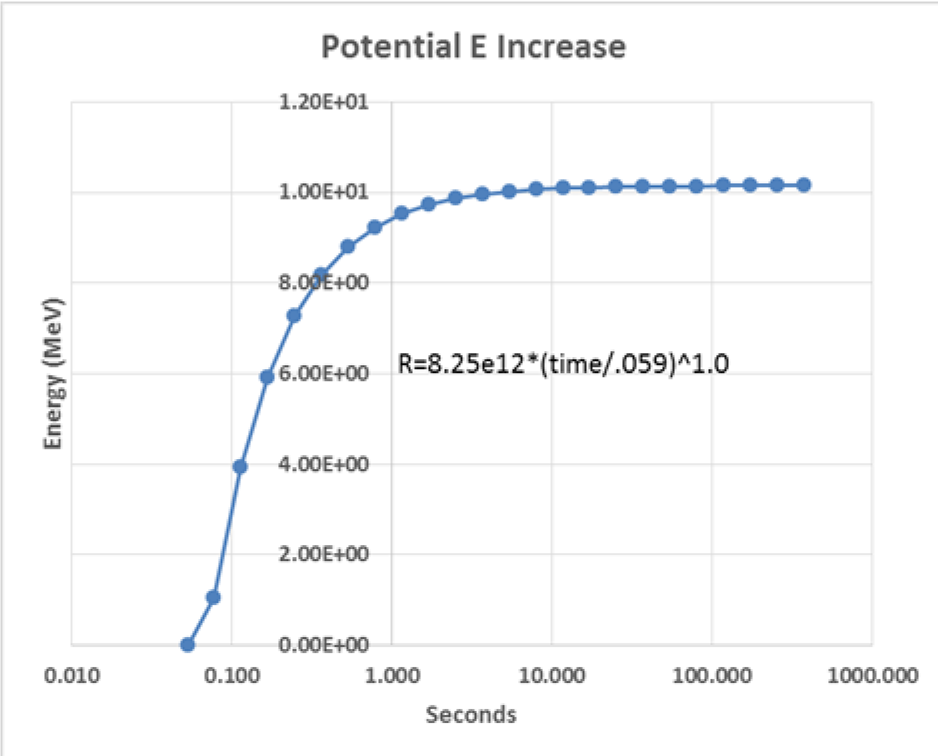
It was shown above that the concept of critical density cannot be used for dark energy. However the current density is 9.14e-27 kg/m^3 and this value is related to measurement of the Hubble constant 2.26e-18/sec. WMAP literature parameters [26] are listed on the left side of the table. Omega is listed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

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

Detailed energy balance for expansion

Derivations that end with (v/r)^2=8/3 pi G rho start with the assumption that initial kinetic energy will become potential energy as expansion occurs. Calculation of kinetic energy at the beginning can't be done with big R because the velocity is greater than the speed of light; hence the wisdom of carrying this out with the cellular model.

The detailed energy balance/particle at different times in the expansion is shown below (all values are in MeV).

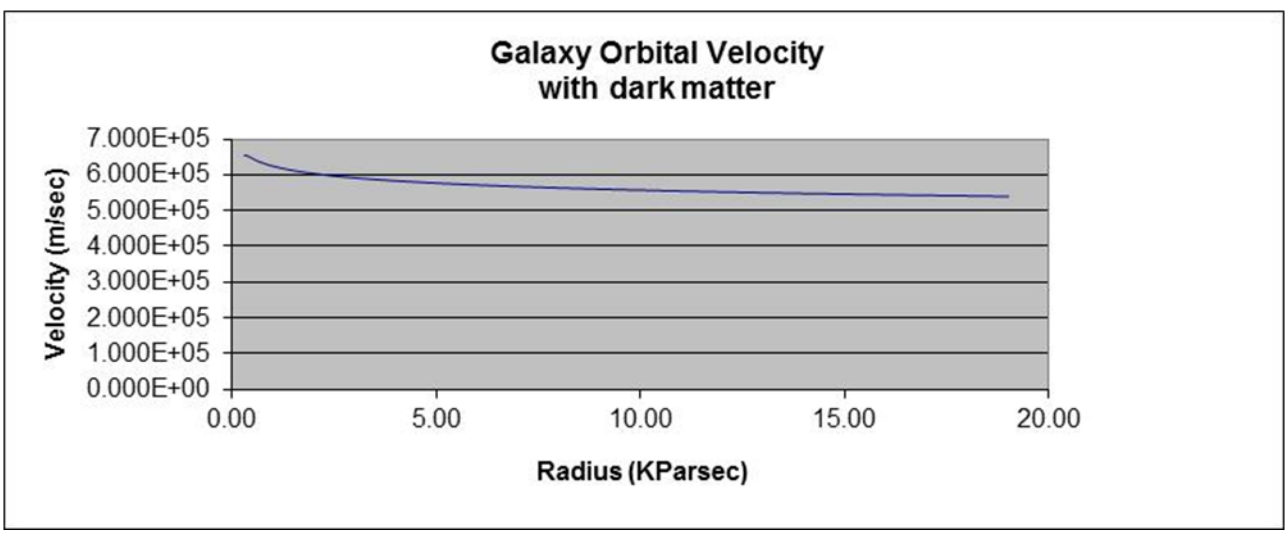


Note that the overall energy balance is zero for each time during expansion, even though expansion kinetic energy has been converted to potential energy. The table below includes all sources of energy and kinetic energy inside the atom has been converted to external kinetic energy (temperature) due to fusion. The original neutron decays to a proton release of an electron, some kinetic energy and a neutrino. The original proton mass table shows that the electron quad produces 27.2e-6 MeV of kinetic energy that just balances the negative 27.2e-6 field. As the electron falls into the field, 13.6e-6 MeV will be released as light/heat. Likewise as mass accumulation occurs, some gravitational potential energy will be reconverted to kinetic energy. It is observed that a particle falling into the gravitational potential eventually creates lateral kinetic energy that allows an orbit to be established. In this process, the fall positions the orbiting body at one half of its original height if its energy is conserved. It is clear that expansion kinetic energy is not reversed. Entries in the table could be changed slightly to reflect exactly where the kinetic energy is but the total of gravitational and kinetic gravitational will not change as a result of gravitational accumulation. Note that the kinetic energy to expand each cell is on the order of 10.11 MeV. At time zero, no fusion has occurred and the neutron mass table shows a small release related to the neutrino quad and nothing else. The initial density is defined by 0.5*1.67e-27 kg divided by the volume associated with the gravitational radius of 7.22e-14 meters (1e12 kg/m^3). Expansion reduces the density quickly but the early temperatures and densities are very high. Particles that fall into orbits as mass accumulation occurs often have kinetic energy/particle on the order of several MeV as shown in the following table for the mass of one proton attracted to a maximum central mass. Particles will fall half way to the center where they establish an orbit with inward and outward forces balanced.

ENERGY BALANCE PER PARTICLE AS EXPANSION OCCURS									
simple cell bk9		Fusion	Fusion		Gravitational	Gravitational	Electron	Total	
begin	Atoms/Strong	ke	Heat	e/m	Kinetic Energy	Potential E	neutrinos	mev	
	131.4566							131.4566	mass
0.000	797.9575	10.15127013	0		**20.303**	**0.00**	4.85E-02	828.4598	ke
-2.732	-957.1847							-959.9164	pot
								0	total
after decay to P & fusion to helium				e/m					
(released as K	129.5409						1.2788	130.8197	mass
	798.5799	8.521270135	1.63	2.720E-05	**10.15**	**10.15**	0.1114	829.1451	ke
-2.7316	-957.1847							-959.9164	pot
					Grav Kinetic E	Grav Pot E	CMB	0	total
Now	6.16E+25								
	129.5409						1.2788	130.8197	mass
	798.5799	8.351270135	1.8	2.720E-05	**1.40E-12**	**20.30**	0.1114	829.1451	ke
-2.7316	-957.1847							-959.9164	pot
								0	total
Near end	2.36E+26								
	129.5409						1.2788	130.8197	mass
	798.5799	8.351270135	1.8	2.720E-05	**0.00**	**20.30**	0.1114	829.1451	ke
-2.7316	-957.1847							-959.9164	pot

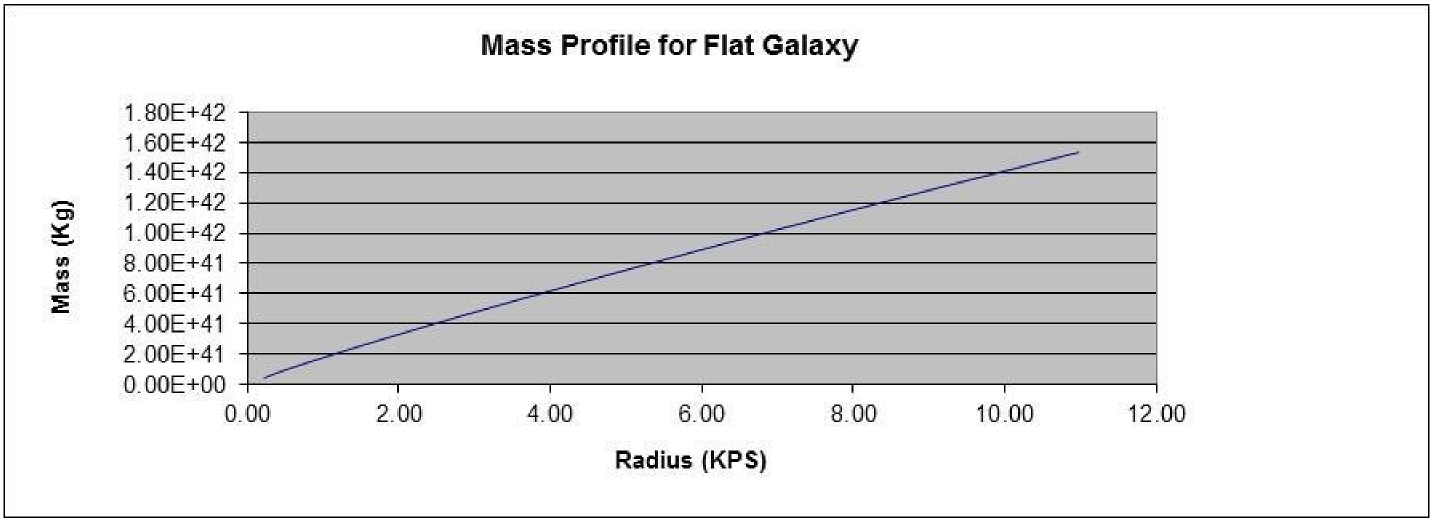
Galaxy velocity and luminosity profiles

An early clue that dark matter indeed exists lies in the observation of the velocity and luminosity across the diameter of observable galaxies. This work is largely credited to astronomers at the University of California Santa Cruz. If a significant amount of dark matter forms a "halo" around observable light matter, the flat velocity profiles and the decreasing light density (MeV/m^2) emanating from the edge of the galaxy can be rationalized. Galaxy mass accumulation studies were carried out for a combination and dark and light matter. The galaxy estimated above has significant amounts of dark matter in their outer regions. It seems reasonable that the dark and light particles have no preferred position initially among the exp(180) identical particles but that dark matter particles tend to accumulate outside gravitationally bound objects because they move readily through other particles and have no way of losing kinetic energy. This flattens the velocity profiles as shown in the graph below. Again, these are estimates only.

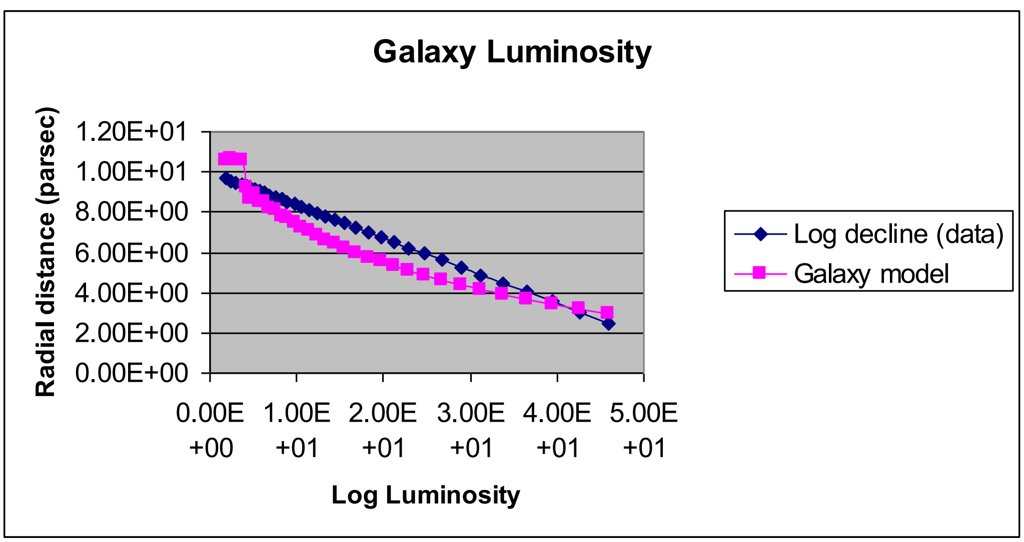


Galaxies with dark matter

Galaxies contain cold dark matter and this "hidden" mass exists in a halo and causes the velocity to be approximately 5.6e5 m/sec from near the center to the edge. This galaxy will be a combination of cold dark matter and hot matter. The normal matter lost considerable kinetic energy by friction as it fell into the galaxy. The only way that the mass distribution for the flat profile could have developed was interaction with another galaxy (see studies of barred spiral galaxies).



The luminosity of a galaxy containing dark matter will decrease exponentially from center to edge although the mass profile increases. This can be simulated assuming that only the normal matter combines into stars that give off light.



The author believes that the current proposal is consistent with the WMAP analysis. Both analyses use a density equivalent to the proton mass for equality. A “dark” particle could be the same mass as a neutron that does not decay and has zero “cross-section” for absorption. Recall that inflation in the author’s proposal is duplication of one particle (based on the proton model) exp(180) times. Reference 3 is the author’s analysis of all the baryons and mesons. Understanding and modeling baryons and mesons requires balancing the properties of particles to zero by including duplicate energy opposites. This balancing would be expected to produce a proton “double” (protons are baryons).

Mass accumulation
It is clear from WMAP that amplification of light matter acoustic waves is the primary mechanism. Plasma exists until the temperature drops enough to allow electrons to form orbits around protons. Radiation pressure prevents gravitational accumulation until radiation is attenuated by expansion. Eventually gravitational forces become dominant and accumulation of mass into clusters, galaxies and clusters begins. The concentration process later allows stars to “light up” with fusion when they become dense and hot. This is known in the literature as re-ionization. Stars burn up their hydrogen and follow the well documented aging cycle that depends on the kinetics of progressive fusion reactions. Literature cites measurements regarding the abundance of the heavy elements that are produced by these reactions. Once density develops conventional gravitational accumulation continues. The approach below should be considered estimates since it is very difficult to calculate processes that are probabilistic.

Partitioning the volume into clusters
Accumulation of mass obeys conventional kinematics and Newton’s law as bodies fall into each others gravitational fields. The final state appears to consist of clusters, galaxies, stars and planets interacting gravitationally in a way that a new semi-stable state is achieved. That state is ideally nested “orbits” in which forces are balanced. Overall movement in the resulting orbital state is neither overall expansion nor contraction. The numbers of spots in the WMAP analysis were probably the seeds of clusters. If the spots represents spheres of early accumulation, the number of spots is (Runiv/Rspot)^3 and equal to 3300. WMAP results suggest that the dense (cool) spots observed are associated with clusters in the era of decoupling. This would place the mass of clusters in the right range. (1e47 kg).

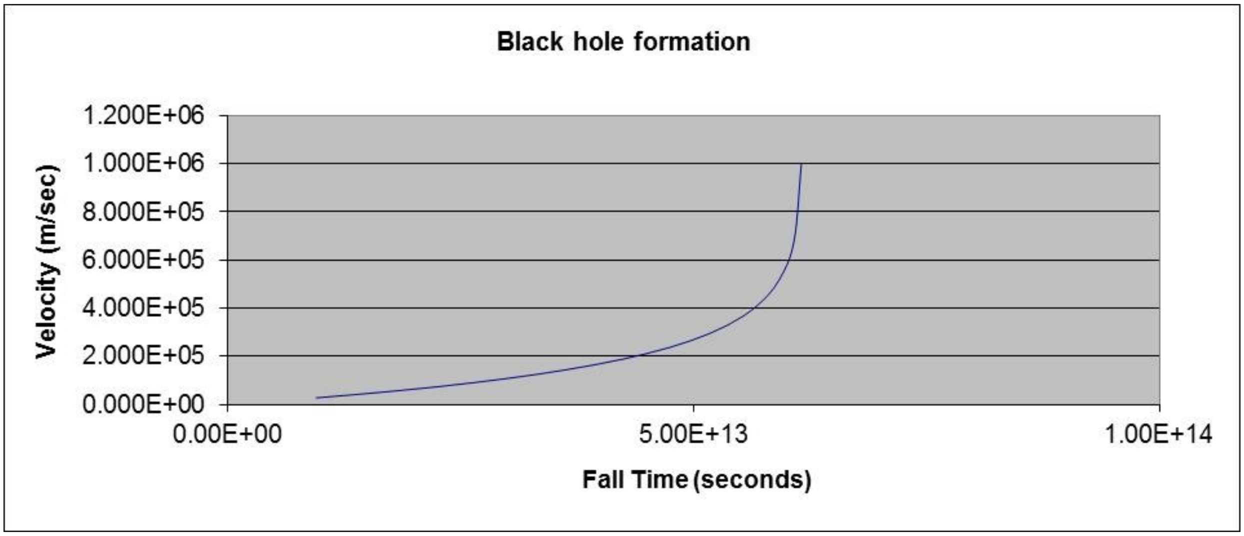
Number of Galaxies and Stars
The ratio of pi*spot size/Jeans wavelength is approximately 1.7e6 according to the following “estimates”. (Estimates (in red) are presented with empirical constants for demonstration purposes). If clusters are approximately 9e46 kg, the galaxies would be about 6e40 according to the following estimates based on the ratio 1.4e6.
At decoupling wave speed drops dramatically as the plasma clears. The Jeans length falls to a fraction of 1e18 meters. This divides the clusters into smaller disturbances that with time form stellar masses due to fractionation of the Jeans length. This divides the 5.45e40 galaxy mass by about 1e11, giving a maximum probability star mass of 5e29 kg.

				Detailed WMAP ratios give mass of						
				clusters & stars based on M universe						
				Universe mass (kg)						
				1.67e-27 kg*exp('	**2.5E+51**	Kg Universe				
	R1+R2	4.72E+22								
		2.6E+04		((4.8e22)/1.62e21	**9.5E+46**	Kg Cluster				
	spot (m)	1.59E+21								
	spot*2 (m)	3.17E+21	meters							
		1.7E+06		((3.76e21)/2.67e1	**5.6E+40**	Kg Galaxy	6.237E+40	avg mass of galaxy from count data		
Jeans lo spee	1.33E+18 →	2.67E+19	meters		4.0E+10	numb galaxy	data http://universe-review.ca/F05-galaxy.htm			
Jeans hi spee	5.00E+22 ↗							mass--kg	dn/d log m	
	Jeans lo (n	2.67E+19	meters					2E+29	5.0000E-02	
		1.1E+11		(2.67e19/5.6e15)'	**5.2E+29**	star mass	~~compare data~~ →	3.17E+29	0.2	References
Jeans fractio	1.33E+18	5.60E+15			4.8E+21	number stars		5.024E+29	0.29	maximum probabilit
				stars/universe=clusters/universe*galaxys/cluster*stars/galaxy				7.962E+29	0.25	

The mass distribution of stars [12] is well estimated by their life cycle data and once again the approach above gives about the right average. As indicated by photography, galaxies and stars are still in the process of development. Mass accumulation at the star level is from material that has been recycled and concentrated from earlier generations. Spiral galaxies are apparently good concentrators and star development is not only cyclical but very incomplete at the present time as evidenced again by photography. Star counts and surveys of matter indicate that only a small fraction is visible. As individual atoms fall toward the central body, most of the material will form orbits. Over time in relatively small accumulations enough kinetic energy is lost to allow "solid" stars to form and "light up" with nuclear fusion.

Formation of Black Holes

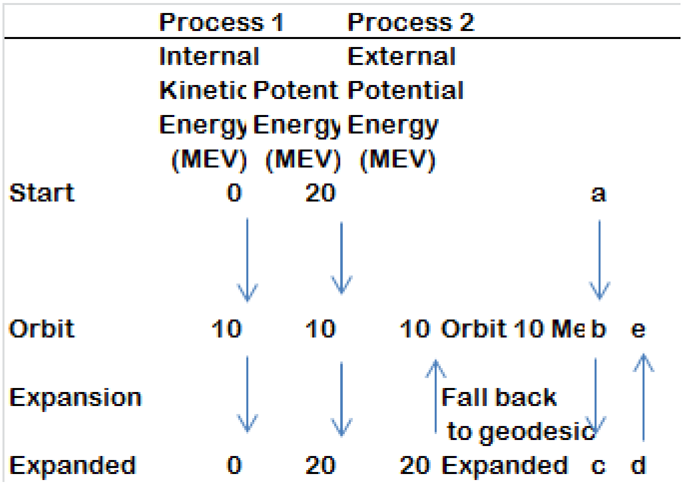
Apparently some black holes formed soon after decoupling of mass and radiation and aided galaxy formation. The excel spreadsheet fallmodel.xls is simply Newtonian kinetics combined with the R1+R3 expansion model. Starting at equality of matter and radiation acoustic waves develop and concentrate mass. WMAP [11] measured the red shift of (spots) that we can now associate with clusters. When the universe was about 1e22 meters in size waves started travelled until they were spots of about 3e21 meters. This dividing matter into approximately 2.6e4 clusters each containing 1e46 kg mass. The Jeans length is a natural wavelength associated with temperature and the state of matter. At decoupling the plasma cleared and the Jeans length transitioned to a much lower value. It went from Jeans high 5e22 meters to Jeans low 3e19 meters. This low Jeans number is listed as "empirical" in reference 12. The low speed Jeans length divided the WMAP spot size of 3e21 meters into about 1e6 smaller spots that we associate with galaxies. The smaller spots contained about 1e42 kg mass. According to the fall model, some mass fell quickly inward and formed a black hole. Some black holes were "seeds" for galaxies. The reason the first masses form black holes is that their fall velocity becomes the speed of light if they are not deflected into orbits. Below the fall velocity as a function of time is shown from fallmodel.xls:



A black hole is an attractor that brings mass into a galaxy. As new mass falls, it falls into orbits around the black hole. The galaxy builds mass from the inside out. As later mass falls, it develops less velocity from the fall.

Gravitational accumulation forms orbits

First review how orbits are formed. The diagram below shows that there was about 20 MeV of potential energy available, the point marked (a) below. The proposed model for expansion is based on an orbiting proton with approximately 10.15 MeV of kinetic energy (b). Since the proton is attracted to and separated from the center of the field, there was also 10 MeV of potential energy when the orbit is established. As expansion occurred (process (b)→(c) below), 10 MeV of kinetic energy was converted to 10 additional MeV of potential energy. At a much later point in expansion (c), although there is motion (temperature) of the proton on the surface of the expanding cell, there is no motion between cells (protons) except for expansion. With the proton velocity nil between cells geodesics will be extremely flat (on the order of 5e38m) compared to 4e25m. This causes acceleration of particles toward one another (process 2 below) and external kinetic energy (between protons) increases as protons fall back toward the geodesic (d)→(c). On average the expanded cells do not change their radius. Theoretically, 10 MeV of external potential energy could be reconverted to10 MeV of kinetic energy as particles fall toward one another. Overall, process (b)→(c)→(d)→(e) converts cellular surface kinetic energy to external potential energy between cells.



What actually happened during expansion was a transition occurred and acoustic waves broke the total mass into about 3300 clusters. After equality of photon density and mass density, process (d)→(e) occurred; protons accumulated and eventually fell into orbits that we observe as clusters of galaxies, galaxies, etc. As an engineer one cannot help but be impressed with the approximate energy conservation of combined processes 1 and 2. These processes represent the largest construction project in nature (the universe) and almost no energy is consumed. The "neat trick" seems to be cells that expand, on average don't re-contract and are able to move and fall relative to each other after they are far apart.

During expansion, the kinetic energy of the proton on the cell surface decreased by KE/ke =10.14/ 7.4e12=1.3e-12 MeV and the current velocity on the surface of each cell fell to16 m/sec. The protons could theoretically regain 4.3e7 m/sec by falling but particles usually fall less than this where orbits are established.

Summary

Information that describes nature in a concise way appears to reside inside the neutron and proton mass model. The R equation "displays" this information on several scales that underlie nature's four forces and its cosmology. The big bang could be an expression of this information. An expansion model was offered that simulates conditions consistent with observations to date. Enough energy to support current observations regarding the size and age of the universe is also associated with the model. Overall, the proposals in this document indicate that nature may be somewhat understandable. In particular, the proposal has the following to offer in the field of cosmology:

- Space is created at the quantum level of 7.22e-14 meters [21][22] and expands with time accompanied by changes in kinetic and potential energy. There are exp(180) cells, each now with radius 0.5 meters, simulating a universe radius of 4e25 meters.
- Fundamental expansion equations have two expansion exponents, one with time to the (1/2) power and the second with time to the (2/3) power depending on whether expansion is radiation driven or kinetic energy driven. Application of these equations agrees with currently accepted expansion curves.

- The proton mass model is the source of the expansion energy per cell of 10.14 MeV. This is enough kinetic energy to expand each cell to 0.5 meters. Calculations show that the second component of expansion requires a negligible amount of kinetic energy. Based on estimates of energy released by stars late in expansion it appears that "dark energy" is just the expansion from this source. There is little question that the critical density rhoC=9.14e-27 kg/m^3 associate with the Hubble constant is correct. However, late stage expansion is not mass driven and the light and dark components can be scaled up so there total is 1.0. Re-analysis of limits imposed on cosmology by deuterium, helium3 and lithium7 abundance calculations was carried out. It was discovered that conventional cosmology does not include the temperature spike that occurs when He4 is formed about 400 seconds after the beginning. When this is included the baryon fraction 0.5 appears to be feasible. At the end of expansion the baryon/photon ratio is 4.4e-10, the value reported by WMAP.
- The number of proton like masses in the universe is exp(180).
- Derived cosmological parameters are consistent with the proton mass model.

The proposal has the following to offer in the field of unification:

- Information in the proton model provides an understanding of gravity at the cellular level. The numerical and geometrical similarity provides a coupling constant for gravity that is the small value 1/exp(90). Properly utilized, it was shown that time dilation (dt from Schwarzschild's equation) for general relativity agrees with special relativity dt.
- The weak interaction (called the strong residual interaction) is responsible for atomic binding energy. The kinetic energy 10.15 MeV from the proton model is proven to be the value that changes and produces the binding energy curve.
- The strong and electromagnetic coupling constants are properly predicted by values in the proton mass model, supporting the concept of unification.

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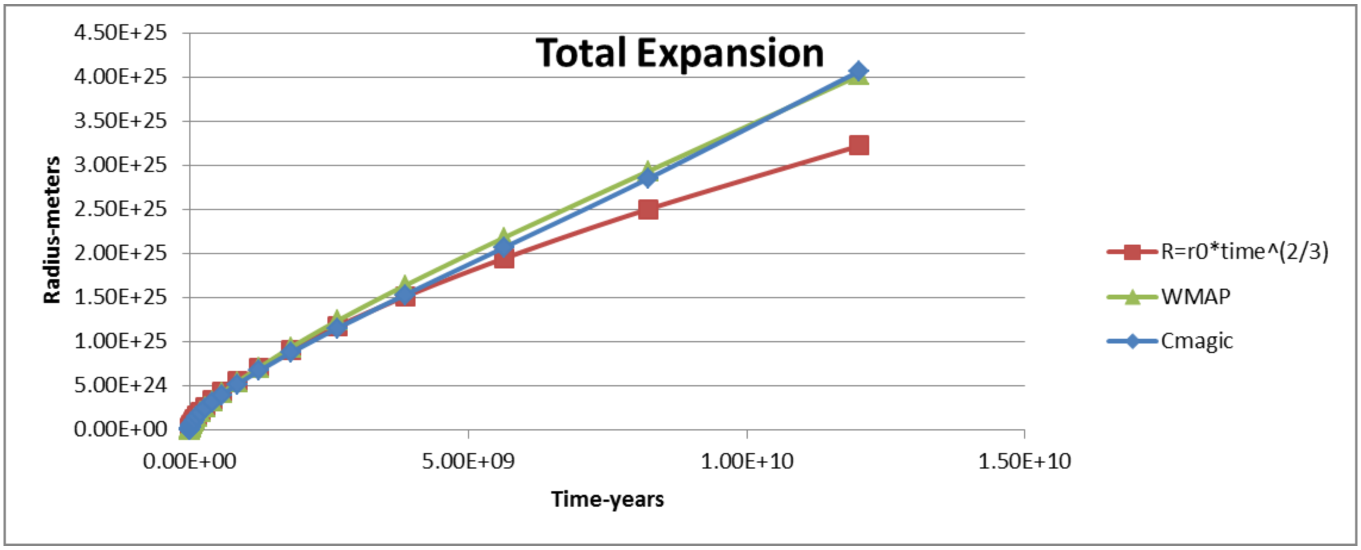
Appendix 1

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.



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.

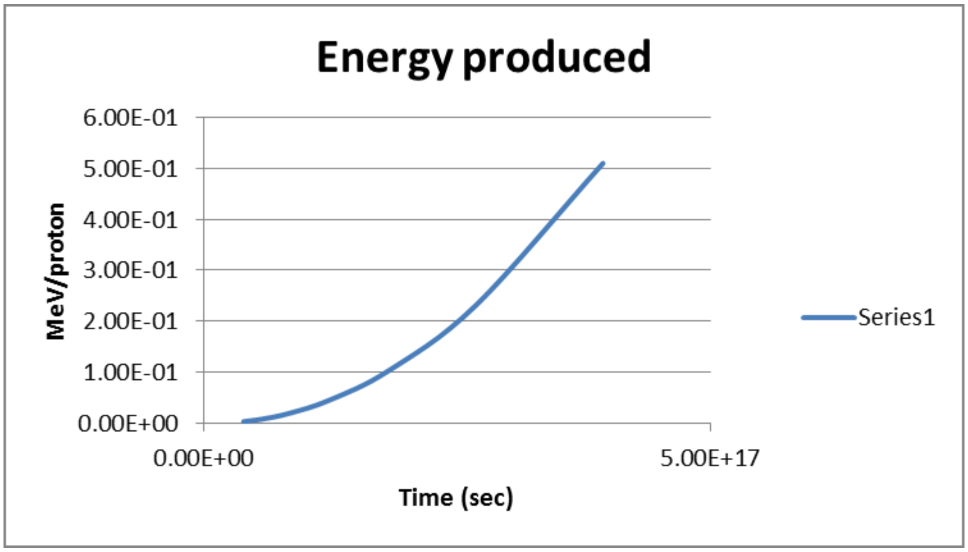
		0.487	MeV stars
fractional abundanc	Binding Energy	9.29E-01	Mev total
5.00E-07	2.490	4.15E-07	He3
2.50E-01	7.075	4.42E-01	He4 prim
	7.075	4.37E-01	He4 star
6.00E-09	5.644	4.84E-09	Li7
2.00E-09	6.492	1.44E-09	Be
2.00E-09	6.952	1.26E-09	B11
5.00E-03	7.681	3.20E-03	C12
1.00E-03	7.477	5.34E-04	N14
1.00E-02	7.977	4.99E-03	O16

Primordial Helium4 fusion released 0.442 MeV/proton but much later the stars produced an additional 0.49 MeV/proton. This 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. 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.

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 0.5*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)

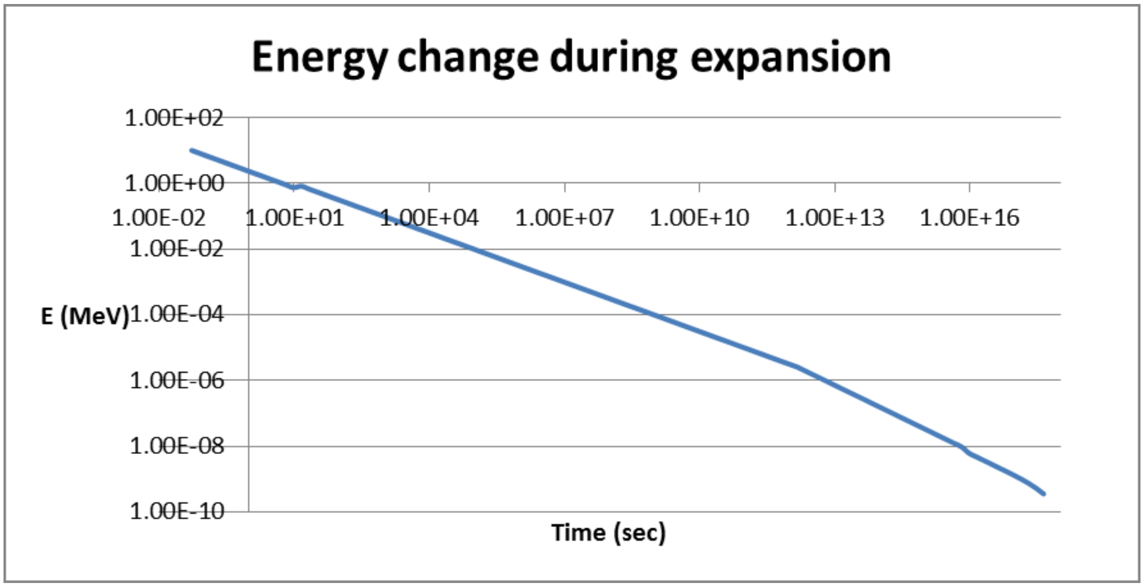
Since star formation rate was not uniform, we will distribute stars over the period z=16 to the present. The graph below provides an estimate.



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

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).

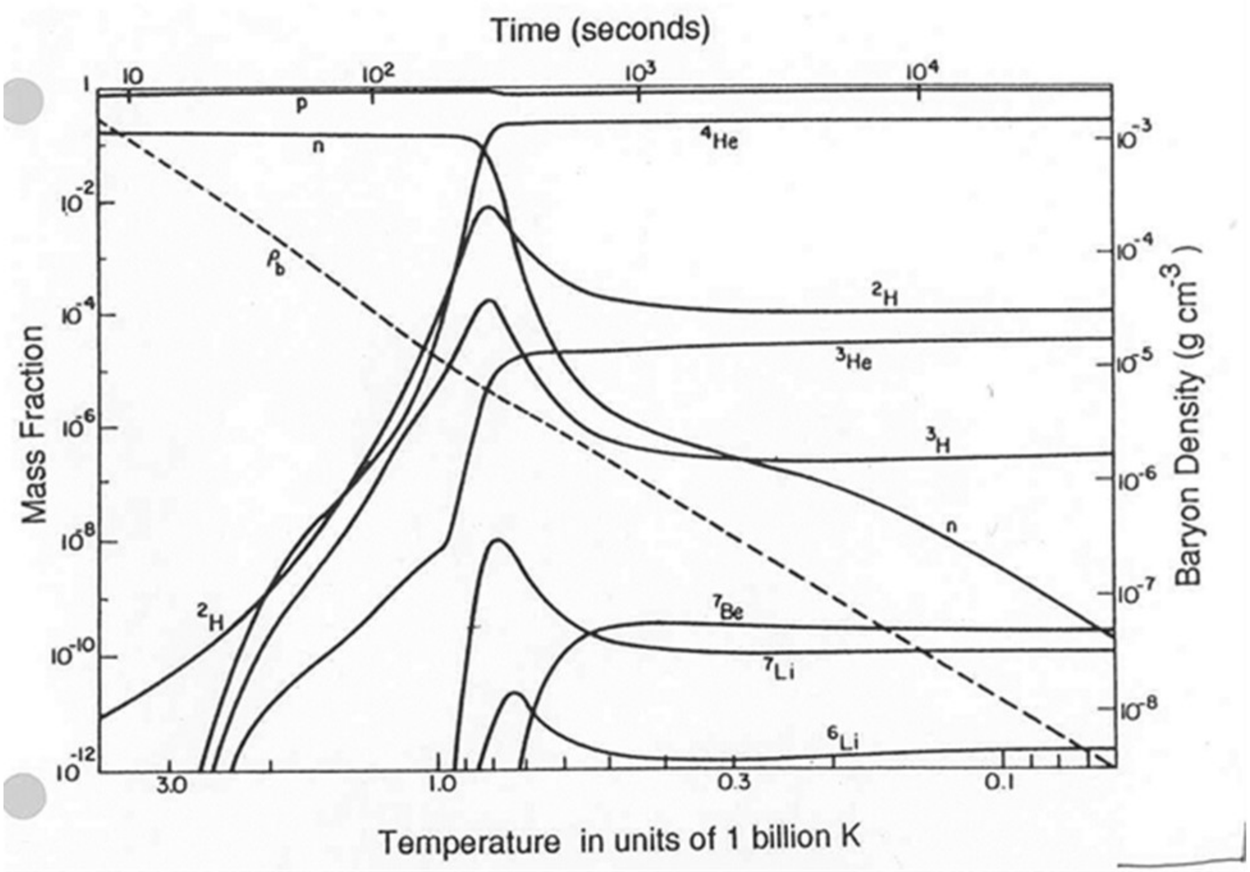


The kinetic energy is converted into potential energy as expansion occurs with the total equaling 10.3 MeV/particle (not all particles are protons). This calculation is made possible by the use of the equations developed above F=mV^2/R/exp(90) and Potential energy = integral F*dR/(2.6e12*exp(30)) that apply to each cell containing a particle.

the measured Hubble constant of 2.26e-18/sec.

Appendix 2

The temperature in the graph below is about 3e9 K at 12 seconds. The kinetic energy associated with this temperature is 1.5*B*T=0.39 MeV, where B is Boltzmann's constant 8.62e-11 MeV/K. One can see from the smoothly decreasing temperature in the horizontal axis that as Helium 4 fuses, there is no increase in temperature. The energy associated with He4 fusion is 7.07*0.23=1.61 MeV. This amount of energy should increase the temperature to about 2e9 K about 150 seconds into expansion. Appendix 1 contains a similar graph from a different source [9]. Again, the temperature does not increase with He4 fusion.



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

Appendix 3

Appendix 2 Detailed equality to decoupling simulation

WMAP used the difference in time between two important transitions to determine the size of the acoustic induced temperature spots detected by radiometers. The two transitions were 1) equality of photon mass and baryon mass when acoustical waves develop and 2) decoupling when the universe became transparent as the plasma clears. When photon mass density matches and falls below mass density a condition known as equality has occurred. But again, the simulation using 0.5 fraction of final density and the temperature and radius history developed above gives equality at the right point for the calculated hot spot to match WMAP measurements at decoupling. Acoustic oscillations are no longer dampened at equality and wave propagation at velocity 3e8/3^.5 m/sec begins. These waves enlarge and are visible in the cosmic background radiation (CMB) as the plasma clears at decoupling. The values 1.16e20 meters (red) to 2.31e21 meters (green) represent progression of a wave traveling at C/3^0.5 meters per second.

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

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

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

Mass density in kg/m^3:

The value 0.5*1.67e-27 kg*exp(180)/volume for mass density is half the total mass based on a proton. This is another clue that baryons are more numerous than WMAP analysis indicates but more information is provided below.

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

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

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

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