Discovery of Quantum Gravity

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INTRODUCTION

Gravity is still an active research area for scientists even though English mathematician Isaac Newton published his work entitled *Principia* in 1867. For the last twenty years or so some of the best theorists have been working on quantum gravity. There is a basic disconnect at the heart of gravity. The problem is that although Isaac's equations are correct they describe large scale behavior of objects. Einstein's general theory of relativity is the modern theory of gravity but again, it describes large scale behavior of objects following paths curved by mass. This leaves small scale (quantum scale) gravity a subject of research. In the author's opinion, a solution to the problem was delayed by general acceptance of an old relationship between fundamental constants. Literature states that the gravitational constant (G) originates at the Planck scale. The Planck length (Compton wavelength) L= (h*G/C^3)^0.5 = 1.61e-35 meters where h is Heisenberg's reduced constant (H/2pi) = 6.58e-22 MeV-Sec and C is of course the speed of light. The energy associated with the Planck length is 1.2e22 MeV. This energy is far greater than the energy of a proton and the Planck length is incredibly small. Many physicists are reluctant to give up the equation that contains G, h and C in what appears to be a defining relationship. Theorists are exploring alternatives like string theory in search of unification but have failed to gain acceptance of a new theory describing the origin of the gravitational constant.

The proverbial apple that Isaac was watching when he conceived of gravity was a bit of Hollywood. He actually rolled objects down an incline and measured time and distance. He was an observational based scientist. But we have high standards for present day physics and should expect someone to find the source of the gravitational constant and its relationship to the other forces. During Newton's lifetime the concept of a small scale was not taken seriously although the idea of an atom came much earlier. We will explore the possibility that the Planck length is too low and the energy 1.2e22 MeV is too high. A new theory of quantum gravity will be proposed at the scale of the proton.

What is space and time? It is interesting to the author that there isn't agreement on these basic concepts. The difficulties with gravity extend to the origin of space. Furthermore, we all experience elapsed time but some physicists don't believe in time that moves forward. They do believe that time cycles at the small scale and of course they know that energy is related to these cycles.

A proposal will be made regarding the origin of space and time and its relationship to expansion of the universe. Most cosmologists believe that expansion exceeds the speed of light. They say that space is being created and carries light with it. This appears to violate one of our most sacred concepts; that particles cannot travel at the speed of light? There is no need to violate C in the author's proposal.

Thermodynamics is one of the most advanced sciences but again there are disconnects at the core. Most physicists agree that velocity is relative but does this mean that kinetic energy is also relative? Kinetic energy is just a form of energy and kinetic energy (1/2*m*V^2) is conserved. Energy according to the first law of thermodynamics can't be created or destroyed. The second law of thermodynamics says that systems of particles containing heat energy always "run down". Entropy is a one way downward street but where is the origin? Unfortunately there appears to be no answer that everyone agrees on. We must tie cosmology and thermodynamics together.

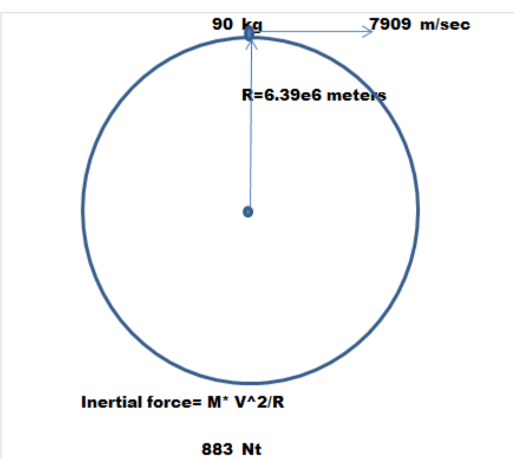
During Sir Isaac's lifetime, the concept of a universe was pretty much limited to a solar system. He wouldn't have believed how large the universe is but he would have been fascinated as we all are about findings in the last 100 years. He probably couldn't even conceptualize of gravity being so strong that even light can't escape an object but this is exactly what happens in a black hole. Many have been discovered and they seem to come in mainly two types: Burnt out stars and supermassive black holes almost as massive as an entire galaxy. Scientists need a quantum theory of gravity because it might help them understand black holes. One question that keeps surfacing is "do black holes collapse?" If they do it suggests a singularity where physics breaks down.

There is another "physics breaks down" possibility at the heart of physics. What was the beginning condition? Some physicists believe that the big bang was a singularity, so hot that relationships we know and use might have been different and there is even speculation that the four forces of nature might have been unified at that point. The author believes that the laws of physics existed before the big bang and are based on information theory [1]. There are interesting parallels between information theory and thermodynamics suggesting that physics is information based like our minds [30].

Note: The document is written in language I call "engineering 101", not very scholarly, but practical. I would recommend following the calculations with a Microsoft excel® spreadsheet. All the equations will use meters for distance (m), kilogram for mass (kg) and seconds (sec) for time. Newton was rewarded by using his name for the force unit. It is abbreviated N. Recall that numbers can be written in scientific notation, i.e. 5.98e24 kg is the earth's mass in kilograms and e24 means move the decimal place 24 places to the right. Conversely, the electron orbits a proton at 5.29e-11 meters meaning that you move the decimal place 11 places to the left.

GRAVITATIONAL FORCE ON THE EARTH

The earth pushes up on our feet but astronauts don't need this help. Here on earth, the reason we feel force upward is that our velocity is too low to be on an orbit (geodesic) defined by the radius of the earth. A geodesic is a combination of velocity V, radius R and mass M that give G, the gravitational constant; G=R*V^2/M=6.6742e-11 N-m^2/kg^2. Astronauts are in orbit and on a geodesic. We can calculate the velocity V required to be on a geodesic. First we calculate our acceleration at the surface of the earth. We need to know that the earth's mass is M= 5.98e24 kg and that the radius of the earth R = 6.39e6 meters. This gives us the gravitational acceleration on the surface of the earth a=G*Mearth/Rearth^2=9.8 meters/second^2 (abbreviated m/sec^2). Next we calculate velocity V= (a*R)^0.5= 7909 m/sec. The force upward on our feet is F=mass*a=m*V^2/R. Your mass in kg is your weight in pounds divided by 2.2. If your weight is 198 lb =90 kg, the earth is pushing up on you with the force F =90*7909^2/6.38e6=883 Newton (N). Force upward from the earth is making up for the outward inertial force you are missing because your velocity is too low. The equation could also be written F=mass*(7909^2-Vlow^2)/R. In this equation Vlow is fixed by us being on earth. Inertial force is outward force in an orbit and gravitational forces are inertial forces. The diagram below describes the situation.



Kids feel inertial force when you they are on a merry-go-round and you calculate it by F=m*a where acceleration a= V^2/r. Gravitational force is also inertial force and Newton recognized this because *Principia*, his book on physics also stated that F=m*a. Force is mass times acceleration. But if an astronaut has this velocity, why is she "weightless"? The essence of

Einstein's general theory of relativity (GR) is that mass follows curved space-time and "doesn't know" about the forces involves. It simply says that the earth curves space-time and the astronaut follows the curve. When the astronaut has the right velocity, V=7909 m/sec in this case, she feels no force. She is falling but also circling the earth fast enough that she never becomes closer to the earth. There is a statement regarding this concept called equivalence of acceleration and gravity. The story goes "if you are in a free falling elevator, how would you know about the force on you?" Since you don't feel it, you don't measure it.

Kinetic energy is converted to potential energy and visa-versa. The equation that applies is kinetic energy (ke) plus potential energy (pe) is a constant, i.e. ke+pe = constant. Potential energy is force times the distance the force pushes through, i.e. PE=F*R. To find the potential energy from the orbital kinetic energy we must get the origin (initial condition) correct. The origin is the big bang when particles with kinetic energy separate. Gravitation resists expansion and kinetic energy is converted to potential energy. Later when the mass starts its fall, potential energy is reconverted to kinetic energy. It either accumulates in bodies from a position established by expansion of the universe or it establishes an orbit. In both cases it has potential and kinetic energy. At the orbital position (the geodesic) the outward inertial force is balanced. We calculated the inertial force 883 N in the orbit assuming that the astronaut had gained 7909 m/sec from the rocket. Here on earth, we are "off the geodesic". The earth must push up on our feet to make up for the inertial force that we are lacking. Yes, there is energy of position (potential energy) but this does not produce the gravitational force. Think about climbing the stairs. Where does your energy go as you climb? It goes into overcoming force F and the potential energy is PE=F*R. It is the result of a force moving through a distance (force units are Newtons N and distance units are meters and energy is N-m). To calculate potential energy you need a conversion factor (PE=F*R (N-m)*conversion factor) to know the potential energy in Million electron Volts (MeV). MeV is a convenient energy unit and represents the energy required to move an electron through a one volt potential (eV) but since it is a small energy, it is multiplied by one million. The conversion 6.24e12 MeV/(N-m) is the main conversion used in the document.

Although this explains our gravitational situation here on earth there are still several questions: 1) how did we get on this curve? 2) Why is our kinetic energy low? 3) Deeper yet, where does gravity originate? 4) What is the resisting force that allows the earth to support us? Overall, we haven't gone beyond what Newton wrote and Einstein taught us, but you will if you keep reading.

CIRCLES

Quantum mechanics (QM) deals with small circles. The circle is a model and the radius is probabilistic. The basic concept is that energy is related to a circle by the equation E=H*v. Frequency v is the number of times per second energy travels around a quantum circle at the speed of light and H is Heisenberg's constant 4.136e-21 MeV-sec. The speed of light is 3e8 meters/second. Frequency can be a large number but cycle time t will be 1/frequency=1/v. How much time does it take to move around a circle (R) at velocity C? The time t= 2*pi*R/C equals time t= H/E. The important constant H (Heisenberg's constant) relates time and energy.

Knowing the constant relationship, radius is defined. If we are to understand quantum circles, we need to know their radii. Below, we will find a radius from accepted facts about an electron circling a proton (the element hydrogen) and then generalize the equation for other quantum circles.

t=H/E and t=2*pi*R/V are equal for a little quantum circle.

2*pi*R/C=1/frequency

2*pi*R/C=H/E

where H=Heisenberg's Constant 4.136e-21 mev-sec.

Electromagnetic field		**2.72E-05**	**MeV**
t=H/E	**t=4.14e-21/27.2e-6**	**1.52E-16**	**seconds**
2*pi*R/V	**equal but V?**	**1.52E-16**	**seconds**

If we know V above, we can calculate R

Known	**1.36E-05**	**MeV**	**kinetic energy**
Known	**0.511**	**Mev**	**electron mass**
g	**0.999973**	**g=0.511/(0.511+13.6e-6)**	
V/C	**0.007296**	**V/C=(1-g^2)^0.5**	

R calculated from H/E=2piR/V

R=H/E*V/(2pi)

R=4.136E-21/27.2e-6*0.00729*3e8/(2*PI())=5.29e-11 meters

The equation for radius R is central to fundamental forces with different inputs.

Where: H=Heisenberg's constant

M=mass of the particle. If the particle is moving fast relativistic mass is m/gamma

E=field energy that helps define the radius of the circle.

R=maximum probabilistic position of the particle.

R=HC/(2*pi)/(E*m/g)^0.5

R=1.973e-13/(E*m/g)^0.5 and sometimes=1.973e-13/E

where HC/(2*pi) =1.973e-13 MeV-m

Gamma

Velocity is distance/time with a small shift in time. Gamma is a ratio indicating the shift and the reason physicists refer to space-time instead of space alone. Gamma can be calculated from kinetic energy or velocity. It is simply gamma (g) = mass/(mass+kinetic energy). We already know that the astronaut's velocity was 7909 m/sec so it is easier to find gamma from the special relativity equation (g)=(1-(V/C)^2)^.5=(1-(7909/3e8)^2)^0.5 = 0.9999999997.

Newton couldn't have discovered that he was dealing with space-time as the very source of gravity based on gamma (g) =0.9999999997. For all practical purposes, gamma was 1 but you can see that velocity V is only a function of gamma. Is this enough to curve space-time? The curvature we are talking about for an astronaut in earth orbit is the radius of the earth 6.38e6 meters (actually a small amount larger so the astronaut orbits above the earth). What does the earth radius have to do with gamma? To understand this we have to turn to one of Einstein's equations and another mathematician by the name Schwarzschild. This story will continue under the heading "Unification of special relativity and general relativity".

LARGE ORBITS and QUANTUM CIRCLES

We are face to face with where gravity originates. If it originates in quantum circles like the other forces, there is a huge gap. Consider what the orbital radius of the earth might be on a proton by proton basis (I am aware that the earth is not made of protons with a circling electron but we can use protons as an example). Speculate for a moment that we can consider the volume of the earth broken into smaller volumes around each proton. The mass of the earth is 4e24 kg and the mass of a proton is 1.67e-27 kg. There are 4e24/1.67e-27=3.58e51 protons in the earth and the volume of the earth is 4/3pi*6.3e6^3=1.1e21 m^3. Dividing these we find the volume surrounding each proton (3e-31 m^3) and then determine the radius for this volume. The answer is r = (vol/(4/3*pi))^(1/3) = 4.17e-11 meters. Actually, this makes sense. We know that the electron orbits a proton at 5.29e-11 meters. The electrons repel each other and resist being compressed. Even with considerable mass building up pressure down through the layers of the earth, the electrons are only on average compressed to 4.17e-11 meters. Remember the concept because later in the document we will try to determine what resists the enormous pressures down through a black hole.

This helps us understand why the earth pushes up on our feet, but it doesn't help us reconcile large orbits like earth with 6.4e6 meters and little orbits like those encountered with quantum mechanics.

Newton could not estimate the number of particles in the universe. Further the whole concept of expansion of the universe was centuries in the future. In Newton's wildest dreams, he would not have anticipated that the sky temperature contains clues regarding the beginning we call the big bang. After cosmic microwave background (CMB) radiation was discovered around 1950, cosmologists started to analyze what the signature of the cosmic background radiation might reveal. They proposed and later received funding for a balloon project called COBE and satellite projects called WMAP [7] and PLANCK. We can analyze how many protons there are in the universe from the data. The data gave us increasingly accurate estimates of rho, the density of the present universe and its radius [4][6][17].

Question about number of particles in universe				
Critical Density Predictions (kg/M^3)				
Density	8.93E-27	pg 337 isHughes		
Density	3.73E-26	rho zero pg 103 Peebles at H=.71		
Density rh	9.5E-27	WMAP basic results Table 3		
R	6.30E+25	meters		
N protons	1.61E+78	N=rho*0.27*(4/3)*PI()*R^3/1.67e-27		
ln (N)	180.0759			

What could be the possible meaning of exp(180) = 1.61e78 protons? (The nomenclature exp(180) stands for the natural number e to the power 180.

CELLULAR COSMOLOGY

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

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

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

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

At any time during expansion		
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)

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

It must be recognized that for equal gravitational constant the radius of curvature and mass are vastly different between the large and small scale. It was unfortunate that the great physicists of the 1900's did not have the advantage of WMAP [7] and Cmagic [8] expansion models, nor did they have the advantage of knowing the approximate number of protons in the universe. Perhaps they couldn't compare cellular scale space to large space because they lacked information.

THE SOURCE OF GRAVITY

A simplified Neutron mass model [10][13][24] is shown below. It is derived from a full Neutron mass model reviewed in Appendix 2. Mass+ke=959.92 MeV is overall equal and opposite field energy 959.92 MeV with the net zero (further comments later). The value of interest for gravity is the field energy 2.723 MeV. (The neutron mass is 939.57 MeV made up of quarks and kinetic energy). Add down through the values in each column of the table below to see the components that total 959.92 MeV. Note that nature uses the value 10.15 MeV many times.

Simple neutron model					
r20 uc2					
	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			

R(meters)=HC/(2*pi)/(E*E)^.5=HC/(2*pi)/2.723=7.224e-14

HC/(2*pi)=1.973e-13 MeV-m

The radius of a quantum circle for gravity is 7.224e-14 meters with E=2.723 MeV.

Large scale gravity is the result of a body with mass m falling into curved space time defined by a central mass M. As a body falls it loses potential energy, gains kinetic energy and finds a geodesic where it feels no force. Again, the geodesic variables R,V and M combine to give G, the gravitational constant; G=R*V^2/M. Quantum gravity follows the same physics except the curvature is the radius 7.224e-14 meters above and the geodesic is G=r*V^2/m/exp(90). The body that falls to the geodesic curvature r= 7.224e-14 meters is the neutron. It has mass 1.675e-27 kg and according to the model above, it initially has potential energy 20.3 MeV but when it achieves an orbit, its kinetic energy has increased to 10.14 MeV and its potential energy has decreased to 10.16 MeV.

Calculation of gravitational force with accepted coupling constant

Literature [2][3][28] regarding a coupling constant for gravity is reviewed below. The gravitational coupling constant α_G is the coupling constant characterizing the gravitational attraction between two elementary particles having nonzero mass. α_G is a fundamental physical constant and a dimensionless quantity, so that its numerical value does not vary with the choice of units of measurement:

$\alpha_G = Gm_e\hat{}2/(hC)=(m_e\hat{}2/m_p\hat{}2)=1.752e\text{-}45$

where G is the Newtonian constant of gravitation; m_e is the mass of the electron; C is the speed of light in a vacuum; ħ is the reduced Planck constant; m_p is the Planck mass.

This coupling constant can be understood as follows:

http://en.wikipedia.org/wiki		
alphaG=(mp/me)^2=1.752e-45		
mp/me=1836.	where mp/me=proton/electron	
alphaG=1836.15^2*1.752e-45=5.907e-39		
F=(5.9068e-39)*hC/R^2		

If R for the force calculation is 7.22e-14 meters, as proposed above, the force is:

F=(5.9068e-39)*hC/R^2				
	hbar		6.5821E-22	mev-sec
	hbar in NT-m-sec		1.05E-34	NT m sec
	hbarC in NT-m^2=K		3.16E-26	NT m^2
F=(5.9068e-39)*K/R^2				
F=(5.9068e-39)*3.16e-26/(7.22e-14)^2=3.58e-38 NT				
3.579E-38	NT			

This result agrees with the simple Newtonian force within adjustments for gamma:

F=Gmm/R^2 (nt)=6.67428e-11*1.6726e-27^2/7.224e-14^2=3.666e-38 nt

Calculation of Gravitational Constant from the Proton Mass Model

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

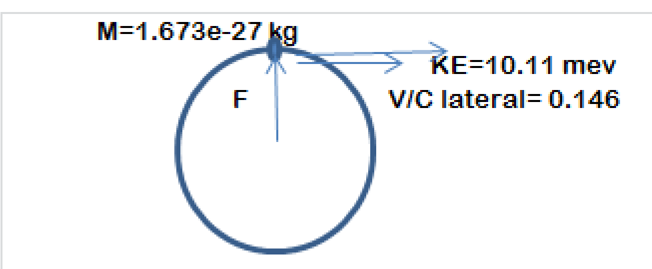
The following table follows a format that will be used several times. The goal is to use the fundamental radius 7.224e-14 meters to calculate the gravitational inertial force. The inputs listed at the top of the table originate in the neutron model above. Firstly, the mass of a proton in MeV and its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

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

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

> Note: There is a small difference in kinetic energy between the proton and neutron. The literature above is based on a proton. The author believes that gravity is based on a neutron. Later in the document I will refer to the kinetic energy 10.11 MeV. The value 10.14 MeV is the neutron kinetic energy and 10.11 MeV ke is for the proton.

The calculation for G above indicates that nature uses the general theory of relativity at the quantum level. The author calls this cellular cosmology. A cell is diagrammed below. The inertial force F=m*V^2/R=3.66e-38 N. The proton "feels" no force just like our astronaut travelling on the geodesic. This geodesic is a "quantum circle" but it is related through cellular cosmology to a large orbit.



Two candidates for the correct gravitational energy scale

We will further explore below whether we can call this circle of radius 7.224e-14 meters the scale for quantum gravity.

Candidate #1 the conventional Planck scale

There are tests for quantum gravity: We will compare the Planck scale relationships [2] with the relationships above.

Nomenclature and review of the Planck scale

	Constants				
h	6.58E-22	MeV-sec	reduced		
E	1.22E+22	MeV	Planck Energy		
M	2.18E-08	kg	Compton mass		
G	6.67E-11	Nt m^2/kg^2	gravitational		
C	3.00E+08	m/sec			
	Relationships				
	L=G*M/C^2	Compton wavelength			
	L=G*M/C^2	6.67e-11*2.18e-8/3e8^2	1.62E-35	meters	
	L=C*h/E	3e8*6.58E-22/1.22E+22	1.62E-35	meters	
	L=h/(M*C)		1.61E-35	meters	
	G=h*C/M^2	6.58E-22*3e8/2.18e-8^2*1.6	6.67E-11	Nt m^2/kg^2	

The criterion for quantum level is quantum mechanical "action" [2]. Action must be 1.0 to be at the quantum level (it just tests whether the variables make a quantum circle.) Action is the value P*L/h where P is momentum, L is the wavelength and h is Heisenberg's reduced constant (H/(2*pi) labelled \h, hbar or just lower case h). Compare action for two energy levels, the Planck scale (1.22e22 MeV and the much lower level 938.27 MeV proposed above.

	action= p*L/h				
	Planck energy	(MeV)	1.22E+22		
	Planck L	(meters)	1.62E-35		
	Momentum	p=E/C	4.07E+13		
	p*L	Mev-sec	6.58E-22		
	action= p*L/h		1.00E+00		

Yes, the Planck scale meets the criteria for being at the quantum level because action=p*L/h is 1.

Candidate #2 quantum gravity (the “dark horse” candidate)

Proposal		(cell d305 "unified")	
Field Energy		2.732	mev
constant	HC/(2pi)	1.97E-13	mev-m
	R=constant/E	7.22E-14	m
	Field side	R side	
	H/E	2*pi*r/C	
time (t)	1.51E-21	1.51E-21	sec
Proposal p	(p=E/C)	9.11E-09	mev-sec/m
p*R/h		1.00	
qm test	M/C^2*R^2/t	6.58E-22	mev-sec
qm test/h	M/C^2*R^2/t/h	1.00	

The proposal also meets the action=1 requirement for a quantum level relationship since action =P*R/h=1.

Further comparison:

The proton mass is 938.27 MeV, not 1.22e22 MeV (1.67e-27 kg, not 2.17e-8 kg). Compare the calculation for gravitational constant for the Planck scale and the quantum gravity mass level and note that they differ by a large factor.

G=h*C/M^2
G=(6.58e-22*3e8/(2.18e-8)^2*1.603e-13)
6.66E-11 N m^2/kg^2

G=h*C/M^2
Proposed mass 1.67e-27 kg
G= (6.58e-22*3e8/(1.67e-27)^2*1.603e-13)/exp(88.03)

6.66E-11 N m^2/kg^2

Gravity, defined the Planck way requires a large divisor exp(88.03). Both candidates use a large divisor but there is a huge difference between exp(88.03) and exp(90). A divisor is required because gravity is shared among exp(180) protons and the surface area of each cell is 1/exp(90) of the surface area of the universe but this makes 1/exp(90) the correct coupling constant. The correct scale for quantum gravity is the radius 7.22e-14 meters not the Planck scale 7.62e-35 meters.

Advantages of this proposal

1) Cellular cosmology unifies the special theory of relativity with the general theory of relativity.
2) It reconciles gravity with the remaining forces.
3) Quantum gravity at the scale 7.22e-14 meters is fundamental to expansion equations that give the size of the universe. It gives us a clear description of the space around us. We are walking around in expanded quantum gravity.
4) Combined with cosmology, quantum gravity shows that time advances and explains the twin paradox.
5) Quantum gravity produces realistic and important results for the study of black holes.
6) Cosmology and quantum gravity explain where the first and second law of thermodynamics originates.
7) Quantum gravity allows us to track potential and kinetic energy changes.

Unification of the Special Theory of Relativity with the General Theory of Relativity

Before Einstein's special theory of relativity (SR), space and time were separate. Experiments had shown (Aether experiments) that the speed of light was a constant but Einstein understood the implications. Basically, SR is the origin of gamma and its relation to the velocity ratio V/C where C is the speed of light. Gamma is defined as g = mass/(mass+kinetic energy). For example if a proton with mass 938.272 MeV has kinetic energy 10.11 MeV, g =938.27/(938.27+10.11) =0.989. Gamma is always less than 1.0 and is considered the shift into space-time for a particle with kinetic energy. Velocity is directly related to gamma in the SR equation V/C =(1-(g)^2)^.5. For 10.11 MeV of kinetic energy, V/C would be 0.145. The new variable gamma is related to a quantity called time dilation. Time dilation dt =1/g-1. In the example above dt =1/0.989-1=0.0103. The saying "moving clocks run slow" describes the situation. When a particle has kinetic energy and if it is moving relative to the observer, time runs 1.03% slower for the particle. This is the basis of the Lorentz transformation [2]. After the development of SR, everyone started combining space and time together as space-time.

The theory of General relativity (GR) came later. Einstein modernized our understanding of gravity and stated that gravity could be considered the geometry of space-time. Thereafter, matrix equations called metric tensors defined relationships between four dimensions. The saying "mass curves space-time and objects follow the curvature" describes how objects move in space-time. Basically, acceleration and gravitational acceleration are equivalent (known as the equivalence principle). Objects do not respond to gravitational fields, they just move along a path defined for them by the space-time they are embedded in. Schwarzschild solved the metric equations for a simple case. His solution was very similar to the equation we use for a geodesic. His solution was G=S*V^2/M but his S is twice the geodesic radius R. A geodesic is the relationship between velocity, mass and radius that give the gravitational constant G, i.e. G=R*V^2/M. Schwarzschild also developed equation for time dilation for the central mass. The equations are in derived in Appendix 2 with examples below:

Schwarzschild's time dilation (dt) is calculated below for earth Mass M and earth Radius R:

Astronaut (kg)	**90**	
Mass M kg (earth)	**5.98E+24**	
earth R (m)	**6378100**	
dt=1/((1-G*m/(R*C^2)))^0.5-1		
3.47E-10		**mass curves space**

The Schwarzschild equation can't be used for the Astronaut's time dilation. It has to be calculated from special relativity using her velocity 7908 m/sec and mass 90 kg.

Gamma (g)=0.9999999997

V/C=2.64e-5 and V=7909 m/sec

dt=1/g-1=3.47e-10

In cellular cosmology variables of interest are related to cell radius. In this case cell radius r= Rearth*1.67e-27/Mearth=6.38e6*1.67e-27/5.98e24=2.17e-6 meters. This characterizes the quantum level with a central mass of 1.67e-27 kg and a velocity of 7909 m/sec. Below the Schwarzschild equation is used to calculate dt:

Astronaut (kg)	**90**	
Mass M kg (earth)	**5.98E+24**	
earth R (m)	**6378100**	
	r=R*1.67e-27/M=2.17e-6 meters	
dt=1/((1-EXP(90)*G*1.67e-27/(r*C^2)))^0.5-1		
3.47E-10	**mass curves space**	
	and particle follows curve	

The SR equation (g)=(1-(V/C)^2)^.5=(1-(7909/3e8)^2)^0.5 = 0.9999999997 also gives dt=1/g-1=3.47e-10. See the difference? Schwarzschild's equation for general relativity doesn't work for the astronaut's mass because it is not the central mass. With cellular cosmology, special relativity and general relativity always give the same correct result because the mass of a proton is always the central mass (1.67e-27 Kg).

Above in the section entitled "Gamma", we asked the question: "How could Newton know that gravity is the curvature of space time?" In fact, we calculated the small gamma (g)=0.9999999997 and wondered how such a small number could curve space time. Continue the story but use cellular cosmology. In cellular cosmology, the geodesic is G =(r* V^2/m)/exp(90) but m is the mass of a proton. Solved for radius, the equation is radius r =(G*m/V^2)/exp(90). Velocity V^2 is the only variable that indicates that space-time is curved because the other values in the geodesic equation are constants (mass m is the mass of a proton 1.67e-27 Kg). When V is small, r is large. When the radius of curvature is large, the geodesic would be almost flat (meaning space time is not curved). Please don't misunderstand the cause of the curvature. It is not mass and it is not velocity, it is a cellular radius established by a field. We can now answer the question: "How does gamma as low as g=0.9999999997 curve space?" It doesn't, but it is an indication that velocity is involved. **General relativity continues right down to the quantum level**. A 2.723 MeV field shapes space and protons fall into the curvature and orbit with velocity V. Velocity is only an indication that there is curvature. Could Isaac have known this? Well maybe if he had read about Albert Einstein's work, known Schwarzschild's solution to the metric equations, been dis-satisfied with the Planck scale, read papers regarding the results of satellite missions that allowed him to know the approximate number of protons in the universe and developed cellular cosmology. Newton, like all of us "stands on the shoulders of giants" and others were asking question about gravitation. He knew that experiments could answer the questions and he deserves to be a hero. Most breakthroughs [5] in science take a long time to become accepted because there is a network that protects the status quo. New work can become recognized only if key people recognize the value of your work and it is correct (Many don't like this system but basic physics doesn't change every day).

Unified relativity will be useful when we use cells to model expansion of the universe. Einstein and Schwarzschild extended Newton's understanding of gravity with their equations for curved space-time. Schwarzschild's equation for the bending of light around massive objects is a tool used to measure distant masses such as black holes.

Quantum gravity reconciles gravity with the remaining forces

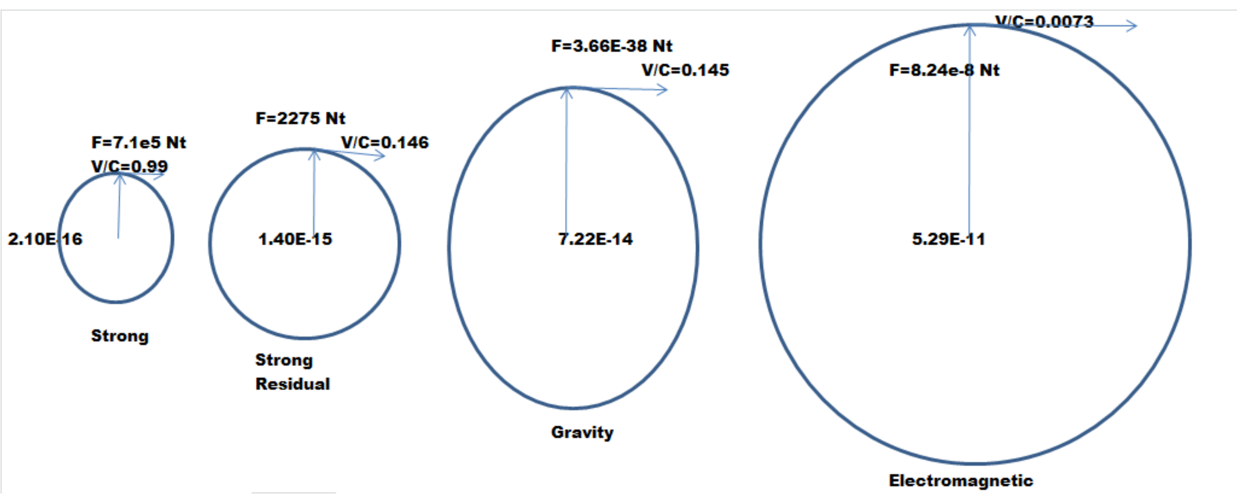
Quantum gravity is only slightly different than the other forces of nature [3][16][22]. Before considering gravitation more thoroughly, it is instructive to review other interactions (forces) supported by information extracted from the proton mass model (Appendix 2). The fundamental forces of nature are simply Force= Field energy divided by Radius (F=E/R) and this is equal to inertial force F=m*V^2/R but only gravity contains the coupling constant 1/exp(90). This makes the equation for radius R basic to force unification. The equation was derived in the section entitled "Quantum Circles".

R=1.973e-13/(E*m/g)^0.5 (called the R equation below)
  where HC/(2*pi)=1.973e-13 MeV-m

The R equation is arranged in a column of calculations below for the Proton. The inputs are: M (energy of the mass), E (energy of the capturing field) and kinetic energy.

Force Table				Strong MeV	Strong Residual	Gravity proton	Electro-Magnetic
		(Higgs ref)		128992.05			
Field Energy E (mev)				957.18	20.303	2.732	2.72E-05
Particle Mass (mev)				129.54	928.120743	938.272	0.511
Mass M (kg)				2.31E-28	1.6545E-27	1.673E-27	9.11E-31
Kinetic Energy (mev)				798.58	10.1513	10.110	1.361E-05
	Rydberg energy from PDG						1.361E-05
Gamma (g)=m/(m+ke)				0.1395	0.989	0.989	1.000
Velocity Ratio		v/C=(1-(g)^2)^.5		0.9902	0.1467	0.1456	0.0073
R (meters) =((HC/(2pi)/(E*M/g)^0.5)				2.0928E-16	1.430E-15	7.224E-14	5.291E-11
Force	F=E/R*1.6022e-13			7.1E+05	2275.20	**	8.242E-08
Inertial	F=M/g*V*2/R nt			7.1E+05	2262.9	3.656E-38	8.24E-08
						1/exp(90)	

These four forces are aspects of the energy interaction involving the exchange of the logarithm 2.0 [10][24] and are referred to as the strong force, residual strong (weak force), electromagnetic force, and the gravitational force. The R equation gives the size of the quantum circle but there are different particles and different kinetic energies for each of the forces. The radial position of the particle can be anywhere near the surface but is probably at R.



The four forces are diagrammed above. First note the similarity. They all have quantum circles of radius R (in meters) associated with them. The proton mass table is summarized below. Note that mass+kinetic energy is opposite and equal to the combined field energies. The total is 959.92 MeV. In the beginning, a separation from zero occurred:

$$0=959.92 \text{ MeV}-959.92 \text{ MeV}$$

For the strong forces, mass+kinetic energy is equal and opposite the field energy. But the quarks+ke total (928.21 MeV) falls into a 20.3 MeV strong residual field energy and with 10.15

MeV of kinetic energy. Nature is built on nested orbits. The resulting neutron has 20.3 MeV of potential energy and falls to the gravitational radius 7.224e-14 meters where it has 10.11 MeV of kinetic energy. After the neutron decays, the proton and electron have opposite 27.2e-6 MeV fields and the electron falls into a field with 13.6e-6 MeV of kinetic energy. The fundamental point is that field energy characterizes the *space* a particle exists in and *mass+kinetic* energy characterizes the particle that orbits on the surface of the space. The exact mass of the proton (938.272 MeV) results from neutron decay.

	Mass and Kinetic Energy			Field energy	
	Mass	KE	Strong Residual	Strong field energy	Gravitational 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		**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**			

Each of the forces is a little different.
Strong Force: There are actually three quarks and confining forces added together in the strong force information above. It confines the quarks inside the atom. High energy colliders can't knock the three individual quarks of the proton out which means they aren't observed independently. Their masses, kinetic energies and associated fields are listed below for a proton.

	MeV	MeV		MeV	MeV
Quark S	101.947	641.880		-753.291	-0.687
Quark U	13.797	78.685		-101.947	-0.687
Quark D	13.797	78.685		-101.947	-0.687
	129.541	799.251		-957.185	-2.061

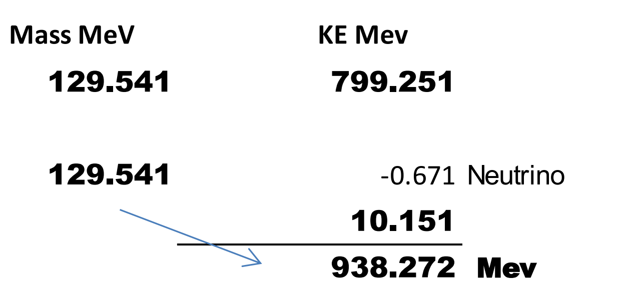
Strong Residual: This circle is associated with fusion. A mass of 129.5+799.25-.67=928.12 (for the proton) orbits a 20.3 MeV residual energy field with kinetic energy 10.15 MeV. When protons and neutrons are forced into the nucleus, they give up a portion of this energy depending on the atoms fusing and this binds the protons and neutrons into a nucleus [14]. This appears to be the main function of the strong residual force but it is involved in particle decay. (Note: The strong residual 20.3 MeV is 960.54 minus the neutron mass 939.56 minus 0.671 MeV).

Gravity: The diagram above shows that there was about 20.3 MeV of kinetic energy available from the proton model. A quantum orbit is formed with 10.11 MeV of kinetic energy. Since the proton is attracted to and separated from the center of the field, there was also 10.11 MeV of internal potential energy when the orbit is established at 7.22e-14 meters for 2.723 MeV of gravitational field energy. It is fundamental to gravity, space-time and the starting point for expansion. As the kinetic energy of the proton on the surface of this radius decreases, the radius increases and the orbit becomes non-quantum. For the proton, it started at 10.11 MeV and is now 1.29e-12 MeV. This increases the radius to 0.54 meters for the cosmological cells. Together will all the other exp(180) cells, they create the space we call the universe. The gravitational coupling constant 1/exp(90) makes gravity weak and long range. The fundamental force associated with gravity is extremely weak (3.66e-38 N). Gravity acts through long distances and the gravity of all the protons in a mass like the earth act together to affect distance objects. Einstein taught us that gravity is the geometry of space-time but actually all the forces are similar. Field energy for each of the four forces shapes space-time into quantum circles and mass falls to the surface of the circle (they all are so similar we can even use the same unit for their radius (meters)).

Electromagnetic (E/M): Electrons circle a proton at the radius 5.29e-11 meters. This is the only circle that shifts in quantum steps and releases light. The E/M force is the force that underlies the thermodynamics of gases. It is also the reason we can't walk through a wall. Our electrons repel electrons in the wall. All the other forces attract but the E/M force repels and attracts. The reason for this is that the electromagnetic energy is separation energy. When a neutron decays, the proton takes a positive E/M field energy and the electron takes a negative E/M field energy.

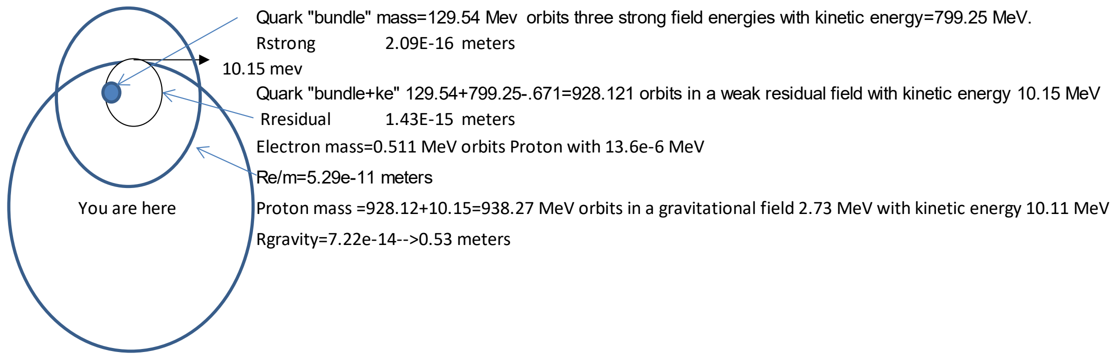
The following diagram illustrates how the circles are arranged by nature.

The quarks are "bundled" by the strong field and orbit the strong residual field energy with kinetic energy 10.15 MeV. Together this makes the proton mass 938.27 MeV after it ejects a neutrino with mass 0.671 MeV.



And of course the 0.511 MeV electron circles the proton with kinetic energy 13.6e-6 MeV.
The proton orbits the gravitational field with kinetic energy 10.11 MeV. Originally this was 20.3 MeV of potential energy but the proton fell into the field and gained kinetic energy.

Four Nested Orbits for the Proton



EXPANSION EQUATIONS

Quantum gravity is fundamental to expansion equations that give the size of the universe. Simple kinetic energy and potential energy equations are applied to expanding cells. Each particle of mass m has kinetic energy and an associated velocity V tangential to the cell surface. The model shows protons with about 20.3 MeV that fall into "orbits" with 10.11 MeV of kinetic energy and 10.11 MeV of potential energy. Initially the proton on the cell surface has high velocity (0.14C) and inertial force, the basis of quantum gravity. Tangential kinetic energy ratio decreases directly with expansion ratio and can be modeled as orbit that maintains the gravitational constant at G.

G remains constant G=rv^2/(M)

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

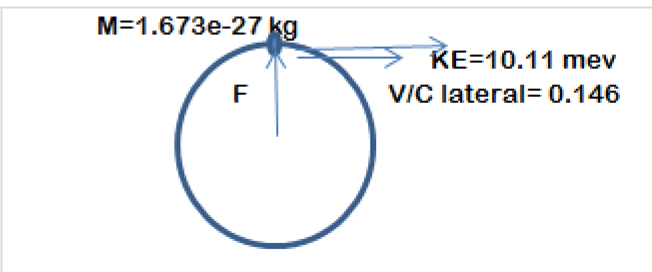
One set of information defines each proton but duplication produces exp(180) produces. Initially the universe has probability 1.0. With each proton's probability 1/exp(180) the duplication process re-establishes probability 1.0=1/exp(180)*exp(180). There is one proton per cell. After duplication and expansion the cells are no longer quantum. (Magnetic moments or other forces may disrupt the proton forcing it to move throughout the cell). This is explored below in the section entitled "Proof of non-quantum behavior". The kinetic energy of the proton can be considered pressure and pressure expands the cell. The integral PdV does work against gravity converting kinetic energy to potential energy (dV is a small volume change and PdV is a small energy change that must be added (integrated) since P and V are both changing). During expansion, gravity causes some protons to fall (accelerate) toward each other and accumulate, exchanging potential energy for kinetic energy. It is this energy that we see when orbits are established around galaxies and planetary systems. It is also this energy that provides pressures and temperatures high enough to initiate fusion.

Cell Diagram

Initial cell radius is 7.22e-14 meters. Initial forces in the cell are balanced and initially are 3.66e-38 N. With an initial kinetic energy of 10.11 MeV, the initial expansion velocity can be calculated.

Gamma (g)=938.27/(938.27+10.11)=0.9897

V/C=(1-0.9897^2)^.0.5=0.146.



PE expansion=integral F dR

The goal below is to model expansion of a small cell that provides values scalable to the universe.

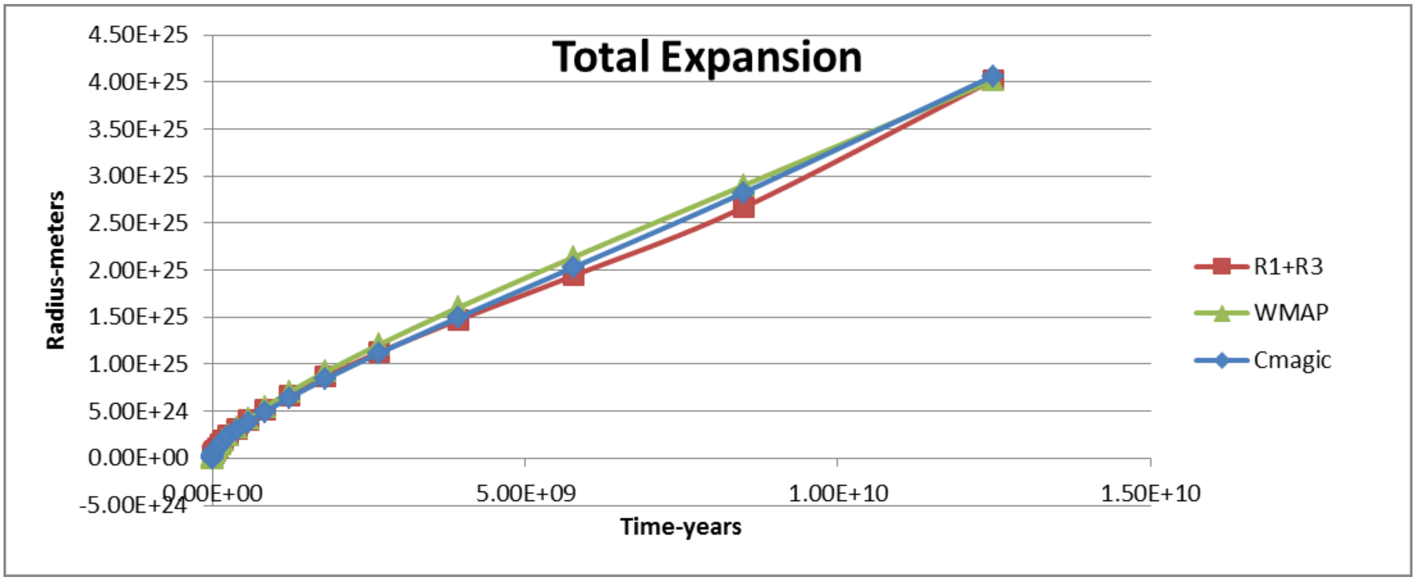
Nomenclature

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

R=R0*(t/t0)^(2/3)

Alpha and H1 are evaluated to fit WMAP *data*. Alpha=0.0529 seconds and H1=2.6e-18/sec.

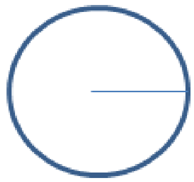
The R1+R3 model can be compared with the concordance [6][7] and Cmagic [8] models. However, the author uses a different dark energy component. It is described in Reference 31.



The above chart is established physics and uses the cosmology presented in Peebles [6]. It is called the Lambda Cold Dark Matter (CDM) model with data gathered from missions COBE, WMAP [7] and PLANCK. It compares favorably with expansion data from supernovae (Cmagic [8]). However, there are differences that should be pointed out. The CDM model assumes that velocity is larger than the speed of light. Early in expansion, the accepted model involves several thousand times the speed of light. The author's cellular model's maximum expansion velocity is V/C=0.146. Cells move apart at greater than C but expansion of the cell is below the speed of light (sub-luminal).

In the author's work, the speed of light cannot be exceeded because it is just the ratio between space dimension and time dimension. Here is the explanation:

The velocity of light is the ratio of dimensions, the distance dimension and time dimension. Both dimensions are on a quantum circle. A quantum circle is defined by field energy juxtaposed by light energy. (It also repeats at psi*psic=1 where psi is the wave function).



Energy is defined by a quantum circle

E=H/t where C=3e8 m/sec and t is time around the circle

t=H/E

Time is measured around a circle of radius r

t=2*pi*r/C

d=2*pi*r

The speed of light is the ratio distance/time

C=d/t

Transition from quantum behavior

The author believes that the space we walk around in is defined by gravity at the quantum level (r=7.22e-14 meters) by cells that expanded to a present radius of about 0.55 meters/cell. In three dimensions exp(180) cells give large R=0.54*exp(60)=6.2e25 meters. You might be wondering, as I did, whether a cell that expands from 7.22e-14 meters to 0.54 meters is still quantum. In quantum mechanics, quantum particles move in circles and are statistically "everywhere" at once near a surface and movement into the interior of the sphere that defines them is very limited. For example, the electron does not normally move inside the sphere 5.29e-11 meters and if it is forced to, it is relativistic or de-generate. For expanded cells, all mass is associated a cell but mass with kinetic energy travels slower than the velocity of light and is no longer quantum in nature.

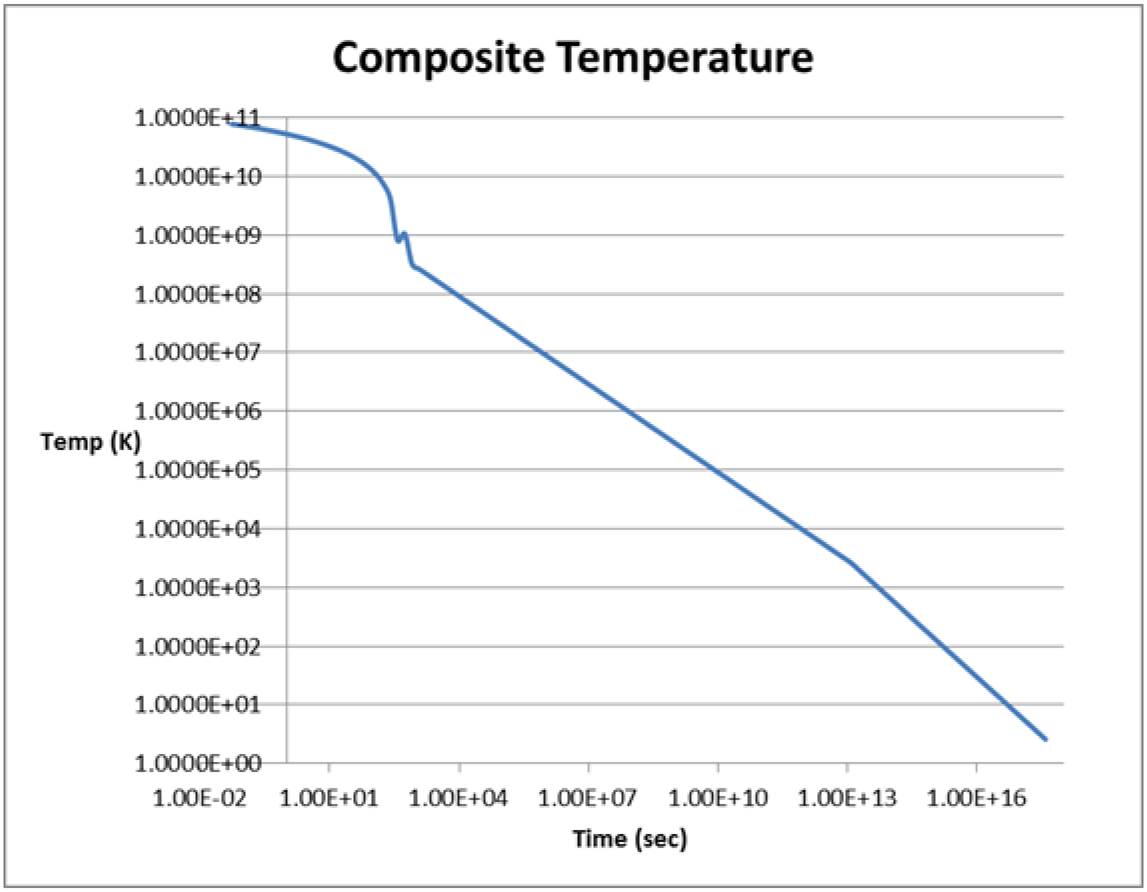
cell uc2 c198			
Field Energy	r cell (m)		r' cell (m)
2.732	7.22E-14		3.14E-12
KE (MeV)	10.11		0.233
Velocity (m/s	3.00E+08		6.66E+06
V/C	1		0.022
gamma	1		0.9998
Field side	R side		R side
H/E	2*pi*r/C		2*pi*r/V
1.514E-21	1.51E-21		2.96E-18
p=E/C (mev-s	9.11E-09		4.10E-07
p*R/h	1.000		1.95E+03

The quantum test p*R/h=1, where p is momentum is maintained by the left side of the diagram above. H/E=4.13e-21/2.73 seconds equals 2*pi*r/C=1.51e-21 seconds (fundamental time) but p*R/h is greater than 1 for the right side, indicating that as expansion occurs we are no longer dealing with quantum size circles. The right side of the diagram shows that as the cell expands from r to r' velocity decreases.

What actually expands the universe?

Pressure is the collective action of particles with kinetic energy (temperature) that collide with each other in all directions. The fact that protons are colliding and able to move throughout the space created by expanding the fundamental radius 7.22e-14 meters indicate that a critical transition has occurred. Protons enter the radius that defines gravity and pressure expands space itself. Particles exhibit non-quantum behavior (perhaps because the force is very low and it is easy to force particles into the interior of the volume). The gravitational kinetic energy 10.11 MeV can now be considered the source of velocity (pressure and temperature) inside cells. The protons and their kinetic energy exist in the space around us. The energy can't escape because there is nowhere for it to go but cells have a specific kinetic energy and potential energy depending on their history.

The Boltzmann relationship T(K)=ke/(1.5*B) with B=8.62e-11 MeV/K assigns a temperature to kinetic energy. Cosmologists use the expansion ratio z to scale temperatures and the horizontal axis in the plot below is the natural logarithm 45 progressing to about 90. Large scale time progresses from exp(45)*1.514e-21=0.0529 seconds to approximately exp(88.5)*1.51e-21seconds= approximately 14 billion years presently.



The discontinuity in temperature is explained in reference 19, but the temperature is 2.73K at the current stage of expansion.

Proof of non-quantum behavior

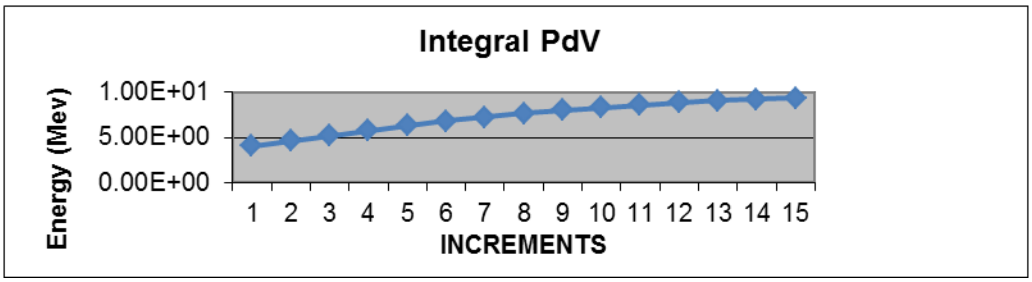
There is a critical concept at stake that needs our understanding. If the particles are non-quantum and the expansion kinetic energy is temperature, it is no longer limited to a surface. Particles with kinetic energy bounce off of one another and create pressure. Is it this pressure that expands the universe? Can the particles fill all of space or are they quantum like and limited in their travel? If we calculate what a gas would do perhaps we can answer the above two questions.

The gas constant R, is 8.317 Joule/K/Mole. (Joule=Nt-m and 1000 Mole/Kg for H). If we assume an ideal gas for hydrogen the gas constant R=8317 Nt-m/K/Kg and the pressure P would be:

Pressure P=8317*density*temperature (Nt-m/K/kg*kg/m^3*K=Nt/m^2) where density is kg/m^3 and temperature is degrees Kelvin (K).

With density based on one proton for half the cells (the other half is probably cold dark matter [13]) and an initial radius of 7.22e-14 meters, the above initial pressure is 2.97e26 Nt/m^2 where initial temperature=7.58e10 K. The following table models integral P*dV (an integral means we add increments together since P and volume change as R increases) for the first few steps in expansion.

Volume/cell (m^3)		1.67E-39	2.72E-39	4.43E-39	7.24E-39	1.18E-38
Density (kg/m^3)		5.02E+11	3.08E+11	1.89E+11	1.16E+11	7.09E+10
Temperature (K)		7.56E+10	1.01E+10	1.08E+10	1.05E+10	9.84E+09
Pressure (NT/m^2)		2.97E+26	2.44E+25	1.60E+25	9.54E+24	5.46E+24
Pressure (lb/in^2)			3.54E+21	2.32E+21	1.38E+21	7.92E+20
Pdv (MeV)			2.11E+00	4.33E-01	4.47E-01	4.28E-01
Integral Pdv (MeV)	6.6		2.11E+00	2.55E+00	2.99E+00	3.42E+00



The integral of P*dv quickly saturates at a level consistent with the initial kinetic energy of 10.11 MeV (the gas is not ideal and the constant is somewhat uncertain). Overall, *pressure* can be considered the driver for expansion. The net effect is the proton receives gravitational potential energy against a resisting gravitational force. For expansion, the kinetic energy term is initially 10.11 MeV of kinetic energy but decreases as integral Pdv increases. Defined this way, we expect the equation 10.11=ke+Pdv to be satisfied. Although the proton model and cellular cosmology define kinetic energy for the cell, it is pressure and temperature that expand the universe. Rather than being limited to a quantum mechanical orbit, particles are free to move throughout space. After two additional early transitions (equality of photon and mass density and decoupling of electrons [7]), gravitation is locally able to dominate gas pressure. This gas does not act like the one that thermodynamics normally describes. The particles are gravitationally "sticky" and small accumulations of matter grow and eventually form clusters, galaxies, stars and planets [6][12].

Current kinetic energy per proton

Each cell (small r) that is still expanding is now about 0.352 meters and large R=0.352*exp(60)=4.02e25 meters. The initial KE=10.11 MeV has diminished by the ratio of current radius to initial radius (0.35/7.22e-14=4.88e12) and is now 10.11/4.88e12 =2e-12 MeV/proton. Of course, we do not see the cells and they blend together to form the space around us.

TIME AND COSMOLOGY

There is a strange situation in fundamental physics regarding time. Well respected physicists [Julian Barbour for example] point out that all quantum mechanical equations are cyclical with time. Common sense tells us that time advances and tension exists between fundamentals and what we observe. This situation extends to fundamentals of space as well as fundamentals of time. Special relativity and curvature of space time is known to be the source of gravity at the large scale but the author's approach to quantum gravity is not generally known. Further, the concept that velocity is relative seems to be accepted but velocity is related to kinetic energy that is conserved.

The author believes that the cycle time 1.51e-21 seconds has repeated many times since the beginning. In other words, a quantum mechanical fundamental time is defined that cycles *and* counts forward (fundamental time*exp(N)).

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		

Consider why the universe expands. Kinetic energy (ke) must be turned into gravitational potential energy (pe=Fr) over *time*. Time enters physics through cosmology! The derivation below indicates that the increasing radius of the universe and increasing time are related through expansion.

ke	pe
ke	F r
1/2M(v)^2	GMM/r
1/2M(r/t)^2	GMM/r
1/2Mr^3/t^2	GMM
1/(2GM)*r^3	t^2

(r/r0)^3 increases as (t/t0)^2

The above derivation contains only radius and time. If we believe that expansion occurred we must believe that time advances (perhaps in snapshots of fundamental time 1.5e-21 sec).

(r/r0)^3 increases as (t/alpha)^2 (kinetic energy requirement)

With the understanding that the large scale we observe is made of cells defined by gravity and the further understanding that fundamental time cycles, counts and moves everything forward we can simplify our understanding of nature. This cycle is established by the quantum mechanics of the gravitational field inside each proton (the proton model in Appendix 2) and each proton is identical and none occupy a preferred position. All protons advance in elapsed time simultaneously ready for the next count. Elapsed time is the primary variable for the expansion equations and they determine the expanded radius we will label radius prime (r'). It determines how much kinetic energy has been converted to potential energy. In fact, expanded kinetic energy is simply ke=10.11*7.22e-14/r' MeV.

Time associated with kinetic energy

According to special relativity time runs slow for particles with kinetic energy (gamma=m/(m+ke) and V/C=(1-gamma^2)^0.5). The slowness of time is expressed by dt=1/gamma-1 and is about 1% slow for an astronaut orbiting the earth. But gamma is established by kinetic energy and kinetic energy is maintained by a particle unless something changes its velocity. Time runs slow for the moving mass even though a new fundamental time cycle has started. This means there are two measures for time. A time phenomenon called the twin paradox has been carefully explored by physicists.

> The twin paradox has been proven with synchronized atomic clocks in satellites. A clock in motion runs slower and when they are brought together they read differently. .

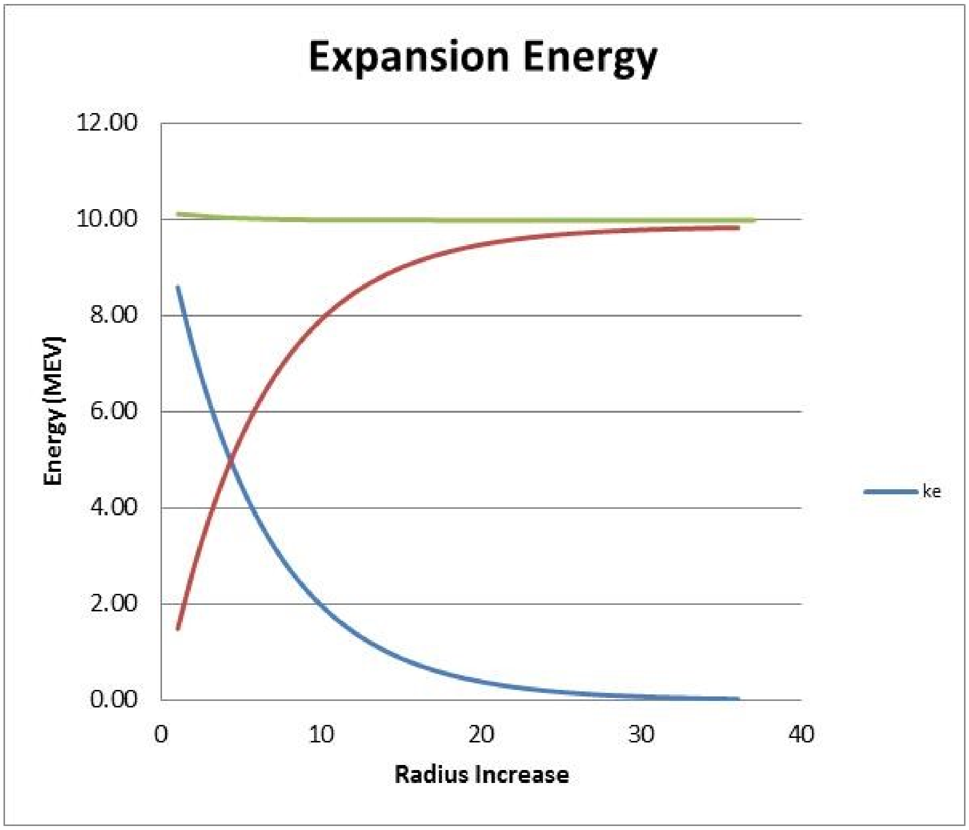
Explanation of twin paradox: Fundamental time is controlled at the quantum level. When the journey is complete both twins are together in fundamental time. However, the traveling twin is a little younger because his gamma was established and maintained by his kinetic energy.

THERMODYNAMICS AND COSMOLOGY

Conservation of Kinetic and Potential Energy

Particles initially have kinetic energy related to the proton mass model. Kinetic energy is converted to potential energy as expansion occurs and is reversed when mass accumulation starts. The total energy is PE+ke=10.11 MeV/particle. There is a new understanding of space and time in cellular cosmology. General relativity extends to the quantum level and we are walking around in space that has expanded from that level.

Gravity is defined at the quantum scale by the energy 10.11 MeV/particle and gravitational field energy 2.723 MeV at Radius =7.22e-14 meters with exp(180) cells. Since expansion is well characterized (and agrees with the author's calculated expansion), one can simply calculate expansion kinetic energy and expansion potential energy as a function of time and determine if initial KE is in fact converted to potential energy. The initial resisting force is the inertial force F=M*V^2/R=3.66e-38 NT where V is the tangential velocity V/C=0.15 that decreases with increasing R. Final potential energy (integral of F*dR) is 10.11 MeV but the initial kinetic energy is reduced to the current value of 2e-12 MeV. Changes in energy are plotted below (the horizontal axis units are increments of time and they quickly saturate).



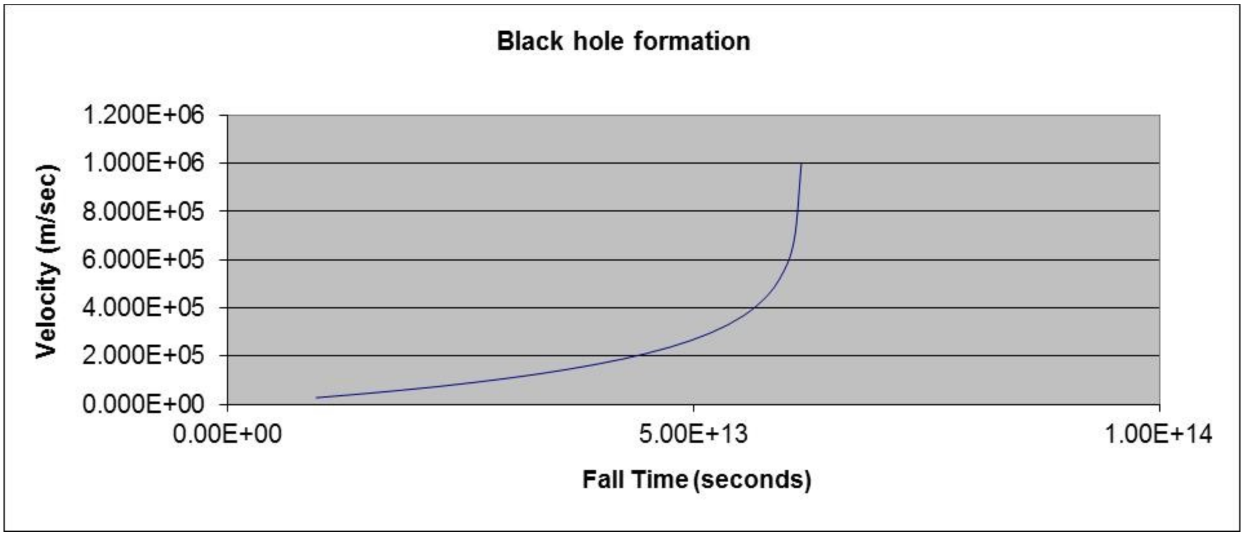
The graph above indicates that kinetic energy and potential energy are indeed conserved.

Gravitational Accumulation

Expanded particles do not simply reverse expansion as they fall due to gravitation. At about 200K years after the beginning a condition known as equality [6][7] of photon density and matter density occurred and gravity became an important force determining their behavior. Initially, gravitational accumulation was aided by acoustic waves but as particles collided, their gravitational attractive forces started to dominate and particles no longer behaved like gases we are familiar with. The pressure at equality was about 5e-8 psi (pounds per square inch) and the temperature was 9100 K. The gas was low pressure plasma. A later critical juncture in thermodynamics occurred as the plasma cleared (this condition is called decoupling and electrons assume orbits around protons). The temperature at this point was about 3300 degrees K and the pressure was 6e-14 psi. At the present time it is 3.7e-27 psi and 2.7 K.

Formation of Black Holes

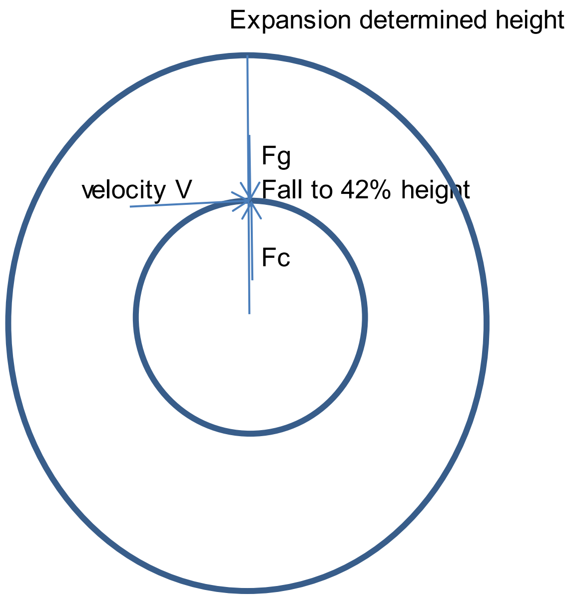
The author uses a spreadsheet (fallmodel.xls) that combines Newtonian kinetics with the expansion equations. Starting at equality of matter and radiation acoustic waves develop and concentrate mass. WMAP [7] measured the red shift of (spots) that we can now associate with clusters. When the universe was about 1e22 meters in size waves were no longer dampened (equality) and 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 “empirical” [12] but divides 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. One possible reason the first masses form black holes is that their fall velocity becomes very high and the absence of other bodies do not deflect the particles into orbits. Apparently some black holes formed soon after decoupling of mass and radiation and aided galaxy formation. Below the fall velocity as a function of time is shown from fallmodel.xls:



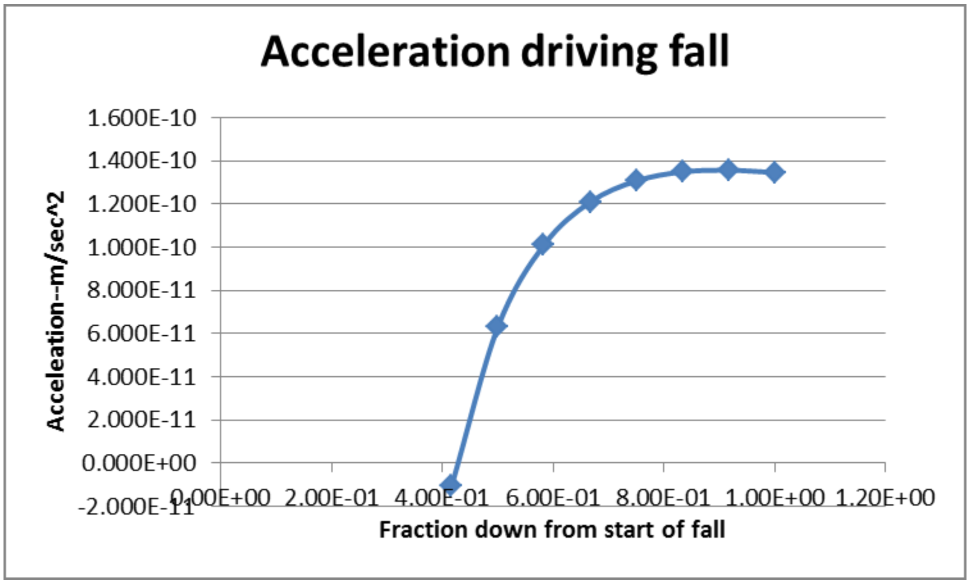
A black hole can be an attractor that brings mass into a galaxy. As new mass falls, it falls into orbits around the black hole and the galaxy builds mass from the inside out since later mass gathers from further away. As it falls to approximately 42% of its origination height, it adds to the outer portion of the galaxy.

Gravitational accumulation forms orbits

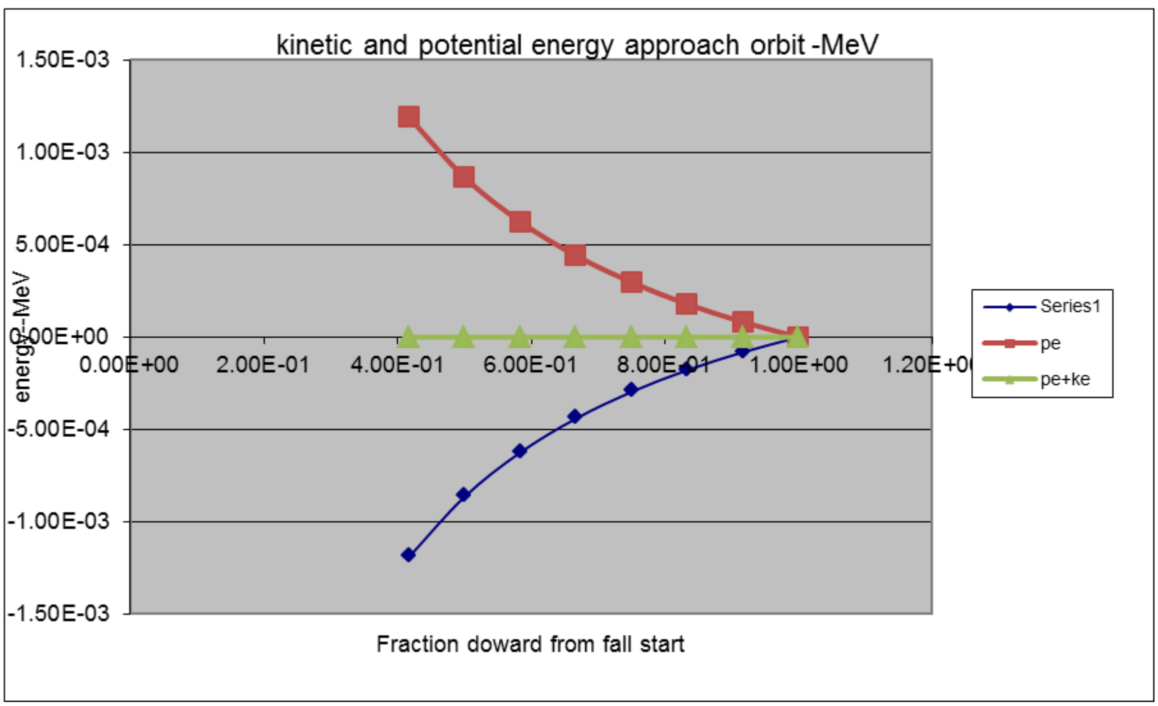
First review how orbits are formed.



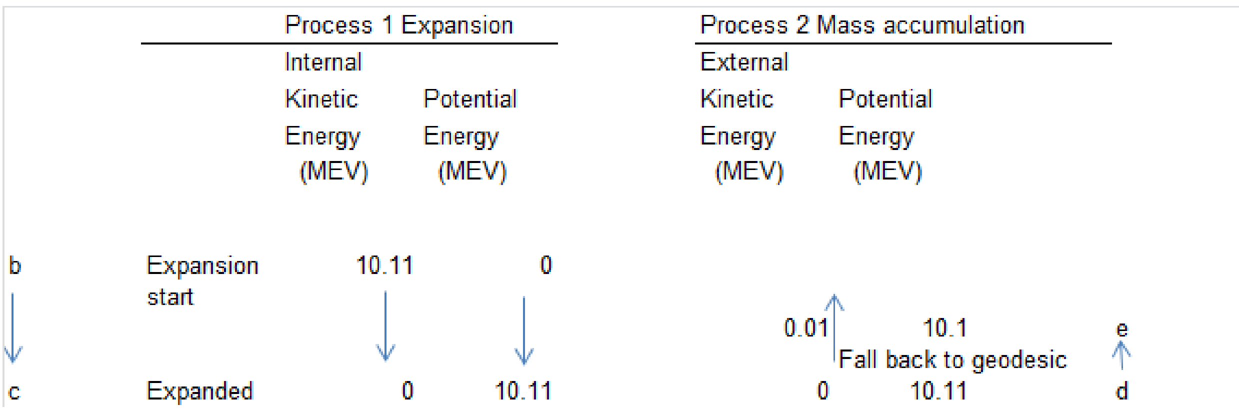
Particles expand to a height determined by the expansion equations. As accumulation starts, particles fall and in general are deflected into an orbit. The orbit (geodesic) is by definition the combination of velocity, mass and radius that gives the gravitational constant G. Orbits, also by definition, are force balanced. In other words inertial forces are balance on a particle in a way that it feels no force. The radius is, in general, less than half the original height. The graph below is a simulation of a particle falling into a galaxy of 1e41 Kg to a position similar to our sun in the Milky Way. The force of gravity on the particle starting for a high position increases as it falls toward the center ($F=GMm/R^2$) since R is decreasing. But as the particle falls it is deflected into a circle ideally and the inertial force increases. The forces are balanced when the particle reaches 42% its original height. The velocity is calculated for a particle given enough time to fall through the distances and the graph below shows the acceleration driving the fall. The gravitational acceleration inward minus inertial forward outward is shown below. The particle achieves orbit when the forces are balanced (zero acceleration).



The chart below shows the kinetic and potential energy changes. Potential energy changes from 10.11 MeV is shown for graphing convenience and kinetic energy is calculated from the velocity increases due to excess gravitational acceleration (gravitation minus inertial). Of course potential energy is converted into kinetic energy.



The proposed model for expansion is based on an orbiting proton with 10.11 MeV of kinetic energy (b). As expansion occurred (process (b)→(c) below), 10.11 MeV of kinetic energy was converted to 10.11 MeV of external 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 6.2e25m. 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)→(e). Theoretically, 10.11 MeV of external potential energy could be reconverted to10.11 MeV of kinetic energy as particles fall toward one another but as we will show below, only a fraction of 10.11 is found in galactic and planetary orbits. (The example below is for 0.01 MeV of kinetic energy re-conversion but later we will show that this it is only 1.6e-3 MeV). Overall, process (b)→(c)→(d)→(e) converts cellular kinetic energy to external potential energy between cells and a small amount of kinetic energy.



What actually happened during expansion was a transition occurred and acoustic waves broke the total mass into about 27000 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 and are able to move and fall relative to each other after they are far apart. Contraction is limited to a fraction of 10.11 MeV since orbits or solid objects are formed. Although gravitation is based on the mass of exp(180) protons, this may be a combination of protons and cold dark matter.

Is Velocity Relative?

To properly address this subject we must show a complete energy balance/neutron as the universe expands. The balance of mass with kinetic (959.91 MeV) exactly balances field energy (959.91 MeV). Zero energy is separated into these components at the beginning and as expansion occurs the energy components change slightly but still balance to zero. About the only thing that changes is the conversion of potential energy to kinetic energy. As expansion starts, using this condition as a reference, there is 10.15 MeV of kinetic energy.

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		**0.00**	20.30254027	4.85E-02		828.4598	ke
-2.732	-957.1848								-959.9164	pot
									0	total
after decay to P & fusion to helium				e/m						
(released as K	129.5409						1.2789		130.8197	mass
	798.5799	8.521270135	1.63	2.720E-05	**10.15**	**10.15**	0.1114		829.1451	ke
-2.7316	-957.1848								-959.9164	pot
					Grav Kinetic E	Grav Pot E	CMB		0	total
Now	6.20E+25									
	129.5409						1.2789		130.8197	mass
	798.5799	8.351270135	1.8	2.720E-05	**1.40E-12**	**20.30**	0.1114		829.1451	ke
-2.7316	-957.1848								-959.9164	pot
									0	total
Near end	2.36E+26									
	129.5409						1.2789		130.8197	mass
	798.5799	8.351270135	1.8	2.720E-05	**0.00**	**20.30**	0.1114		829.1451	ke
-2.7316	-957.1848								-959.9164	pot
									0	total

The first law of thermodynamics is straightforward. It states that energy can be converted from one form into another but not created or destroyed. The concept that velocity is relative seems to be accepted but velocity is related to kinetic energy (ke=0.5*m*V^2) that is conserved. Some would point out that special relativity indicates that simultaneity is dependent on motion and therefore, since motion is relative, time is relative. They use the Lorentz transformation to calculate how time is changed by velocity relative to some other particle. If velocity is relative there is tension between this statement and kinetic energy. How can the first law of thermodynamics be satisfied (no destruction of energy) if velocity is relative but kinetic energy is not relative? Furthermore, the above diagram is violated if energy is not conserved. Using tools associated with cellular cosmology, we will account for kinetic energy/per proton for orbits associated with earth. This will help understand how potential energy and kinetic are now distributed and provide information regarding the "velocity is relative" concept.

Potential and kinetic energy distribution

On earth we feel acceleration. In the section entitled "Gravitational Force on the Earth" an astronaut's velocity was determined as follows:

R (m)	**orbit R =earth R**	**6.38E+06**
M (kg)	**Earth Mass**	**5.98E+24**
a (m/sec^	**a=GM/R^2**	**9.8**
V	**V=(aR)^0.5**	**7909**

Her kinetic energy/proton is 5.32e-15*7909^2=3.3e-7 MeV. Velocity, kinetic energy, gamma and cell radius associated with orbits that involve the earth are listed below. From cell r above, the large scale geodesic is scaled up by the ratio of the central mass/proton mass. For example, for the earth, the cellular r geodesic scales to the earth geodesic as follows: The earth geodesic based on one cell radius is R=r*M/m=2.14e-6*5.98e25/1.67e-27=6.4e6 meters.

Note: All calculations below are per proton. The reason to do this is we can compare the energy to kinetic and potential energy changes/proton for expansion and compare them to the total 10.11 MeV.

Orbit		Vel m/sec	ke (MeV)			gamma	cell r (m)	Mass M	Orbital R (
P/earth	6378100	7.91E+03	3.28E-07	ke from 7898		0.9999999997	2.163E-06	5.98E+24	6.35E+06
earth surface		4.64E+02	1.13E-09	ke earth spin					
earth/sun	1.55E+11	2.92E+04	4.48E-06	ke in earth orbit		0.9999999952	1.583E-07	1.99E+30	1.54E+11
sun/galaxy	2.5098E+20	5.58E+05	1.63E-03	ke from 8.29 kps gala		0.9999982590	4.345E-10	1.17E+42	2.50E+20
	galaxy	5.60E+05	1.65E-03	ke galaxy		0.9999982464	4.314E-10		
			3.28E-03	total ke		0.9999965003	2.161E-10	4.34E-10	

Above we add earth orbit that should have 3.3e-7 MeV/proton adding to that the kinetic energy/proton of the earth orbit around the sun and adding to that the kinetic energy of the sun's orbit around the galactic center. The sun's kinetic energy in a flat galaxy velocity profile is included from the graph below in the topic entitled "Flat galactic velocity profiles". The next orbit should be a galaxy orbiting the center of a cluster but in general this is not observed (the possible reason is below but you can skip if you desire).

> A possible reason that galaxies do not move in orbits around a cluster may be that galaxies have mass all around them and the forces are balanced. This condition may date back to the high to low Jeans length transition that forms the galactic centers on almost equal spacing. Only if a galaxy moves toward another galaxy does gravitation force start the galaxy moving (this appears to be the case for Andromeda and the Milky Way that are moving toward one another). Another possible reason is that galaxies form relatively fast because black holes accelerate their formation and clusters do not have this advantage. Galaxies probably have velocity but a value similar to the stars themselves seems reasonable for the table above.

Adding together the kinetic energies contributions from earth orbit, solar orbit and galactic kinetic energy we can identify only about 3.3e-3 MeV/proton. Compare this to the expanded cell potential of 10.11 MeV. Only a small amount of potential energy has been converted back to kinetic energy by falling. (Black holes are an exception since they develop about 10.11 MeV of internal kinetic energy by compression).

Non-ideality involved in reconversion of kinetic energy to potential energy

Not all cells fall from the geodesic established by the expansion equation and are still expanding. For protons that fall, potential energy is reconverted to kinetic energy (ke) and heat dQ. We will try to account for the energy and determine where the original 10.11 MeV resides. The non-ideal case for normal matter is that collisions occur that cause particles to lose some of their kinetic energy to "friction" between particles. The equation that applies is 10.11=(ke+dQ)+Pdv. The term ke and Pdv are converted back and forth but the term dQ contains the friction energy (heat) and we expect to find this energy in the temperature of the planets and the stars (before fusion adds to the energy). All particles that form a central mass like a star or planet fall are limited in their fall. The electron orbit 5.29e-11 meter limit recompression and establishes the following theoretical limit. The temperature associated with recompression to 5.29e-11 meter cell size is about 1e8 degrees K and 0.013 MeV. We do not find this large amount of energy in solid bodies indicating that the recompression process is highly non-ideal. The process of gravitational accumulation (asteroids and comets) converts kinetic energy to heat but particles in the vicinity of the sun have no more than 0.0013 MeV and when they hit a solid body like the earth the earth heats slightly but subsequently radiates its energy to space. Even at the core temperature of the earth (6000K) the kinetic energy is only 1e-6 MeV.

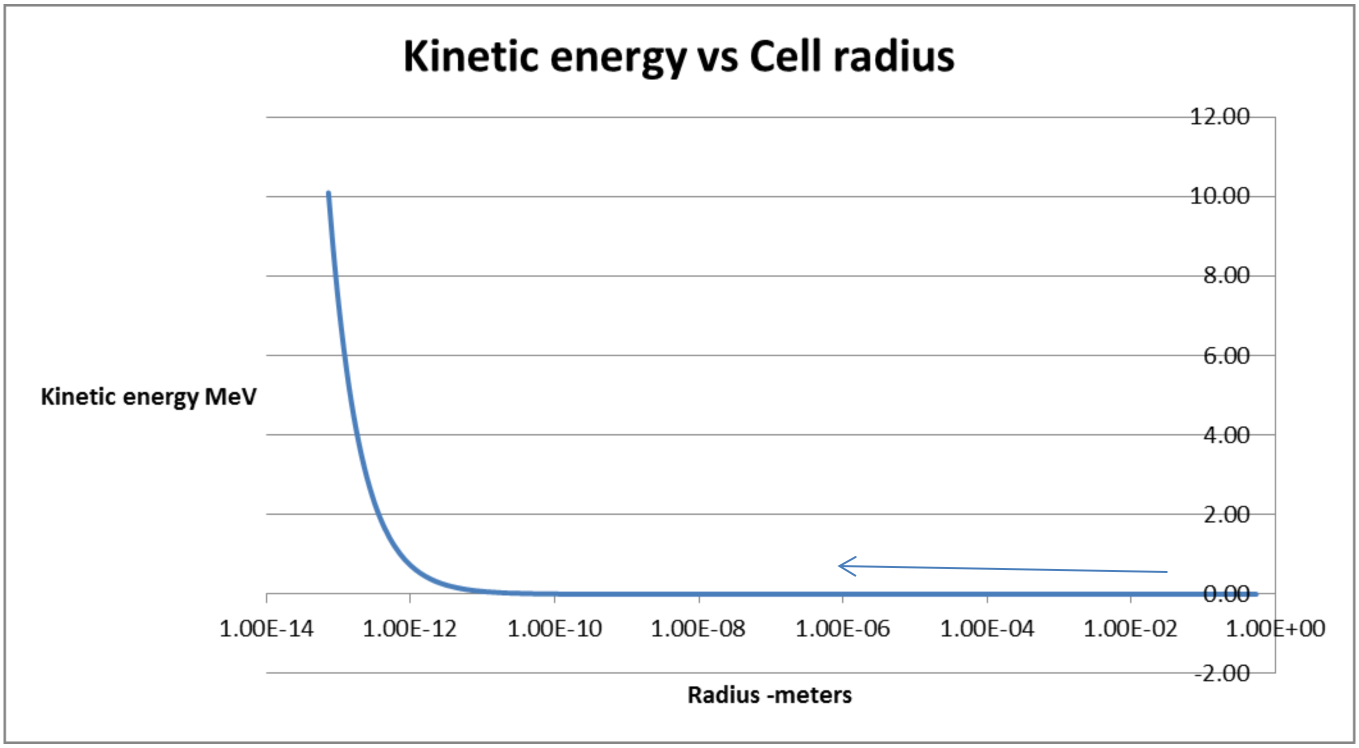
Accounting for friction heat

We found 0.0016 MeV in the orbits we know about but there is also heat energy that needs to be accounted for. Heat energy is related to temperature in the earth and sun. Recall that the particles have 5e5 m/sec and can fall quite hard into solid bodies, i.e. comets and asteroids. The estimates below account for the fact that some protons are more abundant than others.

	Temp	ke/particle	mass each	number	num*mass	num*N*ke	ke/particle (mev)	
sun wit	1E+06	0.0001293	2.0000E+30	1.0000E+11	2.00E+41	1.55E+64	1.2929E-04	
planets	6000	7.758E-07	5.98E+24	1E+12	5.98E+36	2.78E+57	2.3195E-11	
dust	2.73	3.5299E-10	5.98E+24	1E+12	5.98E+36	1.26E+54	1.0554E-14	
					2.00E+41	1.55E+64		
					1.20E+68			
					average ke/particle		1.2929E-04	

Our orbital energy/proton is about 0.003. The total heat energy “found” for the sun, planets and dust was 0.00013 MeV/proton (excluding fusion). Small black holes are compressed and hold more energy but there are relatively few of these. Overall most of the energy we were searching only amounts to about 0.003 MeV/proton. This energy is only a fraction or the 10.11 MeV available.

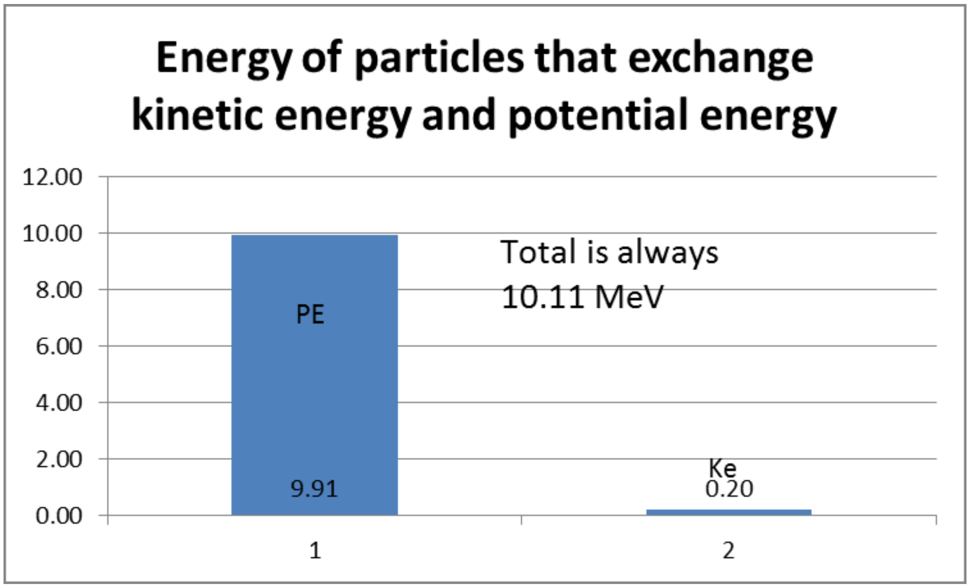
Here is a plot indicating why we only find a small amount of the original energy. Starting from the right side of the potential energy axis, the average cellular radius would have to become quite low to convert a large amount of potential energy back into kinetic energy.



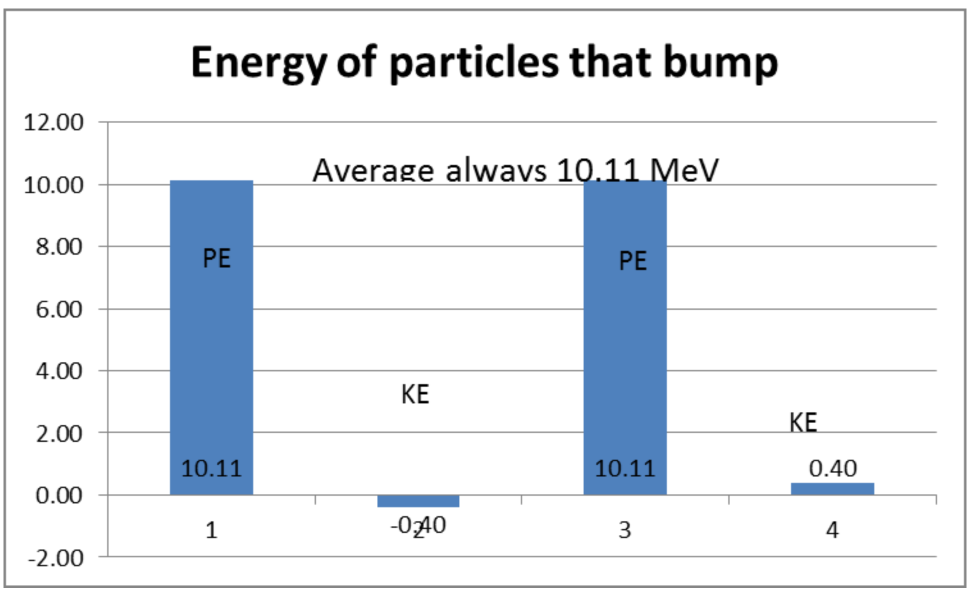
Most of the protons in the universe, on average, are surrounded by a large amount of space. In this condition, they have about 10.11 MeV of potential energy. Most of the potential energy was gained by overcoming strong gravitational attraction when particles were compressed. Falling into orbits and colliding with other particles does not produce much kinetic energy per particle. Even fusion produced energy is relatively low compared to 10.11. For example, the sun's interior temperature of 2e7 K has only 0.0026 MeV/proton.

Velocity is not relative

This concept should be re-labelled "The speed of light C is always measured 3e8 m/sec". The idea that velocity is relative came from experiments that showed object velocities do not add to the speed of light. In addition, velocity is an incomplete specification for kinetic energy. Most of the energy around us comes from gravitational potential energy that has been reconverted to kinetic energy and then to compression energy and heat when bodies like the earth are formed. The total of potential energy and kinetic energy is constant (10.11 MeV). The ke portion is really only 0.003 MeV but it wouldn't show in the graph.



Clearly the energy is accounted for since it totals 10.11 MeV. However, some particles can transfer energy to other particles. This is a local effect because the particles must interact (bump) to transfer energy.



If particles interact, some particles will have lower energy and some higher. However, the average of all particles will be 10.11 MeV. The statement that velocity is relative becomes "on average the potential and kinetic energy of all particles is 10.11 MeV". The statement regarding relativity is only for kinetic energy that we lose track of because we don't know the history of every particle. If you calculate time dilation and the Lorentz transformation on the basis that velocity is relative, remember that your calculation is relative locally and you do not have enough information to apply it globally.

Origin of the Second Law of Thermodynamics

The second law is not as straightforward as energy conservation. A quantity called entropy describes the probability of energy states for systems with many particles. The second law states that more probable energy states become filled over time and energy differences that can be used to carry out work become less available. The source of a high original state that can continually "run down" has been difficult to identify.

Friction, heat and entropy

Thermodynamics is the science of groups of particles. Entropy, S is defined as follows and helps characterize the second law of thermodynamics.

The cyclic integral of change in heat energy/divided by temperature is equal or less than S where S is defined as entropy, i.e. cyclic integral of dQ/T< or = dS.

The change in the entropy of a system as it undergoes a change of state may be found by integrating: S2-S1= integral (dQ/T) from state to 1 to state 2 [29]. The overall change in dQ/T will always be less than entropy dS. In other words entropy, defined this way, always increases. There is a limiting (ideal or reversible) condition where entropy might be equal.

The thermodynamics of a gravitational potential has not been developed to the author's knowledge. After expansion, a very improbable (high information) state has been established. Expanded particles separated from one another are free to accumulate due to gravity. As they do, they fall to lower energy (more probable) states as they collide and accumulate. Mass will accumulate and bodies will fall into orbits around other bodies. As they fall, collisions occur. The collisions/friction causes heat and the temperature rises. As particles form large bodies the temperature and pressure can become so high that they fuse, subsequently explode spewing out elements [15][20] that can combine into molecules and life [24]. Conventional thermodynamics describes the behavior of gases that gathers around planets and stars. There are a lot of potential states awaiting particles that fall and collide due to gravitation potential. In general when particles collide during accumulation, heat will be generated and entropy dS will exceed S2-S1. This is the origin of the universe's initial low entropy state. The "zeroth" law of thermodynamics states that entropy is zero at absolute zero. It might be better to state the "zeroth" law by referring to cosmology. Entropy is zero in the expanded condition before non-ideal collisions occur. The one way downward street begins as the expanded state and the heat we deal with originates from gravitational potential energy.

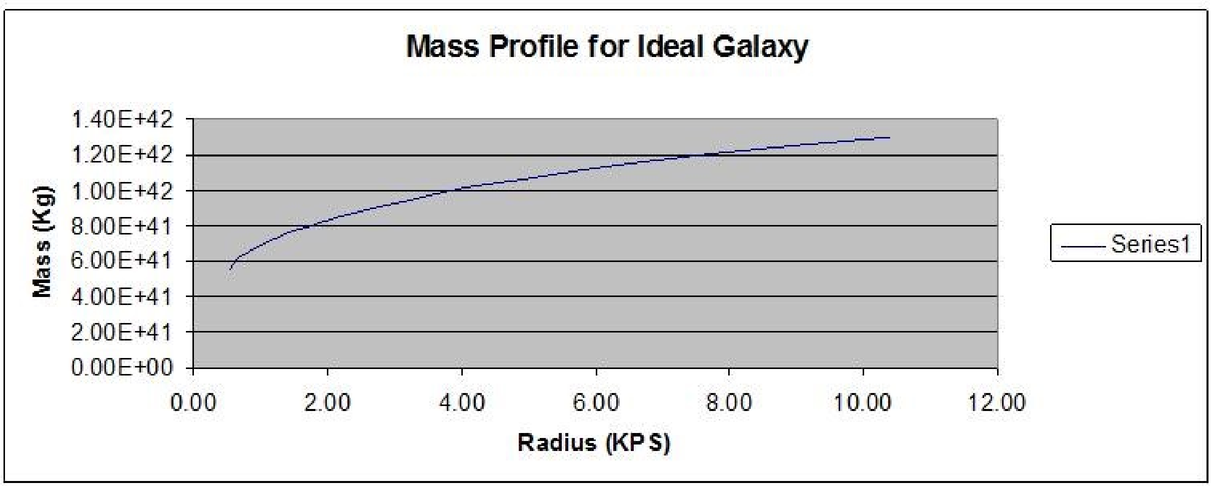
The topic below entitled "Compression thermodynamics" indicates that there are two levels of thermodynamics at play. The particles around are in the electromagnetic controlled region of the chart. The electron is circling the atom and controls the thermodynamics. The proton itself had external energy but most of the 10.11 MeV is now potential energy and a small amount of is the kinetic energy of large body orbits. Under extreme compression, like that in the core of small black holes, the proton's gravitational kinetic energy comes back into play.

DARK MATTER

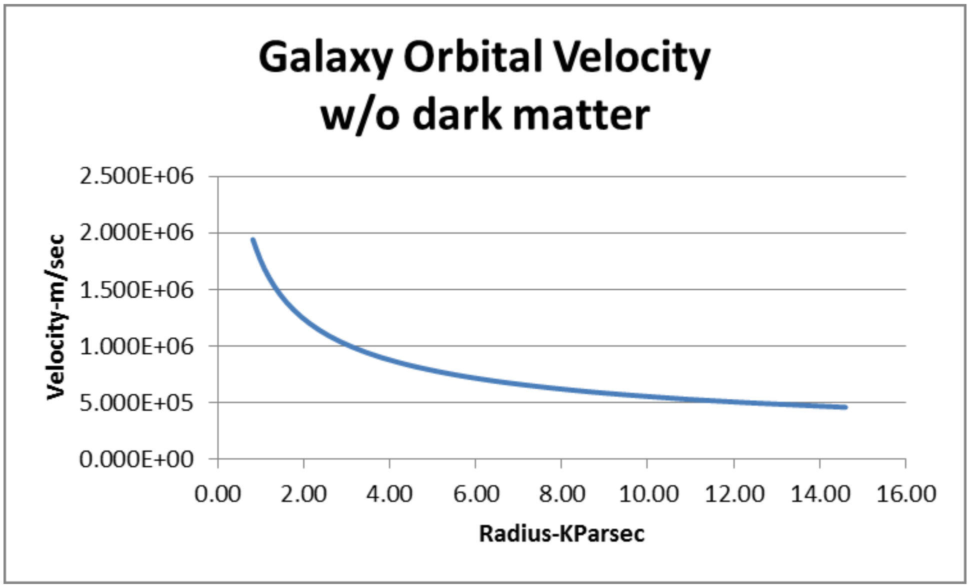
There is matter in the universe that can't be easily observed. It is called cold dark matter (CDM) because it appears to interact only gravitationally. We know about CDM matter in several ways. The velocity in the outer part of galaxies can be explained only if there is dark matter. It doesn't light up with fusion so the light coming from the outer part of galaxies doesn't reveal its presence. The other way we know about dark matter is Schwarzschild's equations for the bending of light due to gravity. Further, expansion data compared to expansion expectations indicate that there is extra "density" in the universe. In the author's work [13], cold dark matter is a gravitationally bound neutron [31] (one hot matter proton for every cold dark matter neutron) except it is transparent to normal particles. CDM is gravitationally active and this aids accumulation.

Galaxy formation

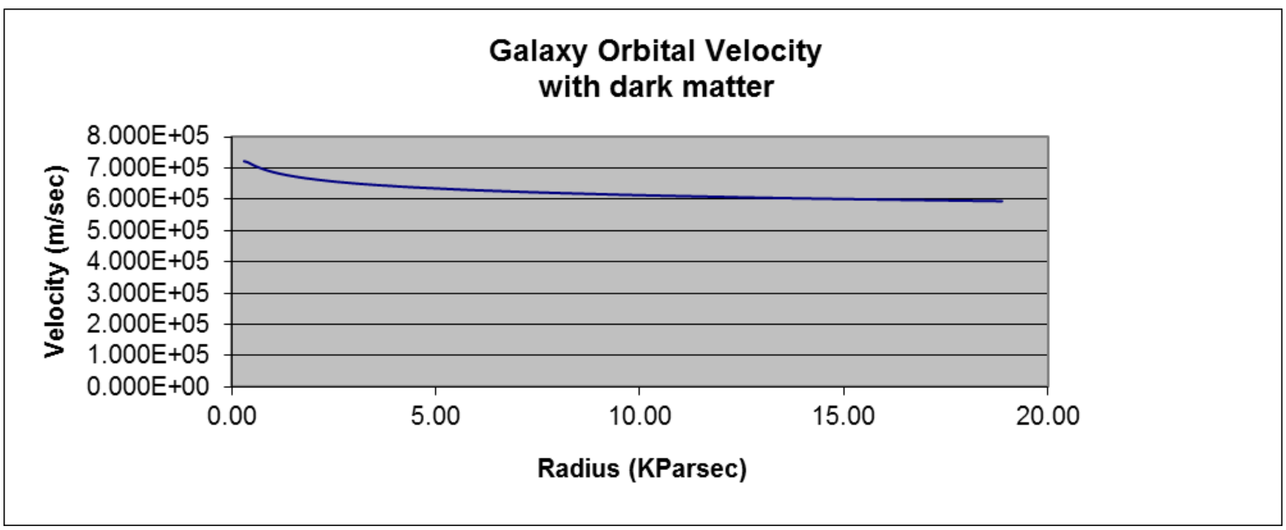
For our Sun in the Milky Way and ideal conversion of potential energy to kinetic energy the fall model gives the velocity profile for orbits from the center of the galaxy out to the sun. The chart below shows what happens to "ideal mass" as it falls. Ideal mass is mass that does not lose kinetic energy from collisions. It could be "cold dark matter" or just particles that don't happen to collide.



This is a simulation of a velocity in a galaxy like the Milky Way that has 5.58e5 m/sec orbital velocity of a 2e30 kg sun at 8.29 kiloparsec (2.5e20 meters) from the center. The velocity falls off with radius due to Newtonian mechanics.



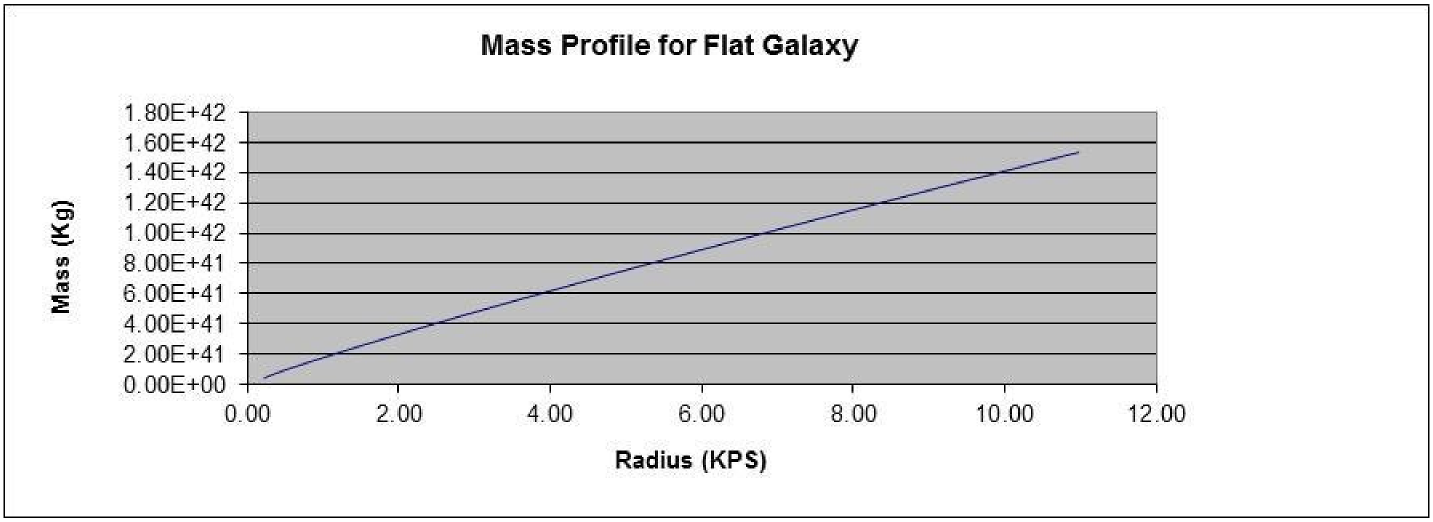
The velocity profile below represents galaxies that are actually observed (the simulation is for a galaxy similar to our Milky Way with a sun in about the same position).



One difference is that the flat profile galaxy starts with 1e40 Kg and the ideal galaxy starts with 5.5e41 Kg but the mass must also be distributed differently. Both end up with 1.19e42 Kg inside the position of the sun.

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).



There are differences in the way cold dark matter behaves gravitationally. The CDM particles fall with gravity but they accumulate around normal matter. Their conservation of PE and ke should be ideal. The expansion equations apply to them as well and there should be many that expanded to 0.54 meters/mass in size and have about 16 m/min velocity. The theory that they do not interact means that there can never be any compression, fusion, friction related heat (dQ) or transfer of energy between particles.

Dark energy

Firstly, what is critical density?

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

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

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

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

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

The equations below appear to define critical density RhoC.

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

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

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

Kinetic energy and critical density

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

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

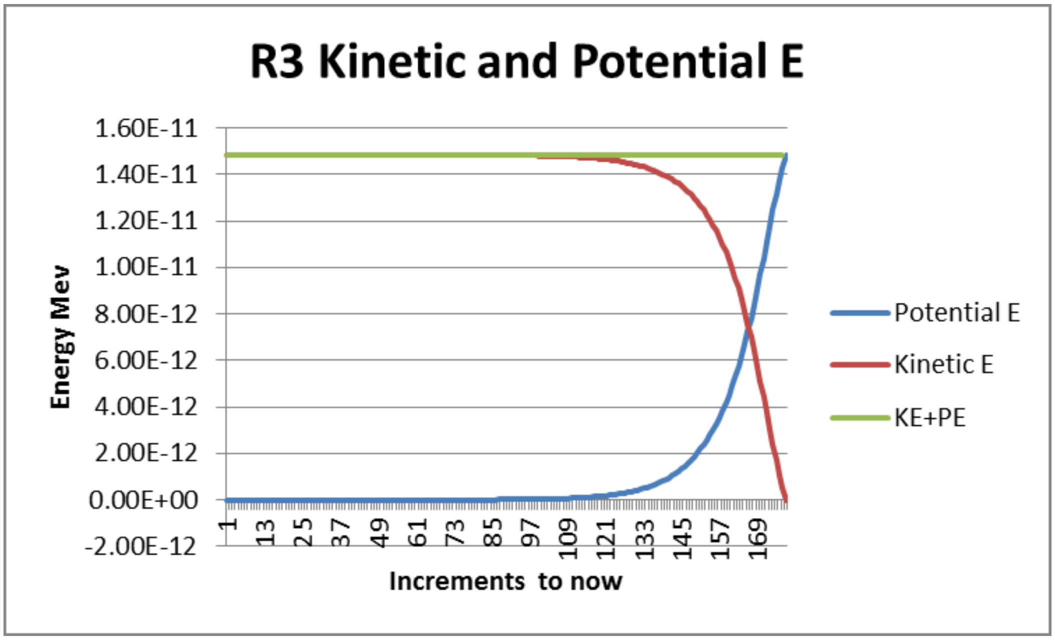
We are starting to see a problem. Kinetic energy should be converted to potential energy during expansion. Potential energy should be high and kinetic energy should be low at the current time but the equations above give the same value. Go back and write the equations without substituting rho into the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

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

As expansion progresses velocity v becomes smaller and kinetic energy becomes smaller. But potential energy becomes larger because it is an integral of force F*dr. F is becoming smaller because r^2 in the bottom of the equation is becoming larger.

Some say that this is a huge unknown energy source so large that accelerating expansion eventually reduces density to near zero. The second expansion component (R3 mentioned in the section entitled "EXPANSION EQUATIONS") is late stage expansion and causes the acceleration observed [8]. Using cellular cosmology the potential energy can be calculated for each expansion component (R1) and (R3). The calculation shows that the potential energy required for expansion component R3 is 1.5e-12 MeV. It is very low because late stage expansion is resisted by small forces. (Stated the other way, when the radius is low forces are high but delta radius is low).

Below, we calculate the kinetic energy and potential energy during early expansion. Observe how flat the curves. Toward the present time the forces involved are on the order of 1e-61 Nt. Since the force is very low at large r^2, the energy required is very low.

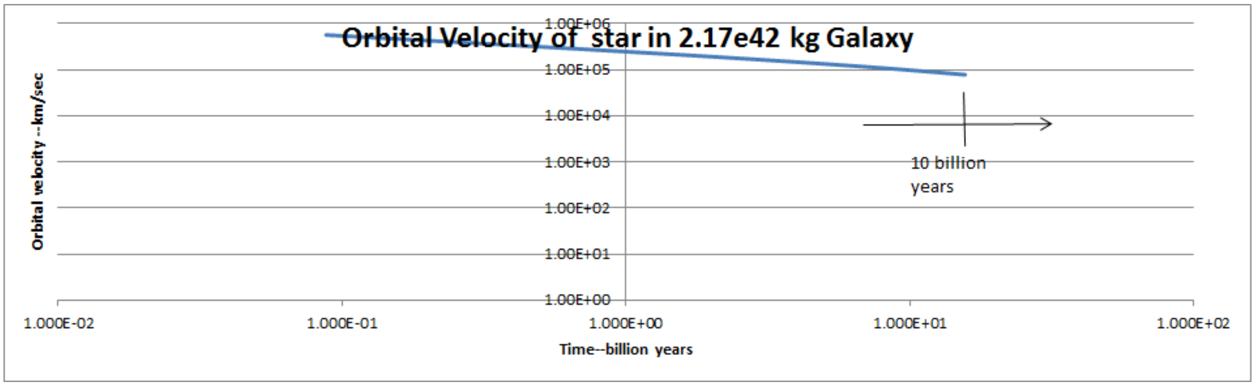


Late stage expansion requires 1.5e-12 MeV of kinetic energy. This can replace the second component of expansion (lambda). This energy is not 0.719 of the kinetic energy 43 MeV calculated above. The difference is 13 orders of magnitude. The critical density concept (V/R)^2=8/3*pi*G*rhoC where rhoC is critical density) is being misused late in expansion since it incorrectly assumes that the second component of expansion consumes a large amount of kinetic energy.

Explanation of dark field compact galaxies

Dark field Hubble photographs show that highly redshifted galaxies appear more compact. They are far away and could have formed earlier than other galaxies. At a particular time in expansion, expanded cells have a certain amount of potential and kinetic energy. The section entitled "Gravitational accumulation", above, indicated that particles achieve an orbit at 42% their original height. The larger the universe is, the higher the particles will be when they start their fall. This means that galaxies formed late in expansion will appear larger than ones formed early.

We can estimate gravitational accumulation using the spreadsheet fallmodel.xls. Study of a model galaxy (1.2e42 kg) allows us to determine where energy resides as it is re-converted to kinetic energy by falling. Some particles leave the radius defined by the expansion equation and fall into orbits around a gravitational center that will become a galaxy. In the graph below, the later galaxies form the lower their star velocities will be. Since they have lower velocities they will orbit at a larger distance from the center. These galaxies will appear less compact. The sun is about 5 billion years old and is half way through its hydrogen fuel.



CONCLUSIONS

The gravitational constant G can be calculated from a new concept called cellular cosmology and information from an energy model of the neutron. The quantum gravitational scale is the radius 7.22e-14 meters and the neutron mass, 1.67e-27 Kg with a coupling constant 1/exp(90). The neutron model contains four field energies and associated masses consistent with data regarding nature's four fundamental interactions. In each case a field curves space and a mass falls into an orbit with kinetic energy, defining the quantum radius. This indicates that general relativity continues down to the quantum level but in cellular cosmology, a field curves space and there is initially one neutron in each cell. The large scale space-time we walk around in is defined by gravity at the quantum scale, the gravitational coupling constant and expansion. During expansion, rather than being limited to a quantum mechanical orbit, protons are free to move throughout space. This means that although the proton model defines kinetic energy in a gravitational orbit, it is pressure and temperature that expands the universe. After two early transitions (equality of photon and mass density and decoupling of electrons), gravitation is locally able to dominate gas pressure. This gas acts according to thermodynamics but the particles are gravitationally "sticky" and small accumulations of matter grow and eventually form clusters, galaxies, stars and planets.

The first law of thermodynamics deals with groups of particles interacting through electromagnetic energy and in extreme cases with gravitational kinetic energy. The top of the "one-way downward street" we call entropy is the expanded universe. As accumulation begins there are many potential states for particles to fall into. As they falls collide and produce heat, the second law of thermodynamics describes their behavior.

Elapsed time enters physics through cosmology. If we believe (r/r0)^3 increases we must believe that time advances (t/alpha)^2 (alpha is a constant). It appears that time cycles at the quantum level and counts forward for all particles. The cycle time for one count is the fundamental time defined by quantum gravity. Elapsed time, expansion equations and conversion of potential energy to kinetic energy define the space around us. Free particles have velocity and an associated gamma.

What about the argument that velocity is relative? Each proton in nature has a specific energy and can be associated with a cell. Expansion potential energy can be re-converted to compression energy, orbital kinetic energy and heat. We can account for energy and find out interesting things about our history using cellular cosmology. The author believes that nature maintains zero energy, made of two opposite energy values. Since particles interact some protons contain more energy than others but they average to zero. It is well known that the velocity light is constant and that time varies slightly. Equations related to the Lorentz transformation should be considered "constant C equations" rather than relativity equations. It can be misleading to compare one velocity with another because we do not have enough information to know where all the energy resides. It is the author's view that velocity (and associated kinetic energy) is not relative.

Cold dark matter exists and makes up about half the mass of the universe. Most cosmologists use critical density as a predictor of energy components but it does not match calculations of potential and energy conservation. Dark energy exists but is almost negligible according to these calculations. The author believes that all energy is accounted for.

REFERENCES

1. Brillouin, L., *Science and Information Theory*, New York: Academic Press, Inc., 1956.
2. Feynman, R., Leighton, R., Sands, M., *the Feynman Lectures on Physics,* California Institute of Technology, Addison-Wesley Publishing Company, 1965.
3. Glashow, S., *Interactions,* Warner Book, Inc., 1988.
4. Hughes, I. S., *Elementary particles Third Edition,* Cambridge University Press, 1991
5. Weinberg, S, *A Unified Physics by 2050?,* Scientific American End of the Millennium Special Issue, December 1999.
6. P.J.E. Peebles, *Principles of Physical Cosmology,* Princeton University Press, 1993.
7. Bennett, C.L. et al. *First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Data*, Astrophysical Journal, 2001 L. Verde, H. V. Perris, D. N. Spergel, M. R. Nolta, C. L. Bennett, M. Halpern, G. Hinshaw, N. Jarosik, A. Kogut, M. Limon, S. S. Meyer, L. Page6, G. S. Tucker, E. Wollack, E. L. Wright
8. Conley, et al, (*THE SUPERNOVA COSMOLOGY PROJECT*), *Measurement of Omega mass and Omega lambda from a blind analysis of Type1a supernovae with CMAGIC*.
9. http://arxiv.org/pdf/1212.5226v3.pdf Table 2.
10. Barbee, Gene H., *A Top-Down Approach to Fundamental Interactions*, FQXi essay, June 2012 and vixra:1307.0082 revised Mar 2014.
11. Barbee, Gene H., *On the Source of the Gravitational Constant at the Low Energy Scale*, vixra:1307.0085, revised Feb 2014. Prespacetime Journal Vol. 5 No. 3 March 2014.
12. Barbee, Gene H., *Application Proton Mass Model to Cosmology*, vixra:1307.0090, revised Mar 2014.
13. Barbee, Gene H., *On Expansion Energy*, *Dark Energy and Missing Mass*, Prespacetime Journal Vol. 5 No. 5, May 2014. Previously vixra:1307.0089, revised February 2017.
14. Barbee, Gene H., *A Simple Model of Atomic Binding Energy*, vixra:1307.0102, revised Feb 2014. Reference spreadsheet atom.xls.

15. Barbee, Gene H., *Semi-Fundamental Abundance of the Elements*, vixra:1308.0009, revised Nov 2013.
16. D. E. Groom et al. (Particle Data Group). Eur. Phys. Jour. C15, (2000) (URL: http://pdg.lbl.gov)
17. Bergstom, L. and Goobar, A., *Cosmology and Particle Astrophysics*, 2nd Edition, Springer-Praxis Books in Astrophysics and Astronomy, 2004.
18. Barbee, Gene H., *Baryon and Meson Masses Based on Natural Frequency Components*, vixra:1307.0133.
19. Barbee, Gene H., *The Effect of He4 Fusion on Primordial Deuterium*, vixra:1404.0465, January 2017.
20. Atomic masses (for binding energy) http://physics.nist.gov/cgi-bin/Compositions/stand_alone.pl?ele=&ascii=html&isotype=some (National Institute of Standards and Technology, **http://www.nist.org**)
21. Shannon, Claude. *A mathematical Theory of Communication*, 1948.
22. http://www.lbl.gov/abc/wallchart/chapters/04/1.html
23. www.FQXI.org
24. Barbee, Gene H., *Unification*, vixra:1410.0028.
25. Barbee, Gene H., *Cosmology, Thermodynamics and Time*, vixra:1407.0187, September 2014.
26. http://en.wikipedia.org/wiki/Black_hole
27. Barbee, Gene H., *Black Holes and Quantum Gravity*, vixra:1409.0242, September 2014.
28. http:/en.wikipedia.org/wiki/Gravitational_coupling_constant.
29. Gordon J. Van Wylen, Thermodynamics, New York: John Wiley & Sons, Inc., 1959.
30. Barbee, Gene H., *Dark Energy*, viXra 1511.0185v4, January, 2017.
31. Barbee, Gene H., *Dark Matter and the Cosmic Web*, viXra:1701.0503v2, February 2017.

Appendix 1 Natural Logarithms

The following "information code" was a result of correlating fundamental energy data [4][14]. I do not know why this code is used by nature but it anchors energy values. The numbers are natural logarithms. There are four sets and total 90.

Mass &			
Ke		**Field**	
N values		N values	
↓		↓	
15.432	set1	17.432	
12.432		10.432	
13.432	set2	15.432	
12.432		10.432	
13.432	set3	15.432	
12.432		12.432	
0.075	set4	0.075	
10.333		10.333	
90		90	
P=1/exp(90)		**P=1/exp(90)**	
	P=1/exp(180)		

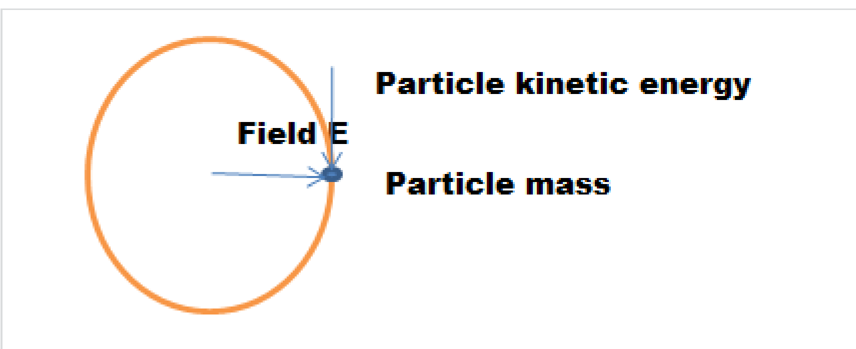
Set 2 is used in the example below. The code doesn't represent energy until after the following exchange on each set. Set 2 starts with the natural logarithms 13.43 and 12.43. The number 2 is added to 13.43 to become 15.43 and 2 is subtracted from 12.43 to become 10.43. This will be called an energy interaction and the four values of N involved in the exchange will be called a quad.

Before adding and subtracting 2				**After adding and subtracting 2**			
		MeV			MeV		
		E=e0*exp(N)			E=e0*exp(N)		
N1	13.43	13.8	E1 mass	N3	15.43	101.95	E3 field
N2	12.43	5.1	E2 ke	N4	10.43	0.69	E4 field

Information N is conserved (13.43+12.43=15.43+10.43). Each of the four positions has a specific meaning. N1 is always a mass, N2 is kinetic energy, N3 is a strong field and N4 is a component of the gravitational field. Energy is evaluated by the equation E=e0*exp(N) where e0=2.025e-5 MeV. E0 was determined from N for the electron (10.136=10.333-2*ln(3/e) and its known energy 0.511 MeV.

Results of the above energy interaction				
	(difference ke)			
	E3+E4-E1-E2		E3 field1	
E1 mass	ke	E2 ke		E4 field2
mev	mev	mev	mev	mev
13.80	83.76	5.08	-101.95	
				-0.69
Sum of energy from above table				
E1+difference ke		102.63	E3+E4	-102.63
Energy is conserved since 102.634=102.634				

Total energy is conserved to zero (102.634 MeV-102.634 MeV) using the convention that fields are negative. The numbers represent two orbits. The 13.8 MeV mass orbits with 83.76 MeV of kinetic energy in a 101.95 MeV strong field energy and a 0.69 MeV gravitational field energy component. Here is the strong orbit:



The particle mass 13.8 MeV is one of the quarks in a neutron. The neutron model below adds three quark energies together from quads 1 through 3. When these quads are treated the same way and added together they make the neutron of mass 939.57 MeV within measurement error [10]. Their masses total 130.163 MeV and their kinetic energies total 799.25 MeV.

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 Mass model is the source of constants for unification of forces in the table above.

Appendix 2 Neutron Model

The Neutron table starts with a left side showing the quads and associated energies after the exchange 2 operation.

	Unified.xls cell g191			
	mass	Energy-mev	S field	Energy
Charge	ke		G field	mev
0.667	15.432	101.95	17.432	753.29
	12.432	5.08	10.432	0.69
-0.333	13.432	13.80	15.432	101.95
	12.432	5.08	10.432	0.69
-0.333	13.432	13.80	15.432	101.95
	12.432	5.08	10.432	0.69
	-10.333	-0.62	-10.333	-0.62
	10.408	0.67	10.408	0.67
	10.33	0.62	10.333	0.6224
	0.000	0.0000	0	2.02E-05
	90.000	sum	90.000	

The right hand side of the Neutron model below lists the total mass, kinetic energy and fields associated with the neutron. Quad 4 of the code also gives us the 4th component of the gravitational field energy (-0.671 MeV) which totals -2.73 MeV.

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

The neutron decays into a proton, an electron and a neutrino. This gives the measured proton mass 938.27 MeV below. As the proton and electron split they develop opposite fields of 27.2e-6 MeV. When the electron falls into the proton field it develops 13.6e-6 MeV.

Information from the proton mass model underlies the four interactions of nature.

	Mass (m) (MeV)	Ke (MeV)	gamma (g)	R meters	Field (E (MeV)
Gravity	**938.272**	**10.11**	**0.990**	**7.224E-14**	**-2.732**
Electromag	**0.511**	**1.36087E-05**	**1.000**	**5.291E-11**	**-2.722E-05**
Strong	**129.541**	**798.580**	**0.140**	**2.093E-16**	**-957.185**
Strong	**928.121**	**10.151**	**0.989**	**1.430E-15**	**-20.303**

Appendix 2 the Schwarzschild equation

Derivation of the Schwarzschild equation is given below:

Show that gamma for General Relativity is derived		
from gamma fromSpecial Relativity		
(Derivation for Schwarzschild equation)		
constants from gravity above:		
ke	**10.11**	**MeV**
m	**1.67E-27**	**kg**
m	**938.27**	**MeV**
r	**7.244E-14**	**meters**
G	**6.674E-11**	**nt m^2/kg^2**
C	**299792458**	**m/sec**
gravitational coupling constant 1/exp(90)		
gamma=m/(m+ke)		
gamma=938.272/(938.22+10.11)		
0.9893	**gamma**	
dt=1/gamma-1		
0.0108	**dt**	
dt=1/((1-(v/C)^2)^.5-1		
G=Rv^2/m		
v=(Gm/R)^.5		
dt=1/((1-G*m/(R*C^2)))^0.5-1		

Apply the above equation to a 90kg astronaut orbiting the earth:

Astronaut (kg)	**90**	
Mass M kg (earth)	**5.98E+24**	
earth R (m)	**6378100**	
dt=1/((1-G*m/(R*C^2)))^0.5-1		
3.47E-10	**mass curves space**	

Mass in the equation above is earth Mass, not the Astronaut. But we can find time dilation (dt) for the Astronaut in a separate (SR) calculation for dt:

ke (MeV)	1.76E+22	
N	5.38922E+28	
ke/N	3.26E-07	object moving
g	9.999999997E-01	
V/C	2.64E-05	
	7908	m/sec
dt=1/g-1	3.47E-10	
	1.00E-16	
	3.34E-10	object has same dt

With cellular cosmology, we can find the equivalent quantum radius:

Astronaut (kg)	90
Mass M kg (earth)	5.98E+24
earth R (m)	6378100

r=R*1.67e-27/M=2.17e-6 meters

dt=1/((1-EXP(90)*G*1.67e-27/(r*C^2)))^0.5-1

3.47E-10 mass curves space
and particle follows curve

And using the following Schwarzschild equation for cellular cosmology, we can find time dilation (dt) for both the curved space and the orbiting proton associated with the cell. This means that General Relativity has been combined with Special Relativity for cellular cosmology.

It may be surprising that the cell radius simulates the earth orbit, but here is proof that the cell radius is a proper geodesic for velocity 7909 m/sec.

G=R*V^2/m*exp(90)=2.17e-6*7909^2/1.67e-27*exp(90)=6.67e-11 N-m^2/kg^2.