Gene H. Barbee
September 2014 Revised August 2020
http://www.vixra.org/pdf/1407.0187.pdf

Cosmology, Thermodynamics and Time

Gene H. Barbee

Abstract

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 author's work on the subject indicates that net energy is zero [13][14] but separated into two different types of energy that balance one another. The second law is not as straightforward. 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.

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. The author developed a relationship between large scale and the quantum scale but it is not generally known [8]. Further, the concept that velocity is relative seems to be accepted but velocity is related to kinetic energy that is conserved.

The author uses a cellular model that describes gravity, space, time, expansion, kinetic and potential energy at the quantum level [7][17]. Using cosmology as a platform, the present paper explores time and the thermodynamic laws. It concludes that elapsed time enters physics through cosmology. If we believe that the universe expands we must also believe that time advances. Further, the gravitational coupling constant converts quantum behavior to large scale behavior. Pressure expands the universe but gravitational accumulation [18] begins at a condition called decoupling. The expanded state creates many available thermodynamic states as particles fall related to gravitational accumulation. This explains how everything can "run down" as time progresses.

Cellular cosmology (Appendix 2) allows us to track the behavior of cell kinetic and potential energy as particles fall due to gravitational accumulation. Study of a model galaxy with the same mass and position of the sun allows us to determine where energy resides as it is re-converted to kinetic energy by falling from an expansion determined geodesic.

Fundamentals of space and time

Reference 6 identifies the source of the gravitational constant at the quantum level. The gravitational field energy 2.801 MeV from the Proton Mass model (Appendix 1) underlies the quantum mechanics for a fundamental radius r and a fundamental time t. In the equation below, the value 1.93e-13 meters-MeV is HC/(2*pi) where H is Heisenberg's constant 4.136e-21 MeV-sec and C is light speed, 3e8 meters/sec. The radius r is the radius of a quantum circle for gravity with 2.801 MeV field energy.

Identify the radius and time for the gravitational orbit described above			
Fundamental radius=1.93e-13/(2.801*2.801)^.5=7.045e-14 meters			
Fundamental time=7.045e-14*2*PI()/(3e8)=h/E=4.13e-21/2.801			
Fundamental time	1.476E-21	seconds	

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 NT meters^2/kg^2. The gravitational coupling constant 1/exp(90) derived below appears in the fundamental calculation for the inertial force in a cell that has cosmological properties.

Origin of the gravitational constant G

The gravitational constant G [8][17] is a combination of values found in the proton model. The values are: kinetic energy 10.15 MeV, fundamental radius 7.045e-14 meters and the mass of protons (1.67e-27 kg). The N values in the model define the probability of one proton p=1/exp(90)*1/exp(90)=exp(180). Probability 1 is recovered with exp(180) protons (described more fully in appendix 2).

The cumulative effect of exp(180) central protons curve space into a large sphere with radius 7.045e-14*exp(90)=8.59e25 meters. The large numbers can be combined into the factor 1/exp(90). This yields the relationship below between two protons.

G=10.15124*2*7.045e-14*1.602e-13/EXP(90)/1.675e-27^2			
6.69E-11	Grav Const Nt m^2/Kg^2		

The factor 1/exp(90) is recognized as a bridge between large scale Newtonian physics and the quantum scale. The value 1.6e-13 Nt-m/MeV in the equation is a conversion constant. With kinetic energy (ke)=10.15 MeV and r0=7.045e-14, the equation above can be used to define how the radius of a cell changes with kinetic energy. A cell is the space that one proton defines, a concept called particle-space. Newtonian gravity is in complete alignment with the concept of particle-space [17]. With G constant, radius R expands as kinetic energy is converted to potential energy.

The use of 1/exp(90) and Heisenberg's uncertainty principle has the affect of dramatically reducing the force between protons and makes gravity very long range compared to the other forces.

Defining gravity, time and distance together allows nature to use the general theory of relativity at the quantum level. The coupling constant 1/exp(90) scales the quantum level to the large scale we observe around us. This is called cellular cosmology.

Gravitational relationships

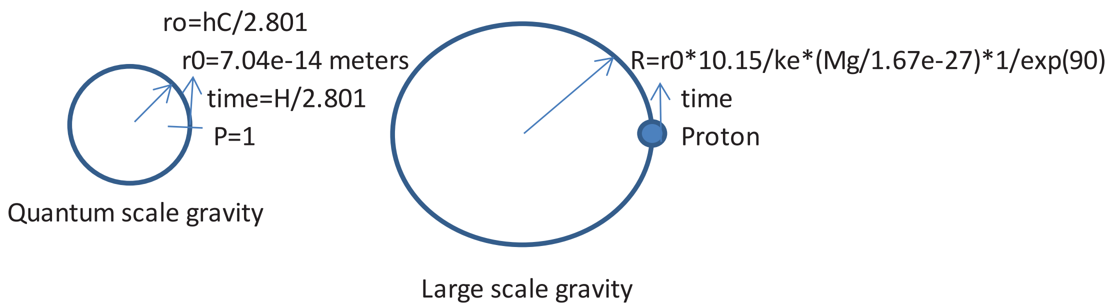
The factor 1/exp(90) is recognized as a bridge between large scale Newtonian physics and the quantum scale since the proton model is for one proton. With ke=10.15 MeV and r0=7.045e-14, the equation above can be used to define how the radius of a cell changes with kinetic energy. A cell is the space that one proton defines. Newtonian gravity is in complete alignment with the concept of particle-space. With G constant fundamental radius r0 can expand with kinetic energy inside space part of proton-space.

G=2*ke*r0/m^2*1.6e-13	
G=G as R increases	
2*10.15*r0/m^2= 2*ke*R/m^2	
10.15*r0= ke*R	
R=r0*10.15/ke	

This means that the proton-space model is more descriptive than Newtonian gravity because kinetic energy is a property of the proton, not just some random V. The above relationships can be further expanded as follows;

Orbital R for galaxy= GM/V^2 where M is the central mass	
substitute G=r0 v^2/m*(1/exp(90))	
R= r v^2/m*(1/exp(90))*M/V^2	
v^2/V^2=1 (cell v and large V equal)	
m/M=m/(m*number of cells in galaxy)	
R= r*(1/exp(90))*M/m	
multiply top and bottom by exp(180)	
R=r*exp(90)*M/(m*exp(180))	
m*exp(180)=Muniverse	
R=r*exp(90)*(Mgalaxy/Muniverse)	
r=r0*10.15/ke=7.04e-14*10.15/ke	
R=7.04e-14*10.15/ke*exp(90)*(Mgalaxy/Muniverse)	
R=r0*10.15/ke*(Mgalaxy/1.67e-27)*(1/exp(90))	

Relationship between the quantum scale and large scale gravity



We are walking around in space that has expanded from the quantum level and rules that exist at the cellular level apply to large scale space. Below we review the rules:

Nature's Rules

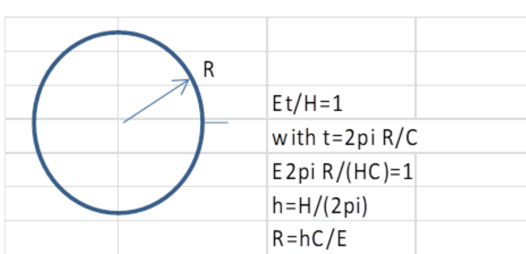
1. The velocity of light is the ratio of dimensions, the distance dimension and time dimension. Both dimensions are on a quantum circle. A quantum circle is defined by energy and repeats at psi*psic=1 where psi is the wavefunction.

2. Relationship between field energy and a quantum circle

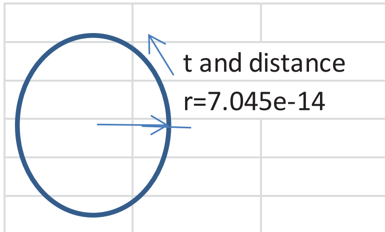
   General relativity was a solution to a basic problem (action at a distance) in physics and is correct but it did not fully bridge the gap between large scale gravity and quantum physics.

   The gravitational field energy 2.801 MeV from the proton model is used in a Schrodinger wave function [9][13]. Collapse of the wave function at P=exp(i*2.801*t/H)*exp(-i*2.801*t/H)=1 is a circle diagrammed below (imaginary vertical axis).

   Et/H=1 where H = Planck's constant = 4.14e-21 MeV-sec leads to R= quantum circle radius= HC/2pi=1.973e-13/2.801=7.045e-14 meters. I consider this fundamental space.



3. Time also originates with this quantum circle. Et/H=1 with t=2pi r/C leads to r=HC/(2pi)/E. Time repeats around this circle in increments of 2pi R/C= 1.47e-21 seconds.



4. Applying these fundamentals to point 1 above: At the next 1 light travelled the distance=2piR=2*pi*7.045e-14/C=1.47e-21 seconds. After one cycle all energy has been passed along to the next cycle including protons because they contain the fundamentals.
5. Elapsed time enters physics through cosmology. If we believe the universe expands **we must believe that time advances because (r/r0)^3 increases as (t/alpha)^2.** Nature counts cycles and elapsed time is cycle count*fundamental time because the universe expands. Elapsed time is the same for all cells because they are identical and none occupy a preferred position in space or time.
6. Large scale observables are related to many quantum scale cells defined by gravity. Gravity is defined at the quantum scale by the energy 10.15 MeV/particle and gravitational field energy 2.801 Mev at Radius =7.045e-14 meters with exp(180) cells. There are two types of gravitational energy (10.15 MeV=kinetic energy + potential energy). Potential energy is converted to kinetic energy as expansion occurs. The expansion equations are in the section entitled "Expansion" below. As the cell expands from r fundamental to r' it is not quantum because the surface contains a particle with mass.
7. Energy is conserved. This is the first law of thermodynamics.

Discussion of Nature's Rules

The author believes that the space we walk around in is defined by gravity at the quantum level (r=7.045e-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=0.53*exp(60)=4.75e25 meters. Further, the author believes that the time we experience is the cycle time 1.47e-21 seconds 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)). I believe rules 1 through 7 define general relativity. Nature is built on circles that enlarge. The central concepts of general relativity is that long range gravity is curvature of space. This of course is similar to special relativity but the concept of velocity needs further work. Some would point out that special relativity indicates that simultaneity is dependent on motion and therefore, since motion is relative, time is relative. The Lorentz transformation is used 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 because this extends to mV^2. If velocity is relative, kinetic would also be relative. Particles have kinetic energy related to conservation of PE+ke=10.15 MeV/particle. Further, if time changes there would be no universal standard for energy. There is a new understanding of space and time in cellular cosmology. Kinetic energy is not relative, time is not relative overall and general relativity extends to the quantum level.

What is velocity?

I have been developing a model of the proton and rely on it to answer tough questions like "what is velocity?". The proton model is described in Appendix 1 and summarized below. It is a list of energies in the proton. For example, all the masses are in the left column and the kinetic energy is in the next column. The model is based on mass plus kinetic energy being equal and opposite field energy in the column on the right. The gravitational field energy 2.801=0.69*3+0.74 MeV defines fundamental space and time. All particles are identical and all contain the gravitational field 2.801 MeV. The clock for fundamental time is t=H/2.801. Fundamental time is the same for all particles regardless of their velocity history. The gravitational field is constant; this means time is constant, uniform laws depend on this. The value C is fundamental to the Schrodinger equation [12]that uses exp(iEt/H)*exp(-iEt/H)=1. Time t is directly related to 1/E through Planck's constant H.

The model indicates that mass and kinetic energy add together and are equal and opposite field energy. The proton defines gravity, time and space plus it gives us fundamental energy values. The proton model becomes a widget I call particle-space when it defines cosmology through its space part of the model (the energy values underneath the proton mass above. This includes the expansion kinetic energy plus potential energy =20.3 MeV/proton in the space part of the model. Since it contains energy conservation rules it defines expansion that obeys the rule: r=r0*(t'/t)^(2/3) where time (t) are increments of repeating fundamental time. Everything is traceable back to R=10.15*7.045e-14/ke. Ke changes with expansion and the proton keeps track of energy. If we want to know velocity, we simply use the proton widget's kinetic energy.

What is velocity? It is simply derived from kinetic energy.

Velocity = (2 ke/m)^.5 = (2 ke/1.67e-27*1.6e-13)^.5 where mass is in Kg and 1.6e-13 is the conversion constant Nt-m/MeV. Velocity is simply V=distance/time.

If we insist on using of gamma=m/(m+Ke) and its relationship to V/C. We can define velocity as: V=C*(1-gamma^2)^.5 where gamma is a local time ratio dependent on perspective.

	Quark mass (MeV)	Kinetic E (Mev)	Field E (MeV)
DOWN	4.36	651.34	753.29
-0.333		88.15	
		9.44	
		0.69	0.69
UP	2.49	88.15	101.95
0.667		11.31	
		0.69	**0.69**
UP	2.49	88.15	101.95
0.667		11.31	
		0.69	0.69
	Weak Void	-20.30	
		0.00	
		0.00	
	Neutrino ke	-0.67	0.74
	ae neutrino	-2E-05	
	E/M field	-2.72E-05	
charge 1	938.2721		
electron	0.51	2.72E-05	
	electron ke	0.11	
		-0.6224	
	electron neut	2.02E-05	
	Neutrino ke	0.67	
		0.74	
	expansion pe	10.15	
	expansion ke	10.15	
	959.99		959.99

	Quark mas (MeV)	Kinetic E (Mev)	Field E (MeV)
DOWN	4.36	651.34	753.29
0.333		88.15	
		9.44	
		0.69	0.69
DOWN	4.36	88.15	101.95
0.333		9.44	
		0.69	0.69
	2.49	88.15	101.95
-0.667		11.31	
		0.69	0.69
	Weak Voic	-20.30	
		0.00	
		0.00	
		0.62	0.74
charge 0	939.5654		
		-0.6224	
		0.74	
	expansion	10.15	
	expansion	10.15	
	959.99		959.99

There has been considerable speculation regarding the nature of time. Does elapsed time exist? Is time travel possible? Articles state that time slows with velocity and the strength of the gravitational field. However, most authors do not claim they understand the relationship between special relativity and quantum theory.

The twin paradox

The twins are standing together at the end of their journey but has one aged more slowly? The following equation describes the journey of a twin in orbit compared to the other on earth.

One twin is in orbit, described by R=10.15*7.045e-14/ke*(Mearth/1.67e-27)*1/exp(90). (This is just another way of writing R=GM/V^2). This twin has a specific kinetic energy (ke) associated with the orbit. The other twin is standing on earth and has a different kinetic energy.

Escape velocity for a massive body is (2Gm/r)^.5=V or 2Gm/r=V^2 and escape velocity can be substituted into the gravitational shift equation and simplified to: t0/tf=(1-2GM/(rc^2))^.5= (1-(V/C)^2)^.5. The escape velocity is the velocity the proton needs to be in its Newtonian orbit. This means on earth the ke value is only ¼ of the kinetic energy it needs to be in orbit (ke=1/2 m*V^2 with V only half of orbital velocity). This causes acceleration of the protons in the body of the twin on earth because he is off the geodesic. He feels acceleration of gravity because he is missing1.6e-7 MeV of kinetic energy, i.e. a=GM/R^2. But there is also excess potential energy. If the earth were not in the way, the protons would seek a new orbit by falling. They would again establish an orbit. Gamma for the missing energy is gamma= (1-(v/c)^2)^.5 and V is 5592 m/sec.

Gamma is small and dt=1-gamma=1.7e-10 associated with V. There is a slight energy rebalancing inside the proton associated with acceleration. The particle-space model below shows these temporary local changes for the proton (twin) on earth. They are equal and opposite.

	2.72E-05	0.296		
	-0.6224	-10.33		
0.5110	0.11	10.14		
electron neu	2.02E-05			
Neutrino ke	0.67	10.41		
	0.74			
Matchin PE	0.00			
excess pe	1.60E-07			
expansion pe	20.29			
expansion ke	0.01			
missing ke	-1.60E-07			
959.99				959.99
Total N values		90.10	90.10	

After the orbiting twin returns, they are standing together. The orbiting twin didn't have the values above highlighted in yellow inside his protons. This causes a gamma ke= m/(m+ke) but did it cause him to age differently?

Potential energy also has gamma associated with it [16]. Gamma pe= m/(m+pe). These could be equal and opposite. The question of whether the twins age differently comes down to the question of whether these are offsetting.

We do know that experiments have shown that orbiting clocks are different than clocks on earth. Does the instrument respond only to kinetic energy, not potential energy? Also, we know that mesons decay more slowly at high speed. But there are two perspectives and we can only view it as high speed. How does it perceive itself? Perspective must be considered. The obvious example is that I see you moving but you see me moving. Which of us has kinetic energy? I believe that everything is related to its cosmological origin. Proton-space does the energy accounting for values related to cosmology. It knows although we may not.

The proton field energy 2.801 MeV that establishes fundamental time is not affected. With correct energy accounting the diagram shows overall energy 20.3-20.3= 0 and total energy 959.99 MeV.

Review: Proton-space is associated with a Schrodinger collapse at P=1 when it is in a gravitational orbit. The proton has gravitational acceleration associated with it when its energy values are balanced slightly differently. Unfortunately, time travel is not possible but the possibility of aging more slowly is possible but not proven.

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. Further, we understand that the first law of thermodynamics is conservation of energy and totals 10.15 MeV for gravitation. The only change is that potential energy is converted to kinetic energy and back over time. Cells have a specific kinetic energy depending on their history. Ordinary mass takes more time to travel and only completes a segment of the cellular circle against the standard 1.47e-21 seconds. This cycle is established by the quantum mechanics of the gravitational field inside each proton (the proton model in the Appendix) and each proton is identical and none occupy a preferred position. All protons advance in elapsed time simultaneously ready for the next count. Each particle participates in expansion of the universe and during expansion 10.15 MeV/particle of potential energy is being converted to kinetic energy. Elapsed time is the primary variable for the expansion equations and they determine r' and how much kinetic energy has been converted to potential energy. During expansion the gravitational constant G is maintained by rv^2/m i.e., it is on a geodesic (orbit). We will call this the expansion determined geodesic.

Expansion

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 occurs, we must believe that time advances.

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

Expansion of each cell involves the kinetic energy of a proton like mass on the surface of each cell. The model's geometrical and numerically similarity allows many small cell surfaces to represent large scale cosmology.

Cell diagram

PE expansion=integral F dR
KE=mv^2/2

Cell diagram showing tangential kinetic energy

Kinetic energy decreases (and gravitational potential energy increases) as expansion occurs. The derivation below is based on gravitation constant G remaining constant.

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

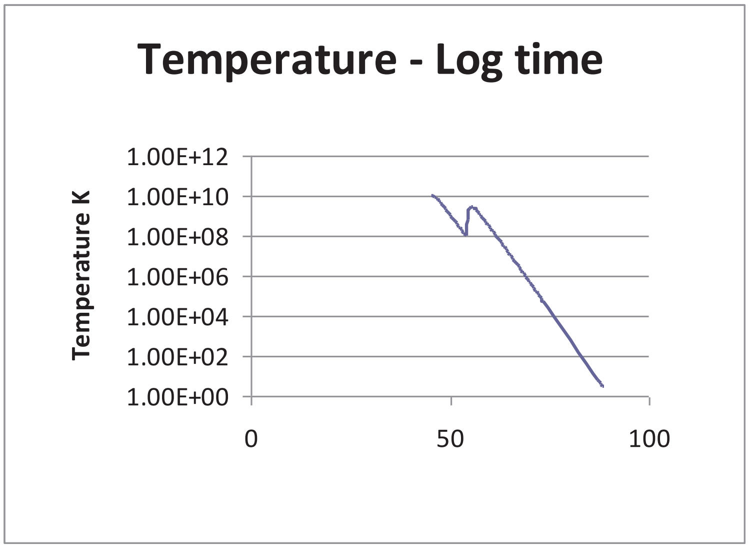
Kinetic Energy decreases with Expansion

Important values originate in the proton model. The model shows protons with about 20 MeV that fall into "orbits" with 10.15 MeV of kinetic energy and 10.15 MeV of potential energy. Initially the mass on the cell surface has high velocity (0.146C) that gives an inertial force equivalent to gravity. Tangential kinetic energy (diagram above) decreases directly with expansion ratio and defines an orbit that maintains the gravitational constant at G. This "orbit" is again a model since it will be shown below that temperature and pressure associated with kinetic energy drive expansion. After expansion, potential energy allows protons to fall (accelerate) toward each other and establish orbits as mass accumulation occurs. It is this energy that we see when orbits are established around galaxies and planetary systems. It is also this energy that provides pressures and temperatures high enough to initiate fusion.

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

Thermodynamics and expansion

The Boltzmann relationship T(K)=ke/(1.5*B) with B=8.62e-11 MeV/K assigns a temperature [1] to kinetic energy. Cosmologists use the expansion ratio z to scale temperatures and the x axis is the natural logarithm 45 progressing to about 90. Large scale time progresses from exp(45)*1.47e-21=0.052 seconds to approximately exp(88.5)*1.47e-21seconds= approximately 14 billion years presently.



The discontinuity in temperature is explained in reference 13, but the temperature is 2.73K at the current stage of expansion.

There is a critical concept at stake that needs our understanding. If 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.

To understand pressure, look again at the bottom part of the proton model.

Weak Energy	-20.30			
Weak KE	0.00			
Balance	0.00			
Neutrino ke	-0.67		10.51	0.74
ae neutrino	-2.0247E-05			
E/M field	-0.0000272			
938.27	MeV Proton			
	0.0000272	0.296		
	-0.6224	-10.33		
0.5110	0.11	10.14		
electron neu	2.02472E-05			
Neutrino ke	0.67	10.41		
	0.74			
expansion pe	10.15			
expansion ke	10.15			
959.99				959.99
Total N values		90.10	90.10	

Above, we discussed the role of the value 10.15 MeV in cosmology. The model also defines the electromagnetic field energy 27.2e6 MeV. After decoupling at about 300,000 years, the energy is low enough for the electron to fall into an orbit around the proton. Of course, it is possible to squeeze particles in a way that the orbit of an electron is lower than 5.29e-11 meters. If we are going to calculate pressure we must deal with the interaction of electrons and this brings us to the subject of thermodynamics.

simple.xls cell ae175		
Compression Thermodyna		8300.00
		← 1.361E-05
		base
degeneracy	(dens/dens0)^	1.000E+00
Radius	compressed	5.292E-11
Volume V M^3		6.207E-31
dens- kg/M^3		2.695E+03
KE electron (r	E0*r/r=E0(d/c	1.361E-05
pressure=R rh	R=287.05	2.350E+12
P*V mev		9.105E-06
Ke at max burn		
Ke =1.5BT		1.359E-05
Temperature= ke elect/cp/93		1.051E+05
cp (mev/mev/K)		1.3800E-13

The table above is the basis of the gas constant and specific heat (cp) but it is not the pressure that expands the universe. It is too low.

The same table for the 10.15 kinetic energy is shown below.

simple.xls cell ae175				
Compression Thermodyna		8300.00	8300.00	8300.00
			←	1.361E-05
			compressed	base
degeneracy	(dens/dens0)	1.000E+00	7.511E+02	1.000E+00
Radius	compressed	7.0450E-14	7.045E-14	5.292E-11
Volume V M^3		1.465E-39	1.465E-39	6.207E-31
dens- kg/M^3		1.142E+12	1.142E+12	2.695E+03
KE electron (r	E0*r/r=E0(d/c	10.150	1.535E+01	1.361E-05
pressure=R rl	R=287.05	7.443E+26	7.440E+26	2.350E+12
P*V mev		6.804E+00	6.802E+00	9.105E-06
Ke =1.5BT		10.152	10.15	1.359E-05
Temperature= ke elect/cp/9		7.852E+10	7.850E+10	1.051E+05
cp (mev/mev/K)		1.38E-13	2.08E-13	1.3800E-13

The column on the left is for the proton. The pressures are so high that the electron is compressed, making it highly relativistic. It serves as a stiff spring "transfer agent" that allows the proton kinetic energy to expand the cell. The proton energy is doing work (dE) against the force of gravity.

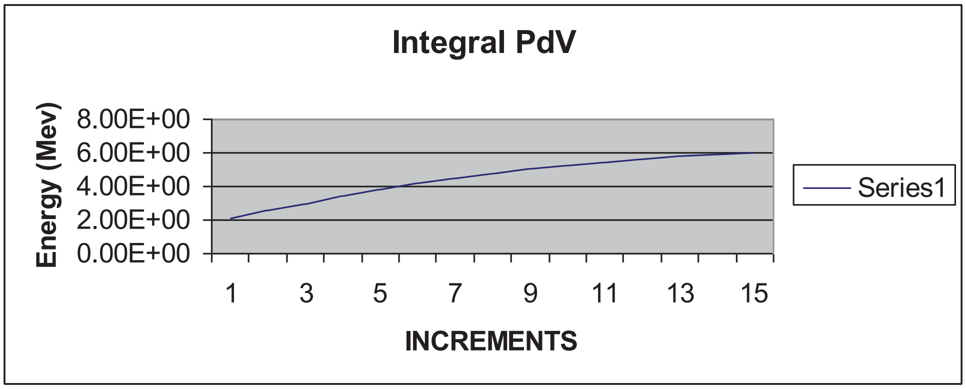
Is it this pressure that expands the universe? Can the particles fill all of space or are they quantum like and limited in their travel. If we calculate what a gas would do perhaps we can answer the above two questions.

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 would be:

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 and an initial radius of 7.04e-14 meters, the above initial pressure is 2.97e26 NT/m^2 where initial temperature=7.58e10 K. The following table models PdV 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 Pdv quickly saturates at a level consistent with the initial kinetic energy of 10.15 MeV (the gas is not ideal and the constant is somewhat uncertain). Overall, *pressure* can be considered the driver for expansion. The net affect is the proton receives gravitational potential energy against a resisting gravitational force.

Transition from quantum behavior

In quantum mechanics, particles move in circles and are statistically "everywhere" at once on 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 called relativistic or de-generate. 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 7.045e-14 meters indicate that a critical transition has occurred. Protons enter the radius that defines gravity and pressure expands space itself. Particles now exhibit non-quantum behavior (perhaps because the force is now very low and it is easy to force particles into the interior of the volume). Apparently the transition is associated with 1/exp(90) that weakens and extends the gravitation force.

For expansion, the kinetic energy term is initially 10.15 MeV [9] of kinetic energy but decreases as PdV increases. Defined this way, we expect the equation 10.15=ke+Pdv to be satisfied [1]. Although quantum mechanics, 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 because the coupling constant 1/exp(90) reduces and extends the force between particles. After two early transitions (equality of photon and mass density and decoupling of electrons [11]), 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 [8][18].

After expansion, a very improbable (high information) state has been established (see comments on entropy in the Appendix). Expanded particles separated from one another are free to accumulate due to gravity. As they do they fall to low energy (more probable) states.

Expanded particles do not reverse expansion as they fall due to gravitation. Normally gravity is not an important force in pressure and temperature changes considered by thermodynamics (it can be important in the thermodynamics of weather). Again, pressure is the collective action of particles with kinetic energy (temperature). At about 200K years after the beginning a condition known as equality [4][15] 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 that 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.

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

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 10.15=(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. All particles that form a central mass like a star or planet fall are limited in their fall. The electron orbit is 5.29e-11 meters and is almost incompressible. The gravitational kinetic energy at 5.29e-11 meters is 1.3e-5 MeV/proton.

Friction, heat and entropy

Thermodynamics is the physics of groups of particles. Entropy, S is defined as follows [1] 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 [1]. 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. Think about it this way. The protons can fall from the geodesic determined by expansion equations and gain kinetic energy. Accretion will occur and bodies will fall into orbits around other bodies. As they fall, collisions will occur. This 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 [5] that can combine into molecules and life [14]. 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. As particles transfer heat the ratio of dQ/T is entropy. Entropy dS will increase from the low state where dQ is zero and T is low. 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. Clearly this statement is not talking about the sky temperature (CMB) but it might be better to state the "zeroth" law in term of heat. Entropy is zero at absolute zero heat. A particle that has expanded but not fallen from its geodesic contains zero heat energy. If it has fallen but not collided it still may contain zero heat energy.

Non-ideal Gravitational Accumulation

Mass falls from the geodesic established by the expansion equation and potential energy is reconverted to kinetic energy (ke) and heat dQ. The overall energy is 10.15=(ke+de+dQ)+PE for particles that have transferred or stored de energy between particles, gained ke by falling and gained heat (dQ) through friction. If a particle gains ke by falling it will normally establish a new geodesic or accumulate in a body like the sun or a planet. If it has stopped falling but is not on its geodesic it will register as acceleration. Kinetic energy lost by friction will show up in dQ. DQ is unknown until we measure the temperature. The particles we experience on earth, even if they are trains moving relative to each other are all "off their geodesic". After falling and gaining some kinetic energy they lost kinetic energy through friction involved with falling on our planet. Because of this they experience gravitational acceleration. Acceleration is a measure of how off their geodesic they are.

Structure is primarily determined by waves that partition an overall sphere (and an associated mass) into smaller and smaller spheres. The universe will be considered to be the total mass= 1.67e-27*exp(180)= 2.48e51 Kg. For this analysis, the number of potential stars times the average star mass (5.8e29 Kg according to Wiki) could at most equal 2.48e-51 Kg. The other structures have specific relationships with wavelengths that partition the volume. Partitioning occurs at decoupling.

Density at decoupling was 2.9e-18 kg/m^3 (from expansion model [8][13] but consistent with WMAP).

Ru universe at decoupling=5.9e22 meters (from expansion model but consistent with WMAP)
N clusters= Rdecoupling^3/(2.35e21)^3=1.58e4
Observation N galaxies (Wiki) =2e12=N clusters*Ngalaxies/cluster=1.58e4*1.27e8
Mass galaxy= 2.48e51/2e12=1.24e39 Kg
Observed average mass of stars=5.8e29 Kg (Wiki)
Potential number of stars=2.48e51/2.6e29=4.29e21

The information above can be summarized as follows. Each sphere is related to a specific radius R and r for the next smaller sphere radius is (R^3/r^3=N).

5.95E+22	R decoupling (M)		2.35E+21	Previous sphere		4.67E+18	Previous sphere
1.58E+04	N clusters	2.01E+12	1.27E+08	N galaxies in cluster	4.29E+21	2.13E+09	N stars in galaxy
2.35E+21	Jeans at decoupling (M)		4.68E+18	Galaxy sphere (Jeans)		3.63E+15	Star sphere (Jeans?)
1.57E+47	Avg mass of cluster (Kg)		1.24E+39	Avg mass of galaxy (Kg)		5.80E+29	Avg mass of star (Kg)

We observe clusters of galaxies and galaxies, all made of stars.

Kinetic energy Accounting

In the topic below the question is "If there was 10.15 MeV/proton at the beginning, where is the energy now?" It is recognized that expansion converted almost all of this energy to potential energy. But as accumulation occurred some potential energy was converted back to kinetic energy. Below we account for kinetic energy/proton for orbits.

	Orbit ke (MeV
star	1.26E-05
galaxy	5.12E-04
cluster	8.00E-06
earth	3.30E-07

Above we add earth orbit that should have 3.3e-7 mev/proton adding to that the kinetic energy of the earth orbit around the sun and adding to that the kinetic energy of the sun's orbit around the galactic center.

The WMAP [15] project gives us information regarding the kinetic in the background radiation. WMAP measured temperature spots of 75 micro-degrees out of the CMB of 2.73 K. This suggests a kinetic energy difference from the background kinetic energy on the order of 7e-10 MeV/proton.

Stars and planets have been compressed into bodies. This converts kinetic energy into temperature and must be accounted for by thermodynamics. For example, earth atoms are compressed to approximately the electron orbit 5.29e-11 meters. We learned above in the section entitled "Non-ideality involved in reconversion of kinetic energy to potential energy" that the gravitational kinetic energy associated with this compression is 1e-5 MeV. This means that most of the re-converted gravitational kinetic energy is in the central body, not the orbits.

The stars are another place where energy is stored and thermodynamics dominates. Appendix 3 contains a model of the sun with mass pressing down on the core, where fusion eventual starts when temperature and density are high enough. The core of the model has a temperature of 1e7 K. The kinetic energy associated with this is 0.001 MeV. The other layers have less kinetic energy toward the surface. When fusion is started, the electrons are “relativistic” (density/standard orbit)^3 or about 7 meaning that the 5.29e-11 meters standard orbit has been compressed to 7e-12 meters.

The highest reconversion is found in the core of stars where 0.001 MeV/proton exists. But compare this to the potential energy 10.15 MeV. Only a small amount of potential energy has been converted back to kinetic energy by falling. (The exception is the black holes that develop kinetic energy of about 10.15 MeV if they can crush the electron orbit to 7.0e-14 meters before particles disappear behind the black hole horizon).

Accounting for friction dQ

There is kinetic energy related to temperature in the earth and sun.

	Temp	ke/particle	mass each	number	num*mass	num*N*ke	ke/particle (mev)
sun witout fu:	9000000	0.0011637	2.0000E+30	1.0000E+11	2.0000E+41	1.3937E+65	1.1636E-03
planets	6000	7.758E-07	5.98E+24	1E+12	5.9800E+36	2.7780E+57	2.3195E-11
dust	2.73	3.5299E-10	5.98E+24	1E+12	5.9800E+36	1.2640E+54	1.0554E-14
					2.0001E+41	1.3937E+65	
					1.1977E+68		

We “found” 0.001 MeV/proton of heat/temperature. This energy is the pressure that the core of the sun must exert upward to support the weight above it. This causes the average radius between protons in the earth to be compressed from 5.29e-11 to 7e-12 meters. They resist this compression and store energy. Overall there is good evidence that formation of our planet, sun and galaxy were not ideal, i.e. there were collisions that caused pressure, friction, heat and radiation. These are all examples of energy conversion from kinetic energy.

This completes the accounting of our current energy on earth. Overall, only about 0.001 MeV/proton of the 10.15 MeV/proton of potential energy has been converted back to kinetic energy in the core of stars. The remaining energy is still potential energy that places the particles very far apart compared to the beginning.

Conclusions

The space we walk around in is defined by gravity at the quantum scale but through expansion and the gravitational coupling constant gravity also defines large scale space time. Special relativity is unified with general relativity in cellular cosmology.

Conservation of energy (the first law of thermodynamics) holds for cosmology and time enters physics through cosmology. If we believe that the universe expands we must believe in elapsed time. Particles have kinetic energy in the beginning that is converted to gravitational potential energy over time. 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 geodesics. As cells expand, time is counted around a larger circle but because velocity is low only a segment of the circle can be completed before everything moves forward at 1.47e-21 seconds/cycle. We can account for energy and find out interesting things about our history using cellular cosmology. Each particle in nature has a specific energy and a cellular level related to the observables around us. Deviation from expansion determined geodesics occurs as particle fall. Large scale orbital radius can give us kinetic energy and we can measure acceleration and temperature.

Expansion and critical transitions create conditions for the second law of thermodynamics. Firstly, although quantum mechanics and the proton model define kinetic energy in the gravitational orbit, 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 because the coupling constant 1/exp(90) reduces and extends the force between particles. After two early transitions (equality of photon and mass density and decoupling of electrons [15]), 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 [8][13]. During expansion there are many potential states for particles to fall into. Particles that have not fallen have maximum potential but are very improbable. As they falls collide and produce heat, the second law of thermodynamics describes their behavior.

What about the argument that velocity is relative? It is the author's view that velocity is not overall relative and should be viewed as an incomplete description of kinetic energy because energy obeys the first law of thermodynamics. Expansion potential energy can be re-converted to compression energy, orbital kinetic energy and heat. Velocity can be calculated from kinetic energy and gamma (v/C=(1-gamma^2)^.5) once motion related kinetic energy is known. It can be misleading to compare one velocity with another.

Nature contains a fundamental clock in the proton. The clock ticks at the rate t=H/2.801 for all of particles throughout the universe. The advance of fundamental time sets a standard for "slow time" for objects with velocity. Although time travel is impossible, it appears that some processes can be slowed.

References

1. Gordon J. Van Wylen, *Thermodynamics*, New York: John Wiley & Sons, Inc., 1959.
2. Brillouin, L., *Science and Information Theory*, New York: Academic Press, Inc., 1956.

3. Shannon, Claude. A mathematical Theory of Communication, 1948.
4. P.J.E. Peebles*, Principles of Physical Cosmology,* Princeton University Press, 1993.
5. Barbee, Gene H., *The Effect of He4 Fusion on Primordial Deuterium*, http://vixra.org/pdg/1404.0465.pdf , May 2014.
6. Barbee, Gene H., *Black Holes and Quantum Gravity*, http://vixra.org/pdf/1409.0242.pdf , September 2014
7. Barbee, Gene H., *A Top-Down Approach to Fundamental Interactions*, FQXi essay, June 2012 and viXra: http://www.vixra.org/pdf/1307.0082.pdf ,Nov 2014.
8. Barbee, Gene H., *On the Source of the Gravitational Constant at the Low Energy Scale*, Prespacetime Journal Vol. 5 No. 3 March 2014. http://www.vixra.org/pdf/1307.0085.pdf , Feb 2014.
9. Barbee, Gene H., *A Simple Model of Atomic Binding Energy*, http://www.vixra.org/pdf/1307.0102.pdf , revised Feb 2014. Reference spreadsheet atom.xls.
10. Barbee, Gene H., *Baryon and Meson Masses Based on Natural Frequency Components*, http://www.vixra.org/pdf/1307.0133.pdf , April 2017 revised August 2020.
11. Barbee, Gene H., *Discovery of Quantum Gravity*, http://www.vixra.org/pdf/1508.0120.pdf , September, 2019.
12. Barbee, Gene H., *Schrodinger Fundamentals for Mesons and Baryons*, October 2017, http://www.vixra.org/pdf/1710.0306.pdf
13. Barbee, Gene H., *Zero dark matter and zero dark energy,* http://www.vixra.org/pdf/1805.0449.pdf *, March, 2020.*
14. Barbee, Gene H., *Creation and Schrodinger's Equation*, http://www.vixra.org/pdf/1811.0334.pdf , January 2018
15. Hinshaw, G. et.al, *Nine Year WMAP Observations*, draft June 5, 2013. http://arxiv.org/pdf/1212.5226v3.pdf Table 2.
16. Barbee, Gene H., *Analysis of five galaxies with flat rotation curves*, Academia.edu, October 2019. http://www.arxiv.org/pdf/1910.0184.pdf

17. Barbee, Gene H., *Particle-space a unifying theory*, Academia.edu, July 2020. http://www.arxiv.org/pdf/2007.0246.pdf
18. Barbee, Gene H., *Mass accumulation and cosmology*, Academia.edu, July 2020. http://www.arxiv.org/pdf/2008.0178.pdf

19.

Appendix 1 **Details of the proton model**

The proton model is shown below (I believe it is consistent with the standard model [10]. It is simply a list of energy components inside the proton. The left-hand side is mass plus kinetic energy and the right-hand side is the opposing and opposite field energy components. Toward the center of each particle diagram values called N are listed. Energy is related to N by the equation E=2.02e-5*exp(N).

Quark mass (MeV)	Kinetic E (Mev)	N=ln(E/2.02e-5)		Field E (MeV)
101.95	646.96	15.43	17.43	753.29
	5.08	12.43	10.43	0.69
13.80	83.76	13.43	15.43	101.95
	5.08	12.43	10.43	0.69
13.80	83.76	13.43	15.43	101.95
	5.08	12.43	10.43	0.69
Weak Void	-20.30			
Weak KE	0.00			
Balance	0.00			
Neutrino ke	-0.67		10.51	0.74
ae neutrino	-2E-05			
E/M field	-2.7E-05			
938.27	MeV Proton			
	2.72E-05	0.296		
	-0.6224	-10.33		
0.5110	0.11	10.14		
electron neu	2.02E-05			
Neutrino ke	0.67	10.41		
	0.74			
expansion pe	10.15			
expansion ke	10.15			
959.99				959.99
Total N values		90.10	90.10	

Probability=1/exp(N) is written below in tabular form. Information = negative natural log(p1*p2*p3, etc.) = 90.1 is written at the bottom of each fundamental N column. With these probabilities, the components become parts of the N=90 information system.

	N	P=1/exp(N)	N	P=1/exp(N)	
Quad 1	15.43	1.99E-07	17.43	2.69E-08	
	12.43	3.99E-06	10.43	2.95E-05	
Quad 2	13.43	1.47E-06	15.43	1.99E-07	
	12.43	3.99E-06	10.43	2.95E-05	
Quad 3	13.43	1.47E-06	15.43	1.99E-07	
	12.43	3.99E-06	10.43	2.95E-05	
Quad 4	10.41	3.02E-05	-10.33	3.07E+04	
	-10.33	3.07E+04	10.41	3.02E-05	
Quad 4'	10.33	3.25E-05	10.33	3.25E-05	
	0.00	1.00E+00	0.00	1.00E+00	
	P1*P2*etc	8.19E-40		8.19E-40	
	ln (Ptotal)	90.00		90.00	

The next level involves placing the probabilities in the Schrodinger equation to produce the neutron and proton.

Probability 1=e0/exp(N). This probability is an energy ratio and leads to the equation E=eo*exp(N). The probability is 1/exp(N) and e0=1 in natural units or 2.02e-5 in MeV units, evaluated from the electron N from the table in Appendix 1.

Energy zero= 0= E-E. Energy is created by a separation but there are two types of energy. Appendix 2 explains how energy separations from zero and probability 1 represent the neutron and proton. Probability 1 represents the other initial condition, zero information. Everything was apparently produced by separations. The components of the neutron and its fields encode the laws of nature. It means that there are particles separated in distance, each with kinetic energy for expansion of the universe.

The work below derives Schrodinger based orbits that obey energy zero. This means there will be positive and negative energy terms created through separation. This E=0 constraint and related P=1 constraint are further defined. There are sets of four probabilities of interest that contain exponential functions 1/exp(N).

Evaluating E

Evaluating E in the RHS requires consideration of overall probability, not just the probability of particles. Initially there was a probability for many neutrons to make up the universe. Specifically, P= 1= probability of each neutron* number of neutrons= 1/exp(N)*exp(N).

1=1/1=exp(180)/(exp(90)*exp(90)) where exp means the natural number e to the power 90, where 90 is a base 10 number (count your fingers).

Number of neutrons in nature

Based on the neutron model the components of mass plus kinetic energy add to N=90.0986. I used N=90 in early work and haven't resolved the 0.0986 difference. With P=1/exp(90) and equally improbable field energy components, the probability of the neutron is 1/exp(180) since probabilities multiply. If P=1, there are exp(180) neutrons in nature. These are apparently placed outside of each other to prevent nature from occurring as one large superposition. Is this the origin of the Pauli exclusion principle? The value exp(180) agrees with estimates of critical density but P=1 is difficult to accept. Does this mean there is one neutron expressed as exp(180) low probability duplicates throughout nature? I consider it a system but know this is difficult to accept.

The probability of each neutron is 1/exp(N). The neutron itself is made of improbable components like quarks. Appendix 2 uses the logarithmic values called N values for probabilities to produce an alternative table of the neutron model. The probability of particles that makes up the neutron are energy ratios, i.e. p=e0/E=1/exp(N), where e0 is a small constant. Eo is evaluated with data for the mass of the proton 0.511 MeV and its known N value 10.136 [appendix]. This means the set of N values gives the energy of its components through the equation E=e0*exp(N).

Information theory probabilities

C. Shannon [10] used S= -ln P to represent information and thermodynamics incorporates similar concepts except it is the statistics of many particles. The author's N identifies particles such as an electron and components of the electric field and E= e0*exp(N). In this system, dimensionless energy ratio e0/E=P probability. Since wavelength is proportional to 1/E=1/hv (h is Heisenberg's constant and v is frequency), the probability and a dimensionless wavelength are equivalent.

P=e0/E=(h v0)/(h v)=v0/v=wl/wlo.

p=e0/E=1/exp(N), i.e. E=e0/p.

With p=1/exp(N), E=e0*exp(N).

E1-E1+E2-E2+E3-E3+E4-E4=0
Identify E as E=e0*exp(N), using the same N values as the LHS.

0=eo*exp(13.431)-eo*exp(13.431)+e0*exp(12.431)-e0*exp(12.431)+e0*exp(15.431)-e0*exp(15.431)+eo*exp(10.431)-e0*exp(10.431)

Mass plus kinetic energy will be defined as positive separated from equal and opposite negative field energy. E1 is the only mass term, E3 and E4 are field energy and the remainder is kinetic energy.

E1+(E3+E4-E1-E2)+E2-E3-E4=0 (rearrange)
E1 is mass, (E1+E4-E1-E2)+E2 is kinetic energy.
E3 and E4 are equal and opposite field energies
mass1 + kinetic energy- field energy3-field energy4=0

The four N values discussed in the section entitled “Evaluating E” and their associated energy is called a quad. It is defined as the E values E=e0*exp(N) in a box to the right of each N value. The key to distinguishing mass (E1) from kinetic energy (E2) and two fields is shown below. The positions are not interchangeable.

Mass	Field 3
Kinetic Energy	Field 4 (G)

		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

E1=2.02e-5*exp(13.43)=13.79, E2=2.02e-5*exp(12.43)=5.08, E3=2.02e-5*exp(15.43)= -101.95, E4=2.02e-5*exp(10.43)= -0.69 (all in MeV).

Separation of energy from zero

Overall E1+(E3+E4-E1-E2)+E2- (E3-E4) =0= (E1-E1)+(E2-E2)+(E3-E3)+(E4-E4) obeys the energy zero restriction. I call these diagrams energy zero, probability 1 constructs. They contain energy components of a quark.

Repeating the process for the quark quads and quads that lead to the electron yields the proton model in the text [11][12].

Comparison of proton model and PDG data

Compare the above values for the neutron and proton with measured values.				update feb 2017					
931.4940281	nist		0.510998946	0.510998946					1.30E-07
931.4940955	pdg	548.5799095	0.51099895		0.5110011		-2.15856E-06		2.40E-07
simple cell g67	Data		Data (mev)		Calculation (mev)	calculation	Difference	Difference	measurement
			Particle Data Group		Present model	(amu)	(mev)	(amu)	error (amu)
		(amu)		(an	(mev)				
Neutron	nist	1.008664916	939.5654133	939.5654135	939.5654127	1.0086649	5.629623E-07	8.71281E-10	6.20E-09
Proton	nist	1.007276467	938.2720813	938.2720813	938.2720767	1.0072765	4.620501E-06	4.98855E-09	6.2E-09
Neutron/electron	1838.683662		939.5654133	nist	939.5654127		5.6296233E-07		
Proton/electron	1836.152674		938.2720814	nist	938.2720767		4.6785007E-06		

Below the proton mass the model shows energy outside the proton. This part represents space. The right two columns contain field energy values. Overall, the bottom (space) part of the diagram indicates that total mass and kinetic energy is equal and opposite total field energy 959.99 MeV.

Values extracted from the model above unify nature’s forces:

Appendix 2 Cellular cosmology

Using a small cells of radius r to simulate a large radius R (literature would call this the radius of the universe) is critical to understanding cosmology. In this model, the universe is filled with the *surface* of many small cells that are equivalent to the *surface* of one large sphere. This is important conceptually because we can be inside the universe (something we all observe), each surface can be identical and the concept that there is no preferred location can be preserved. The model proposed is based on exp(180) cells, each associated with a proton like mass.

The derivation of a coupling constant for gravitation from reference 7 is reviewed below: Let small r represent the radius of a many small spheres and large R represent the same surface area of one large sphere containing exp(180) spheres. There is one proton like mass (m) on the surface of each cell. The mass of the universe M equals m*exp(180). The laws describing each particle are no different than any other particle. Geometrically, many small cells with the same combined surface area offer this feature. General relativity uses the metric tensor (ds^2)[4]. The surface area of a 2-sphere is broken into many small spheres with an equal surface area, i.e. A=a*exp(180) and r=R/exp(90). The total energy will be that of a proton mass/cell plus a small amount of expansion kinetic energy. Based on geometry, two substitutions are placed in the gravitational constant G below, i.e. M=m*exp(180) and R=r*exp(90).

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

For G to be equivalent between many small cells and one large sphere the geodesics (the combination of r,v and m that give G) of cells must be multiplied by the small factor 1/exp(90). This value is the gravitational coupling constant [6] for a cell that has cosmological properties, i.e. the force is shared with exp(180) particles on a surface that is 1/exp(90) of the total surface.

Appendix 3 Energy content of the sun

The model below calculates the gravitational pressure exerted down toward the core of our sun. Initial conditions come from the expansion model at time 4 billion years ago.

The model is built with 10 layers that together have mass 2e30 Kg like our Sun. The bottom layer is consistent with Wiki data for density and temperature. The fusion calculations are from the author's fusion model described in Appendix 3.

1.07E+00	m/m	Kinetic Energ
2.15E+30		(MeV)
1.40E-02	rho0	
6.70E+06		
4.33E+08	h	
1		
7.13E+02	ghigh	
9.73E+04	T (red=fl)	1.26E-05
1.43E+24	mass	
4.40E+08	P	
9.18E-01	rhonew	
3.90E+08	h	
0.81	A/A	
8.81E+02	ghigh	
1.22E+06	T	1.58E-04
7.61E+25	mass	
3.55E+10	P	
5.89E+00	rhonew	
3.47E+08	h	
0.64	A/A	
1.11E+03	ghigh	
2.35E+06	T	3.03E-04
3.86E+26	mass	
3.20E+11	P	
2.76E+01	rhonew	
3.03E+08	h	
0.49	A/A	
1.46E+03	ghigh	
3.48E+06	T	4.49E-04
1.39E+27	mass	
2.06E+12	P	
1.21E+02	rhonew	
2.60E+08	h	
0.36	A/A	
1.98E+03	ghigh	
4.61E+06	T	5.94E-04
4.44E+27	mass	
1.24E+13	P	
5.48E+02	rhonew	
2.17E+08	h	
0.25	A/A	
2.85E+03	ghigh	
5.73E+06	T	7.39E-04
1.40E+28	mass	
8.02E+13	P	
2.84E+03	rhonew	
1.73E+08	h	
0.16	A/A	
4.46E+03	ghigh	
6.86E+06	T	8.85E-04
4.65E+28	mass	
6.29E+14	P	
1.86E+04	rhonew	
1.30E+08	h	
0.09	A/A	
5.94E+03	ghigh	
7.99E+06	T	1.03E-03
1.72E+29	mass	
5.43E+15	P	
1.38E+05	rhonew	
8.67E+07	h	
0.04	A/A	
8.92E+03	ghigh	
9.11E+06	T	1.18E-03
5.66E+29	mass	
2.92E+03		
5.88E+16	P	
1.31E+06	rhonew	
4.33E+07	h	
0.01	A/A	
2.50E+04	ghigh	
1.02E+07	T	1.32E-03
1.34E+30	mass	
1.48E+18	P	
4.19E+06	rhonew	
1.02E+07	temp core	
4.19E+06	Kg/m^3	
2.00E+30		
4.19E+06	density Kg/m^3	
1.02E+07	Temp (K)	1.32E-03
7.94E-06	p1	
3.46E-05	p2	
6.574E-09	p3	
1.81E-18	P	
8.8	B years	
1.20E+57	N	
0.082	fract burn	
1.77E+38	N/sec	
1.18E+39	Fusion MeV/sec	

Appendix 4 Comments

Literature states that gravitational force obeys the following relationship:

http://en.wikipedia.org/wiki

alphaG=(mp/me)^2=1.752e-45			
mp/me=1836.15 where mp/me=proton/electron			
alphaG=1836.15^2*1.752e-45=5.907e-39			
F=(5.9068e-39)*hC/R^2			
G/hC=1/Mp^2			
alphaG=(m^2*G/hc)=5.907e-39			
F=alphaG/R^2			
F=(G m^2/hc)/R^2			
compares to F=Gm^2/R^2 if multiplied by hC			
F=(5.907e-39)*hC/R^2			

If radius r for the conventional physics (Wiki) force calculation is 7.045e-14 meters, as proposed above, the force in Newtons (NT) is:

F=5.9068e-39*hC/R^2				
	hbar		6.58E-22	mev-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/(7.045e-14)^2				
3.76078E-38	NT			

This result agrees with the simple Newtonian force for particles separated by 7.045e-14 meters.

F=Gm^2/R^2 (NT)=6.67428e-11*1.6726e-27^2/7.045e-14^2=3.762e-38 NT where m is proton mass and R is meters.

Alternative definition for entropy and comments

In some thermodynamic texts S=-ln P where P is probability. Information theory uses this convention [2][3]. A negative natural logarithm can be confusing. Remember that improbable states contain more information (S). When P is low, S is high and decreases to zero when probability is 1. In thermodynamics, this convention allows energy TdS to be positive but dS is always decreasing. (Actually temperature is energy and dS is information about the energy state).

P	S=-ln P
1	0
0.1	2.302585093
0.01	4.605170186

After expansion there are many potential states for particles to fall into. Particles that have not fallen have maximum potential but are very improbable. As they falls into the many probable states below, the second law of thermodynamics describes their behavior. Potential energy increases to about 9.8 MeV. This leaves Tds zero if there is ideal conversion of kinetic energy to potential energy. If it is slightly non-ideal, TdS will have a low positive value. For Tds to remain low during expansion the term dS would increase dramatically to account for the decrease in temperature.