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The Source of the Gravitational Constant at the
Low Energy Scale-Updated

Abstract

In general relativity, gravity is attributed to the geometry of space-time. Literature states that the gravitational constant (G) originates at the Planck scale. The Planck length L=(\h*G/C^3)^.5 is 1.61e-35 meters and associated with the Planck energy 1.2e22 MeV. This energy is far greater than the energy of a proton and the space surrounding each proton is far greater than the Planck length. It is generally accepted that the Schwarzschild solution to Einstein's wave equation is nature's response to geometry and mass. In this paper a low energy scale source for the gravitational constant is proposed based on a unique cellular approach. Cosmology literature allows one to estimate the numbers of protons in the universe. This allows the source of gravity to be associated with the mass of one neutron. A cell is the space associated with a proton mass and has cosmological properties that allow it to represent the universe geometrically. Each cell has an initial radius of 7.045e-14 meters and expands utilizing kinetic energy found in a proton-space model. This model, previously reported, provides information required to quantify fundamental interactions. Coupled with the cellular approach the model helps bridge the gap between gravity and the quantum scale.

Key Words: gravitational constant, cellular cosmology, expansion, Schrodinger.

Accepted relationships:

Et/H=1

Where E=Energy (in this documents we will use million electron volts (MeV) and convert it as follows:
1.602e-13 Nt-m/MeV where m is meters
Mass: M (Kg) =E/C^2, i.e. kg=MeV/C^2= MeV/3e8^2 m^2/sec^2*1.602e-13 Kg/Nt-m.
Time in seconds to travel around a quantum circle of radius r at velocity C
H Plancks constant= 4.136e-21 MeV-sec
h or hbar (reduced Planck's constant)= H/(2*pi)= 6.582e-22 MeV/sec

Derived relationship r=hC/E, also written Er/C=h

F=G MM/r^2

Where G= gravitational constant= 6.672e-11 Nt meter^2/Kg^2
M=mass in Kg
r= distance in meters
F= force in Newtons (Nt)

E=Fr

Where E is the energy expended by a force acting through radius r. This leads to gravitational potential energy.

Rs=GM/C^2

Where Rs= Schwarzschild's solution to the metric tensor equations from General Relativity derived by Einstein.

Rs=r assumption

This assumption is the basis of the Planck scale radius calculated from G.
The value r is the wavelength associated with the de Broglie wavelength hC/E.
When Rs=r associated with a mass m in the relationship Rs=GM/C^2
Derived relatioship combining Er/C=h with E= GM^2/r: G=hC/M^2
Derived Planck scale mass and energy:
M=(hC/G)^2=(6.5821e-22*3e8/6.67e-11*1.602e-13)^.5=2.176e-8 Kg=1.22e22 MeV.
Derived radius:
Rs=GM/C^2=hC/E=6.58e-22*3e8/1.22e22= 1.6e-35 meters

The value 1.62e-35 meters is known as the Planck scale and is **the accepted source for the gravitational constant G.**

Fundamentals of curvature and gravity

The accepted equation above Et/H=1 is one fundamental equation of quantum mechanics. It is simply E=H/t or more simply energy is reciprocal time. This relationship can be considered a circle. Time around the circle at velocity C is t=2*pi*r/C. Combined with Et/H=1, the radius of the circle is r= h*C/E. Since h and C are constants, the radius of the circle is simply reciprocal energy. The higher the field energy, the smaller the radius R. The four fundamental interactions (forces) of nature are simply different size circles. The circles are sometimes orbits for particles with kinetic energy.

	Mass (m)	Ke	gamma (g)	R	Field (E
	(mev)	(mev)		meters	(mev)
Gravity	938.272	10.151	0.9893	7.0445E-14	-2.801
Electromagne	0.511	1.36E-05	0.99997	5.2911E-11	-2.72E-05
Strong	9.959	918.162	0.0107	2.0936E-16	-957.18
Strong residua	929.414	10.151	0.9892	1.4287E-15	-20.303

Only the gravitational force is long range, very weak and the physics for large masses throughout the universe (Newtonian). For gravity, curvature is caused by mass (General Relativity); the other three curvatures are caused by field energy E, i.e. r=hC/E and are quantum in nature. These differences prevent gravity from being united with the other interactions.

Cellular cosmology

Using an information based approach [3][9], energy components were identified that allowed the author to model the mass of a neutron and proton and the space they occupy. The model supports the value exp(180) as the number of neutrons (Appendix 2 topic “Number of neutrons in nature). Cosmology data [4][5] was used to estimate the number of protons in the universe and there was substantial agreement.

The proton is thought to be a primary manifestation of underlying laws and as such contains information that determines many aspects of nature. The Proton-space model (Appendix 1 and 2) is the source of constants for unification of forces in the table above and detailed in Appendix 3. The author has been working on and publishing the model for many years [8][9][10][13]. More recently it was recognized that it describes the space the neutron is embedded in and it now called the proton-space model. It may be a “bot” that tracks/calculates [16][10] as the universe expands.

Scaling large scale gravitation values to the quantum level

Gravitation according to the general theory of relativity [4] is the geometry of space and time. The first step in unification is to consider gravity on a particle by particle basis like the other forces. This requires identifying the space/neutron. What would this space look like? Would it be a circle associated with a proton? But we know that space is three dimensional. The space required would be a sphere, specifically its surface and we can find a radius r=hC/E like the other forces. At radius r, the space/neutron of interest is the area of a sphere that I will call a cell. A=4pi*r^2.

Consider large mass M (for our purposes the mass of the universe although this is quite presumptive) broken into exp(180) cells, each with the mass of a proton [Appendix 2 topic “number of neutrons in nature]. Fill a large spherical volume with exp(180) small spheres. We will consider the surface area of many small cells and equate this to the surface area of one large sphere. For laws 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 where they are in the large sphere. As such a “many small cells” surface model is useful if the fundamentals of each cell are known. The proton-space model provides these details.

In general relativity the large-scale metric tensor [10][Wiki] is based on (ds^2). The surface area of a large 2-sphere can be broken into many small spheres with an equal surface area. Let small r represent the radius of each small cell and big R represent the radius of one large sphere with the same surface area containing exp(180) cells. 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 many small cells.

Area=4 pi R^2
Area=4 pi r^2*exp(180)
A/A=1=R^2/(rs^2*exp(180)

R^2=r^2*exp(180)
Rs=rs*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 (small r,v and m below are for cellular space). We will first consider the quantum level with velocity v=C.

The Schwarzschild equation Rs=GM/C^2 is a solution to Einstein's field equations [10][Wiki]. The equations are written for large scale curvature caused by a large mass. The Planck scale was associated with large mass 2.18e-8 Kg (energy equivalent 1.22e22 MeV which is about exp(44) times the mass of one proton). The radius Rs is adjusted in the relationships below to represent one neutron or proton. It will be called rs (lower case). The geometry described above as cellular cosmology is the basis for the adjustment.

Rs^2=rs^2*exp(180)	
Rs=rs*exp(90)	
M=m*exp(180)	
G=rs*exp(90) C^2/(m*exp(180))	
G=rs*C^2/m*1/exp(90)	
rs= G m/C^2*exp(90)	

The value rs compares a one neutron solution to the field equations to a one neutron de Broglie radius. The de Broglie radius required is for the mass only (excluding the kinetic energy inside the neutron). We know the value of mass through the proton-space model. It is 101.95+13.8+13.8=129.54 MeV (2.3e-28 Kg) (refer to the model in the section below entitled "fundamental space"). This true mass value is the same for the proton and neutron and the remainder is kinetic energy totaling 939.57 MeV (1.675e-27 Kg) for the neutron.

Radius r de Broglie= hC/E=6.58e-22*3e8/129.54= 1.523e-15 meters.
rs (solution to wave equations for one neutron)= GM/C^2*exp(90)= 6.67e-11*1.675e-27 Kg/3e8^2*exp(90) = 1.523e-15 meters.
The two low energy scale radii are equal just like Rs equals the de Broglie radius for the high energy scale 1.22e22 MeV (mass 6.18e-8 Kg).

Calculating the gravitational constant, G

The fundamental that allowed G to be used to determine r for the Planck scale was the assumption that Rs from the Schwarzschild's solution was equal to r, the de Broglie wavelength.
rs=GM/C^2*(exp(90))=r deBroglie=hC/E where E=mC^2
From this equality, G=hC/Mm*1/exp(90)
Example calc:
M=1.675e-27 Kg (939.57 MeV)
m=2.31e-28 Kg (129.54 MeV)

G=hC/Mm*(1/exp(90))
G=6.58e-22 MeV-sec*3e8 m/sec/(1.675e-27 Kg*2.31e-28 Kg)*1.602e-13*(1/exp(90))
G=6.678e-11 Nt m^2/Kg^2

This is the source of the gravitational constant at the quantum scale.

Proton-space model

The proton-space model is a very specific list of energy components that add exactly to the measured proton mass 938.272 MeV plus energy associated with the space it is imbedded in. (Appendix 1 and 2 derive and explain the model). It is a zero total energy model with mass plus kinetic energy in the left-hand side of the table (positive) exactly equal and opposite to the field energy total on the right-hand side of the table (negative). Below the proton mass 938.27 Mev energy values for space are listed. The total energy for both sides at the bottom of the table is 959.99 MeV. Overall 959.99-959.99=0.

Quark mass (MeV)	Kinetic E (Mev)			Field E (MeV)
101.95	646.96			753.29
	5.08			0.69
13.80	83.76			101.95
	5.08			0.69
13.80	83.76			101.95
	5.08			0.69
Weak E	-20.30			
Weak KE	0.00			
Balance	0.00			
Neutrino ke	-0.67			0.74
ae neutrino	-2.0247E-05			
E/M field	-0.0000272			
938.27	MeV Proton			
	0.0000272			
	-0.6224			
0.5110	0.11			
electron neu	2.02472E-05			
Neutrino ke	0.67			
	0.74			
expansion p	10.15			
expansion k	10.15			
959.99				959.99
Total N values		Sum of yellow=Grav		2.801

Fundamental space

From the above work, we identify r=hC/E or E*r=hC

The equation for G can also be written:

G=hC/Mm*1/exp(90)= E*r/Mm*1/exp(90)

The gravitational field energy is 2.801 MeV based on the Proton-space model value (shown above in yellow). Like the other three forces, a field energy defines radius but in this case the gravitation field defines fundamental space.

r=hC/E= 6.48e-22*3e8/2.801= 7.045e-14 meters

An equivalent quantum level source for the gravitational constant G

Above we used G=hC/Mm*(1/exp(90)) to determine G, but hC=E*r. If we can find the proper E, we can calculate G from E*r where r= 7.045e-14 meters.

Again, the Proton-space model comes through with the value. The value is 10.15+10.15=20.3 MeV shown in the bottom left-hand side of the model. Initially the proton has 10.15 MeV of potential and 10.15 MeV of kinetic energy but it is converted to gravitational potential energy by expanding the universe opposed by the gravitational force. The value E=F*R=GMM/R^2*R= 20.3 MeV.

Example calculation for G:
G=hC/Mm*1/exp(90)= E*r/Mm*(1/exp(90))

G= 20.3 MeV* 7.045e-14 meters/1.67e-27^2 Kg^2*1.602e-13*(1/exp(90))

G=6.678e-11 Nt m^2/Kg^2

Note that G depends (conveniently) only on the mass of the neutron squared in the bottom of the equation.

G remains constant throughout expansion

There is an expansion model for the universe associated with the proton-space model. In this model fundamental space radius r= 7.045e-14 meters increases because the proton associated with each cell has kinetic energy. As the radius of each cell expands the potential energy increases. G remains constant and E*r=20.2*7.045e-14 remains constant. Nature is clever. If E*r was only hC, we wouldn't understand the cause and energy associated with expansion.

Is belief in the Planck scale good science?

There is a historical perspective to this question. When physicists dealt with one electron and its field energy, they knew they were working with the quantum scale and it was normal to calculate de Broglie wave lengths. However, early physicists did not yet understand that gravity is the geometry of space time. When the Schwarzschild solution Rs became known it is admirable that they settled on equating Rs with a de Broglie wavelength. As pointed out above this is a way of deriving an equation involving the velocity of light and the gravitational constant. Rs=GM/C^2. It was reasonable, as a working assumption, to assign a de Broglie wavelength to gravitational mass and calculate a Planck length. But they derived a rather suspicious energy value 1.22e22 MeV (6.18e-8 Kg) by working backwards from a known gravitational constant (most recognize that working backward from a known result is bad science). The mass did not correspond to the known neutron mass that should have been central to a gravitational theory. In addition, the Planck length 1.6e-35 meters was suspiciously low.

It was recognized that action at a distance was a problem and we must be grateful to Einstein for his recognition that space is curved and the associated wave equations. It was unfortunate that the great physicists of the 1900's did not have the advantage of WMAP [11] and Cmagic [12] expansion models, nor did they have the advantage of knowing the approximate number of protons in the universe. Perhaps they could not consider a cellular approach to bridge large scale gravitation with the quantum scale because they lacked information.

What curves space?

Even post general relativity, this is not an easy question to answer. For the electron's orbit around a proton, the answer seems straightforward. The electromagnetic field curves the electron's orbit. The equation r=hC/E yields a measurable orbit at 5.29e-11 meters associated with field energy 27.2e-6 MeV. The discovery that the orbit can change in quantum (Q) amounts simply meant that the electromagnetic field energy changed by E/Q^2, associated with a jump to a larger orbit. The energy was simply changed into light. The Proton-space model gives E=2.801 MeV as the gravitational field. It initially curves space into a radius of 7.045e-14 meters. This radius changes dramatically as expansion occurs and is now about 0.36 meters. But this is not due to the value E=2.801 changing, it is due to loss of kinetic energy in the proton associated with the cell.

The factor 1/exp(90) is recognized as a bridge between large scale Newtonian physics and the quantum scale since the Proton-space 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 the proton-space model defines. With G constant fundamental radius r0 can expand as kinetic energy decreases. Just like the electron's orbit, the proton's cellular orbit can change. In this case the energy is changed from kinetic energy to gravitational potential energy since the proton must do work on the cell to expand it and it resists expansion according to Newtonian gravity. The equation derived above for G with E*R can be re-written to give the change in the cell radius as kinetic energy is converted to potential energy.

G=E*r0/m^2*1/exp(90)
E=2*ke=2*10.15
G=2*10.15*r0/m^2*(1/exp(90))

This means that the E*r form of the equation for G becomes a powerful tool because the original E=2*ke=2*10.15 is known. Since m is always 1.67e-27 Kg, and G is constant the only variable in the equation is r0 and its original value is 7.045e-14 meters. The multiple E*r is fixed but E is inversely proportional to r.

Ke=0.5*mv^2 can be substituted into the equation above.

G=2*0.5*mv^2*r0/m^2*(1/exp(90))= r0*v^2/m*(1/exp(90))

The Newtonian relationship R=GM/V^2 can be combined with the above equation if we know the relationship between the cell v and large V (for example the velocity of an orbit around a galaxy). The following relationships apply with the two substitutions from cellular cosmology.

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 relationship between v and V is: v^2=V^2.

The following box combines the relationships above.

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))			

The factor (1/exp(90) in the equation above scales Rs (Schwarzschild's solution to the wave equations) to one proton.

The equation R=r0*10.15/ke*(Mgalaxy/1.67e-27)*(1/exp(90)) is another way of writing R=GM/V^2 because they both yield the radius R of a large orbit around a central mass (M). But the first equation helps understand what curves space for gravitation. The radius R responds both to decreasing kinetic energy and the accumulation of mass (Mgalaxy). R describes the orbit of a test mass (one proton) around central mass M. Based on derivation of the gravitational constant G above it is clear that the Einstein's field equations do indeed curve space. The gravitational energy 2.801 field energy and r0=hC/2.801 is fixed. Kinetic energy (ke) changes as the universe expands but large V does not appear until mass accumulation occurs. Large V results from falling into gravitational orbits at various times throughout expansion.

What curves space for the other three forces? To fully answer this question, we need to know what field energy is. The proton-space model is based on an energy zero beginning. But the other constraint for the proton-space model is probability 1. The energy values in the proton-space model are solutions to a Schrodinger wave equation:

The proton-space wave function

For each set of values, P=1 satisfies the Schrodinger equation:

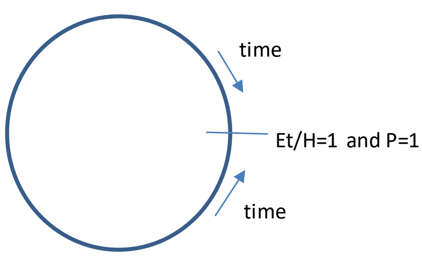
				P=1=exp(itE/H)*exp(-itE/H)				
	E					E		
	Mass plus					Strong Field Energy		
	Kinetic Energy (MeV)					Gravitational Field Energy		
	E=2.02e-5	Diff KE	N	P	N	E=2.02e-5*exp(N)		
Down Qua	**4.36**	744.55	**15.43**	**1**	17.43	**753.29**	Down Strong Field	
Kinetic E		5.08	12.43		10.43	**0.687**	Grav Field component	
Up Quark	**2.49**	95.07	**13.43**	**1**	15.43	**101.95**	Up Strong Field	
Kinetic E		5.08	12.43		10.43	**0.69**	Grav Field component	
Up Quark	**2.49**	95.07	**13.43**	**1**	15.43	**101.95**	Up Strong Field	
Kinetic E		5.08	12.43		10.43	**0.69**	Grav Field component	

The probabilities are p=1/exp(N), where N is N=ln(E/2.02e-5). For example;

P=1/exp(15.43)*1/exp(12.43)/(1/exp(17.43)*1/exp(10.43))=1. This means when we write:

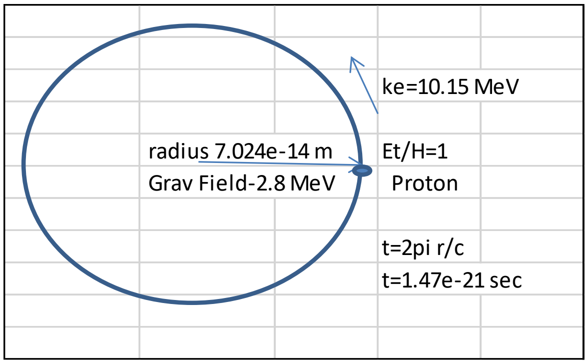
15.43+12.43=17.43+10.43, we are specifying N values that represent P=1.

The 4 sets of the proton-space model multiply 1*1*1*1=P=1. This is the wave function for the proton-space model more fully described in Appendix 2.



The Schrodinger wave equation P=1=exp(iEt/H)*exp(-iEt/H) appears to be the cause of space curvature [8][13]. Energy is reciprocal time and time repeats in circular fashion.

Cellular expansion model



The first step in the expansion model is duplication of cells from one cell to exp(180) cells, each with a proton. Post duplication the radius of the universe would be 8.02e12 meters (exp(60)*7.045e-14 meters). Since the physics of each cell is identical, the horizon imposed by the speed of light is not meaningful. This could explain observations indicating uniformity (the cosmological principle and temperature uniformity). All calculations are based on one cell and scaled to the radius of the "universe" with the scaling factor R=rcell*exp(60). (180^(1/3)). The initial velocity is associated with a proton positioned at R in an orbital (this is idealized since kinetic energy is in the form of temperature and pressure]. As kinetic energy (velocity) changes the cell expands R=ro*10.15/ke. Forces for the orbit are shown in Appendix 3 topic "Another method of calculating G).

The author explored the possibility that the proton-space model is an active participant as a driver and tracker of expansion [16]. From the space part of the proton-space model described above, only two values change as the universe expands. The proton model total 20.3 is constant but pe= 20.3- kinetic energy.

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	20.29			
expansion ke	0.01			
959.99				959.99
Total N values		90.10	90.10	

Expanding cells maintain G

Consider how kinetic energy and potential energy change in the derivation below. Kinetic energy (ke) is be turned into gravitational potential energy (pe=Fr) over time. The increasing radius of the universe and increasing time are related through expansion.

Kinetic E ke	Potential 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	

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

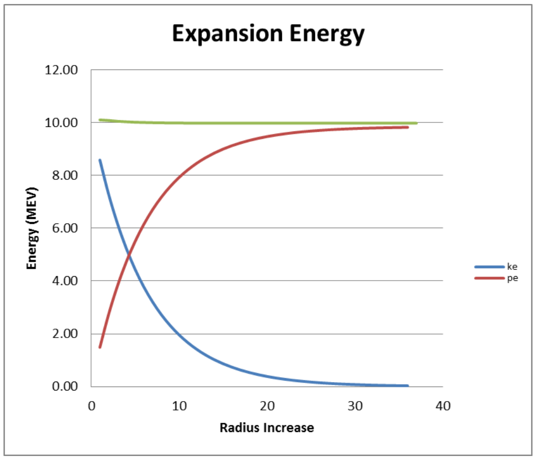
Returning to the basic concept that particles define space locally, the above equations indicate that time is changing two things simultaneously. 20.3 MeV= ke+pe. Combining the equations above:

(r/r0)=(t/alpha)^(2/3)
With r= r0*10.15/ke
r/ro*10.15/ke= (t/alpha)^(2/3)
ke=10.15/(t/alpha)^(2/3)
pe=20.3-10.15/(t/alpha)^(2/3)

These can be substituted into the space portion of the model as follows:

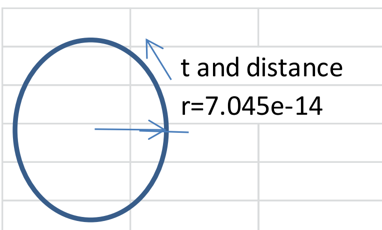
	2.72E-05	0.296	
	-0.6224	-10.33	
0.511	0.11	10.14	
electron n	2.02E-05		
Neutrino k	0.67	10.41	
	0.74		
expansion	ke=10.15/(t/alpha)^(2/3)		
expansion	Pe=20.3-ke		
939.68			959.99
Total N values		90.10	
r=7.045e-14*10.15/ke			

Expansion energy
Since the expansion history is partially known [11][12], kinetic and potential energy can be evaluated for an expanding cell. With 7.045e-14 meters as the initial cell radius and the tangential velocity decreasing, the inertial force can be calculated for each time increment. Changes in energy are plotted below (the horizontal axis units are increments of time and they quickly saturate).



Time

Space and time originate with a quantum circle related to the gravitational field energy 2.801 MeV.



Et/H=1 with t=2pi r/C leads to r=HC/(2pi)/E. H=Planck's constant=4.14e-21 MeV-sec. With R=7.04e-14, circle time= 2pi R/C= 1.47e-21 seconds. I consider this fundamental time.

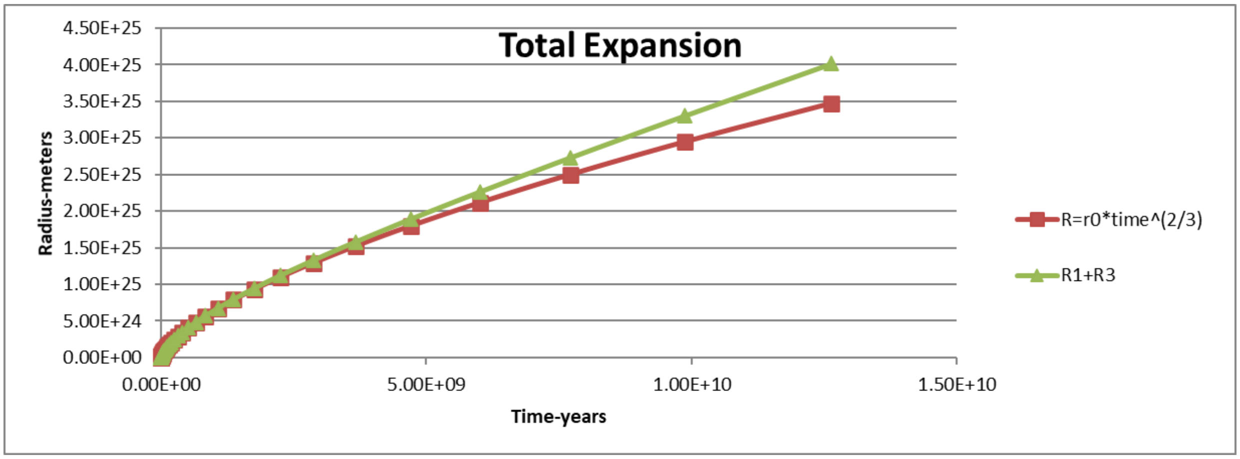
With this understanding the Proton-space model describes expansion with time. Since time is defined by the proton and it also contains expansion kinetic energy, the proton becomes a cosmological particle with the capability of creating the universe we see around us. Proton-space appears to be a cosmological model.

			Start	He4 transition	spike	now	with dark
Kinetic energy (MeV)			10.1500	0.110	0.110	3.14E-10	3.5217E-10
Fusion energy release of He4 (MeV)					3.12E+00		
Temperature spike He4=Wke/(1.5*B)					8.33E+10		
R meters=8.04e12*10.15/(Ke)					5.47E+15		
Rspike=7.42e14*(Ta/Tb)^0.565			2.53E+14	2.11E+18	2.64E+18	2.13E+33	
Radius final (meters)						4.00E+25	
Temperature Final (K)						0.00E+00	
baryon photon ratio			0.109960409		1.32E-10		
					2.7		
			Start	He4 transition	He4 Spike	R1	R3 stars
Time (seconds)			0.0515	438.8		4.352E+17	now
KE MeV			10.15	0.099	2.81E+00	3.24E-10	
KE expansion algorithm			10.15*(0.0511/time)^.5		2.81*(539/time)^0.666		
Expansion Time (sec)		Time (se	0.052	539	539	4.32E+17	
Temp before He4 spike K=ke/(1.5*E			7.87E+10	7.66E+08		0.355	settle back r
R meters=8.05e12*10.15/(E*pi)			8.04E+12	8.26E+14			
R after spike=8.23e14+2.8*1.6e-13/(3.6e-42*exp(90)*exp(60)					1.20E+16	3.70E+25	4.16E+25
Temperature after He4=KE/(1.5*B)					2.18E+10	2.51	2.73
baryon photon ratio					6.98E-10		
		Stars energy delta radius (m)					4.6E+24
						3.65E+25	

The table above is a summary of expansion stages based on energy values in the proton-space model. This is fully discussed in references 8 and 16. The original expansion energy 10.15 MeV and associated temperature decrease until the temperature associated with 0.111 MeV is reached. This value is found in the Proton-space model as 0.662 MeV-0.511 MeV= 0.111 MeV. Neutrons and protons are in equilibrium at the beginning but neutrons start to decay with a half time of 661 seconds. There are enough neutrons remaining at energy 0.111 MeV to readily react with protons. About 25 percent of everything becomes He4 (He4 transition above). This spikes the temperature but as expansion continues it falls to near present values.

Expansion curve

Expansion energy becomes very low late in expansion [8] and as stars light up they add a significant amount of energy. Calculations show that this keeps the expansion curve from following the curve proportional to time^(2/3) after stars light up. I believe photon energy represents the second expansion component. Its addition makes the curve more linear and replaces the concept of dark energy.



The proton-space energy values and gravitational relationships create the cosmology we observe over time. A comparison was made with finding of WMAP but there are substantial differences regarding composition [8][14]. These will eventually be resolved but over-all we cannot help but be impressed. These processes represent an ultimate construction project with only 10.15 MeV of energy per proton. Galaxies, stars and planets literally fall into place as a result of proton-space being duplicated, expanded and able to use some of the original kinetic energy to create gravitational orbits.

Conclusions

The author used an information-based approach to identify basic energy components of protons and the space they occupy. Information from the model coupled with general relativity helped identify a low energy source for the Newtonian gravitational constant.

A cellular expansion model was presented based on a better understanding of gravitational relationships, cosmology literature, and energy available from the proton-space model. The cellular approach avoids calculation on the large scale when expansion velocity is super-luminal. The models described have implications for the ongoing dark matter and dark energy search.

It is the author's view that the radius and time associated with field energy 2.801 MeV and the associated expansion curves define space and time.

The Proton-space model becomes especially productive for cosmology. It provides the following:

1. The kinetic energy/proton associated with the big bang (10.15 MeV).
2. The original radius of the universe (exp(60)*7.045e-14 meters).
3. The way cell kinetic energy (KE) changes with time: KE'=10.15*(t/t')^(2/3).
4. The way cell radius changes with R=7.045e-14*KE/ke meters.
5. The temperature at which primordial nucleosyntheses occurs (0.11 MeV), the kinetic energy difference between 0.622-0.511 MeV in the model.
6. The fusion release and the spike temperature that gives the required baryon/photon ratio (consistent with isotopes that are uniformly measured throughout nature and associated with the H→He4 transition.)

7. The mass density at equality and decoupling, leading to consistency with WMAP analysis of CMB.
8. It allows us to calculate the forces involved in late stage expansion. Energy release by stars seems to account for recent flattening of the expansion curve.
9. The simplicity of the model indicates that everything is based on a fairly simple equation, the Schrodinger equation [9].
10.

The big "take away" from this work is that energy values in the Proton-space model help us understand nature. Our currently understanding is based on the Standard Model. There are similarities between it and the proton-space model [reference 10]. When Schrodinger wave functions like those defined by the proton-space model are considered, we understand that mass+ kinetic energy exp(iEt/H) multiplied by exp(-iEt/H)= 1 (Probability=1). Another initial condition appears to be energy=0 (E-E-0). The third initial condition is the Schwarzschild solution, Rs.

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Appendix 1 Fundamental proton-space and neutron-space models

The left hand columns for each particle are mass and kinetic energy values that add to the value 938.27 MeV (939.565 MeV for the neutron). They are accurate to within 5 significant digits. The appendix contains a comparison with Particle Data Group data. 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.

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	Kinetic E	N=ln(E/2.02e-5)		Field E
(MeV)	(Mev)			(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	

Quark mas	Kinetic E	N=ln(E/2.02e-5)		Field E
(MeV)	(Mev)			(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 Voic	-20.30			
	0.00			
	0.00			
	0.62		10.51	0.74
939.5654	MeV Neutron			
	-0.62			
	0.74	10.51		
expansion	10.15			
expansion	10.15			
959.99				959.99
Total N values		90.10	90.10	

The model represents particle-space. The entire right-hand side field energy must equal the entire left hand side mass plus kinetic energy. One characteristic of the model is that balancing occurs between the two part of the model allowing it to maintain constant energy and a constant wave-function. Both sides add to 959.99 MeV. The negative (-20.3 MeV) energy above (weak void) is the weak energy field (sometime called residual strong energy in the literature). One half of this value is the kinetic energy of a quark bundle in this model. There is a relationship between the particle (top) part of the model and the space part (bottom). The balancing energy in the bottom (space) part is expansion plus potential energy that equals 20.3 MeV. During expansion, kinetic energy is converted to potential energy conserving 20.3.

Appendix 2 Details of the Proton-space model

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)	
	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 [3] 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-space model in the text [11][12].

Comparison of Proton-space model and Particle Data Group (UC Berkeley) 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		

Appendix 3 Proton-space energy values for four interactions

It is instructive to review other interactions supported by information extracted from the proton mass model. An updated table from [2] is reproduced below:

Unification Table		cell ax74	Strong "Comb	Strong Residu	Electromagn	Gravity
			(MeV)	MeV	MeV	MeV
		2.720E-05	939.5654133			
Field Energy E (MeV)			958.56	20.303	2.72173E-05	2.801
Particle Mass (mev)			129.54	929.414	0.511	939.565
Mass M (kg)			0.00	1.66E-27	9.11E-31	1.6749E-27
Kinetic Energy (mev)			828.33	10.151	1.361E-05	10.151
			957.87		1.361E-05	
Gamma (g)=m/(m+ke)			0.1352	0.9892	0.99997	0.9893
Velocity Ratio		v/C=(1-(g)^2)^.	1.0000	0.1466	7.298E-03	0.1458
R (meters) =((HC/(2pi)/(E*M/g)^0.5)			2.0593E-16	1.4287E-15	5.291117E-11	7.0445E-14
					5.291E-11	3.7706E-38
Force	Newtons	F=E/R*1.6022	745771.2	2276.7	8.242E-08	3.7634E-38
					8.623E-04	3.7283E-38
Inertial F Nt		F=M/g*V^2/R	0.000	2264.43877	8.241E-08	3.7634E-38
Force=HC/(2pi)/R^2=3.16e-26/Rang			745504.0	15488.2	1.129E-05	6.4
)			n	y	y	n
time=2pi R/C (sec)			4.32E-24	2.04E-22	1.52E-16	1.48E-21
e*t (mev-sec)			4.137E-21	4.147E-21	4.136E-21	4.136E-21
e*t/h			1.00036	1.00271	1.00001	1.00000
Coupling constant derived from thi			1.00036	0.1470	137.03046	1/exp(90)
Derived c^2 (E*R) mev m			1.97E-13	2.90E-14	1.440E-15	1.17E-51
Derived c^2 joule m			3.16E-26	4.65E-27	2.31E-28	1.87E-64
Derived exchange boson (mev)			958.215	138.11	0.0037	2.801
*published c^2 mev m				1.56E-14	1.442E-15	1.17E-51
*published c^2 joule m				2.5E-27	2.31E-28	1.87E-64
*Range					5.29E-11	8.60E+25
*http://www.lbl.gov/abc/wallchart/c			4.32E-24		5.29177E-11	

The field energies for three strong (color) interactions and their associated particles are from the proton mass table but have been added together for simplicity. A force coupling constant is calculated to be 1.00 and derived c^2 (E*R) values are presented in MeV-m and joule-m. The author did not find published values for comparison (quarks are not independently observable). The lower hierarchy electromagnetic coupling constant is well known and the author's calculations substantially agree [15].

The atomic binding energy curve is a result of the strong residual interaction. Again, the proton mass model provides information. The key value is the kinetic energy 10.151 MeV associated with the proton. The strong residual force F=hC/R^2= 15467 NT requires the coupling constant 0.147 and the derived c^2= 2.9e-14 MeV m is similar to the published value 1.56e-14 MeV m. Also, the radius of the proton appears to be credible. Reference 6 describes a simple model using the value 10.15 MeV as the basis for binding energy. In this model 10.15 MeV is the kinetic energy that changes as atoms fuse. (928.121 MeV+10.151 MeV =938.272 MeV). Further support for fundamental required for unification are in references 7 and 10.

Another method of calculating the gravitational constant

The Proton-space model is based on one proton and measurement for G can only be performed for large masses. The field energy values for one proton appear in the Proton-space model but they are small scale values. The reasoning led to what I call the cellular model of cosmology.

A model with no preferred position places the mass on the surface of a sphere. But it doesn't have to be a large sphere. It can be many small identical spheres that have the same surface area. The author developed a concept called cellular cosmology that defines space as N=exp(180) spherical "cells" each with a proton. Collectively they represent large scale orbits.

Gravitational relationships define geodesics that are surfaces where particles orbit. Equating a large surface area with many small surface areas yields the following relationships:

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 and lower case r, v and m for cellular space) that determine the geodesic (the curved surface where an orbiting body feels no force). G large space= G cellular space with mass substitution M=m*exp(180) and surface area substitution R=r*exp(90).

GRAVITY			
			neutron
Neutron Mass (mev)			**939.5654**
Proton Mass M (kg)			**1.675E-27**
Field Energy E (mev)			**2.801**
Kinetic Energy/neutron ke (mev)			**10.151**
Gamma (g)=939.56/(939.56+ke)			**1.0000**
Velocity Ratio v/C=(1-g^2)^0.5			**0.0000**
Velocity (meters/sec)			**4.407E+07**
R (meters) =(HC/(2pi)/(E*E)^0.5			**7.045E-14**
Inertial Force (f)=(m/g*V^2/R)*1/EXP(90) Nt			**3.784E-38**
Calculation of gravitational constant G			6.693E-11
G=F*R^2/(M/g)^2=NT m^2/kg^2			**6.69292E-11**
Published by Partical Data Group (PDG)			**6.6741E-11**
R (meters) =(HC/(2pi)/(E*E)^0.5=1.97e-13/2.801			**7.045E-14**

Comparison with gravitational constant literature

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:

α_G =Gm$_e$^2/(hC)=(m$_e$^2/m$_p$^2)=1.752e-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:

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:

F=Gmm/R^2= 6.67e-11*1.67e-27^2/7.045e-14^2= 3.76e-38 Nt

Appendix 4 Example using the value 1/exp(90) to scale cell values to large size observations

Example 1: The earth's gravitation

			large space		cell size at current expansion			
R is the earth size geodesic			RV^2/M	G=G	rv^2/m	r is the cell radius		
R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the cell size geodesic		
			R'=r*('v/V)^2*(M/m)*1/exp(90)					
	R' geodesic (meters)		6.40E+06		0.547	r' is the cell size geodesic (m)		
	Velocity of orbit (m/sec)		7897.71		15.78	meters/sec		
	Earth mass kg		5.98E+24		1.67E-27	kg		
	nt m^2/kg^2		6.67E-11	G=G	6.67E-11			

The table above indicates that the surface of the earth must be moving at 7898 m/sec to be on the geodesic; however rotation only gives the surface 464 m/sec. Since the velocity is low we experience acceleration of 9.8 m/sec^2.

	Mass kg (earth	5.98E+24	
	earth R (m)	6378100	
a=gm/r^2	m/sec^2	9.80	

Of course, to reach a force balance one would increase velocity to the geodesic value.

The table above indicates that the surface of the earth must be moving at 7898 m/sec to be on the geodesic; however rotation only gives the surface 464 m/sec. Since the velocity is low we experience acceleration of 9.8 m/sec^2.

	Mass kg (earth	5.98E+24	
	earth R (m)	6378100	
a=gm/r^2	m/sec^2	9.80	

Of course, to reach a force balance one would increase velocity to the geodesic value.