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February 2014
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The Case for a Low Energy Gravitational Scale

Abstract

Gravity is known to be the geometry of space time (general theory of relativity). It is generally accepted that the source of the gravitational constant (G) is the Planck scale. The fundamental relationship gives the Compton wavelength (for gravity the Planck length L), L=(\h*G/C^3)^.5 as a function of the reduced Planck or Heisenberg constant (\h pronounced hbar), G and C the speed of light. The Compton wavelength is 1.61e-35 meters and this is associated with the Planck energy 1.2e22 mev. This energy scale is far greater than the energy of a proton and the space surrounding each proton is far greater than the Compton wavelength. Literature states that the Compton wavelength is nature's response to geometry and mass at the quantum scale. The Planck scale causes difficulties including infinities and quantum foam like space.

This paper reviews a hierarchy of interactions with a focus on gravity. A low energy scale source of the gravitational constant is proposed and a more fundamental coupling constant with the value 1/exp(90) is identified (where exp(90) stands for the natural number e to the power 90). The proposed field energy is 2.683 mev and is associated with a radius of 7.34e-14 meters.

The author uses a cellular approach to model expansion [3]. WMAP data [5] allows an estimation of the number of protons in the universe. A cell is the space associated with each proton and has cosmological properties that allow it to represent the universe geometrically. Each cell has an initial radius of 7.34e-14 meters and if it expands according to WMAP history its current value is 0.46 meters. Using this approach is was possible to compare the kinetic energy that expands cells with potential energy. Implications for the field of cosmology are discussed. Several examples involving the use of the factor 1/exp(90) are presented that demonstrate how cellular values predict large scale observations.

General relativity is the geometry of space time and special relativity describes how fixed laws appear to different observers when time is correctly identified as an equal fourth dimension. Schwarzschild equations include a prediction of time dilation that curves space time (delta time). These equations are known to be solutions in general relativity. Calculations using the factor exp(90) indicates that time dilation is equal for special and general relativity throughout expansion.

Hierarchy of Interactions

Calculation of gravitational force with accepted the accepted coupling constant

In physics, the gravitational coupling constant, αG, is the coupling constant characterizing the gravitational attraction between two elementary particles having nonzero mass. αG is a fundamental physical constant and a dimensionless quantity, so that its numerical value does not vary with the choice of units of measurement (Wiki).

AlphaG=Gme^2/(hC)=(me^2/mP^2)=1.752e-45

where:

G is the Newtonian constant of gravitation;
me is the mass of the electron;
C is the speed of light in a vacuum;
ħ ("h-bar") is the reduced Planck constant;
mP is the Planck mass.
m below is the proton mass.
This coupling constant can be understood as follows:

http://en.wikipedia.org/wiki/Gravitational_coupling_constant			
	alphaG=(me/mP)^2=1.752e-45		
	m/me=1836.15		
	alphaG=(m*1836.15/mP)^2=1.752e-45		
	alphaG=(m*1836.15/mP)^2=1.752e-45		
	alphaG=(m/mP)^2=1836.15^2*1.752e-45=5.907e-39		
	alphaG=5.9068e-39		5.90677E-39
	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 the R for the force calculation is 7.35e-14 meters, as proposed above, the force is:
(The abbreviation NT or nt is the force in Newtons)

F=(5.9068e-39)*hC/R^2				
	hbar		6.58212E-22	mev-sec
	hbar in NT-m-sec		1.05E-34	NT m sec
	hbarC in NT-m^2=K		3.16E-26	NT m^2
F=(5.9068e-39)*K/R^2				
F=(5.9068e-39)*3.16e-26/(7.35e-14)^2=3.39e-38 NT				
3.4527E-38	NT			

This agrees with the simple Newtonian force:

F=Gmm/R^2 (nt)=6.67428e-11*1.6726e-27^2/7.354e-14^2		3.4524E-38

Reference 1 is the author's attempt to unify fundamental interactions. WMAP data [5] was used to estimate the number of protons in the universe. The possibility that the result (exp(180)) was significant in other ways was explored. Using an information based approach [8], energy components were identified that allowed the author to model the mass of a neutron and proton. The result is reproduced in Appendix 1. It appears that the proton is a manifestation of fundamental laws and as such contains information basic to four interactions. The following information was extracted from the proton model:

	Mass (m) (mev)	Ke (mev)	gamma (g)	R meters	Field (E (mev)
Gravity	938.272	9.800	0.9897	**7.3543E-14**	-2.683
Electromagne	0.511	1.36E-05	0.99997	**5.2911E-11**	-2.72E-05
Strong	129.541	799.251	0.1395	**2.0928E-16**	-957.18
Strong residu	928.121	10.151	0.9892	**1.4297E-15**	-20.303

The table gives us the field energy 2.683 mev as the basis for gravitation. The proposal below indicates that this field energy is associated with a radius of 7.35e-14 meters. The test for quantum level is action. Action is 1.0 when momentum*radius/h=pR/h=1. The proposal meets the test (actually by definition). One question this paper addresses is "can we substitute this low energy scale for the Planck scale energy".

Proposal	**(** cell d305 "unified")		
Field Energy		2.683	mev
constant	HC/(2pi)	1.97E-13	mev-m
	R=constant/E	7.35E-14	m
	Field side	R side	
	H/E	2*pi*r/C	
time (t)	1.54E-21	1.54E-21	sec
Proposal p (p=E/C)		8.95E-09	mev-sec/m
p*R/h		1.00	
qm test	M/C^2R^2/t	6.58E-22	mev-sec
qm test/h	M/C^2R^2/t/l	1.00	

Gravity is known to be the geometry of space time. If a proton with potential energy falls into the above field and follows the radius 7.35e-14 meters we would expect an orbit to be established. The inertial force could be the basis of gravitation. Note the calculations below:

				GRAVITY
				proton
Proton Mass (mev)				938.272
Proton Mass M (kg)				1.673E-27
Field Energy E (mev)				2.683
Kinetic Energy ke (mev)				9.720
Gamma (g)=M/(M+ke)				0.9897
Velocity Ratio		v/C=(1-(g)^2)^.5		0.1428
"R equation"	**R (meters) =((HC/(2pi)/(E*E)^0.5)**			**7.3543E-14**
	F (NT)=M/g*(v/C*C)^2/R/exp(90)			3.4524E-38
HC/(2pi)	1.973E-13	mev-m		
Calculation of gravitational constant G				
Inertial Force=(M/g*C^2/R)*1/EXP(90) NT				3.4524E-38
Radius R (Meters)				7.3543E-14
Mass M (kg)				1.673E-27
Gravitational Constant (G=F*R^2/M^2=NT m^2/kg^2)				6.67428E-11
	Published by Partical Data Group (PDG)			6.67428E-11
PE fall	mev			19.34
KE orbit	mev			9.720
F (NT) =PE/R=19.34*1.603e-13/7.3543e-14/exp(90)				3.4524E-38

Note the agreement with published coupling constant derived force and Newtonian mechanics force 3.4527e-38 NT presented above under the heading "Calculation of gravitational force with accepted the accepted coupling constant"). Also note that inertial force MV^2/R force equals field force E/R. However, the match (highlighted in yellow) depends on a very small factor, namely 1/exp(90). This match has several implications further explored in this paper. Firstly, space at the quantum level is defined by 7.35e-14 meters. Secondly, a balanced force orbit defines a geodesic in which the gravitational constant is defined by the inertial force and thirdly, the low published coupling constant is replaced by the factor 1/exp(90) in force calculations.

With G constant at 6.67e-11 nt m^2/kg^2, the geodesic radius for a cell is:

V	m/sec	0.144*3e8=4.3e7
M	kg	1.67E-27
R=GM/V^2*exp(90)		7.35e-14 meters

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

Unification Table		cell ax74		Strong strange	Strong down	Strong down	Gravity	Electromagnetic	
Higgs energy (mev)				128992.0	128992.0	128992.0	proton		Strong Residual
***Field coupling to Higgs field Energy				0.00629	0.00085	0.00085			
	Potential energy of proton falling into gravitational field (mev)						19.340		
Field Energy E (mev)				811.96	109.89	109.89	2.683	2.72172E-05	20.303
Mass Coupling to Higgs field energy				0.00085	0.00012	0.00012			
Particle Mass (mev)				109.887	14.872	14.872	938.272	0.511	928.121
Mass M (kg)				1.96E-28	2.65E-29	2.65E-29	1.6726E-27	9.11E-31	1.65E-27
Kinetic Energy (mev)				702.07	95.02	95.02	9.720	1.36086E-05	10.151
	Rydberg energy from PDG							1.360569E-05	
Gamma (g)=m/(m+ke)				0.1353	0.1353	0.1353	0.9897	0.99997	0.9892
Velocity Ratio		v/C=(1-(g)^2)^.5		0.9908	0.9908	0.9908	0.1428	0.0073	0.1467
R (meters) =((HC/(2pi)/(E*M/g)^0.5)				**2.4303E-16**	**1.7957E-15**	**1.7957E-15**	**7.3543E-14**	**5.291126E-11**	**1.4297E-15**
Electromagnetic R minus proton R=5.291627e-11-1.4297e-15								5.2910E-11	
Force	Newtons	F=E/R*1.6022e-13		535295.6	9804.3	9804.3	3.4524E-38	8.241498E-08	2275.2
Inertial F	Newtons	F=M/g*V*2/R		535295.626	9804.281	9804.281	3.4524E-38	8.241389E-08	2262.86246
Force=3.16e-26/Range^2 (nt)				535295.6	9804.3	9804.3	4.8E-39	1.129E-05	15466.9
HC/(2pi)	3.16E-26	(4.13e-21*3e8*6.24e12/(2*pi())							
	F=(5.907e-39)*hC/R^2 (nt)						3.4527E-38		
	F=Gmm/R^2 (nt)=6.67428e-11*1.6726e-27^2/7.354e-14^2						3.4524E-38		
Coupling constant derived from this work				1.0000	1.0000	1.0000	0.99989	137.030687	0.147099
Derived c^2 (E*R) mev m				1.97E-13	1.97E-13	1.97E-13	1.17E-51	1.44E-15	2.90E-14
Derived c^2 joule m				3.16E-26	3.16E-26	3.16E-26	1.87E-64	2.31E-28	4.65E-27
Derived exchange boson (mev)				811.960	109.887	109.887	2.683E+00	0.0037	138.02
*published c^2 mev m							1.17E-51	1.44E-15	1.56E-14
*published c^2 joule m							1.87E-64	2.31E-28	2.5E-27
*Range	Range for gravity equals		8.98E+25	meters				5.29E-11	
*http://www.lbl.gov/abc/wallchart/chapters/04/1.html									
Published coupling constant (PDG)								137.03599	
***	0.0063	EXP(17.432)/EXP(22.5)							
***	0.00085	EXP(15.432)/EXP(22.5)							
***	0.00012	EXP(13.432)/EXP(22.5)						2.72121E-05	

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

The lower hierarchy electromagnetic coupling constant is well known and the author's calculations substantially agree.

The value highlighted in red does not agree with calculations in the box. The relationship hC/R^2 is too simple to characterize gravity since gravity involves defining a radius and a proton with potential energy falling to that radius. However, the other c^2 coupling constants [11] do agree with the author's derived values although the author did not convert them to force for comparison.

The atomic binding energy curve is considered to be a result of the strong residual interaction. Again, the proton mass model provides information. The key value is the kinetic energy 10.151 mev associated with the proton. The strong residual force 15467 NT=hC/R^2 requires the coupling constant 0.147 and the derived c^2= 2.9e-14 mev m is similar to the published value 1.56e-14 mev m. Also the radius of the proton appears to be credible. Reference 9 shows a simple model using the value 10.15 mev as the basis for binding energy verifying that 10.15 mev is the kinetic energy that changes as atoms fuse. (Note that 928.121 mev+10.151 mev =938.272 mev).

A possible candidate for gravitational energy scale

Nomenclature and review

	Constants			
\h	6.5821E-22	mev-sec	reduced Heisenberg	
E	1.2200E+22	mev	Planck energy E	
M	2.18E-08	kg	Compton mass	
G	6.670E-11	nt m^2/kg^2	gravitational constant	
C	3.00E+08	m/sec		
	Relationships			
	Compton wavelength=GM/C^2			
	GM/C^2	6.67e-11*2.18e-8/3e8^2		
	L=GM/C^2		1.62E-35	meters
	L=Ch/E=h/MC		1.62E-35	meters
	L=h/MC=GM/c^2		1.61E-35	meters
	G=hC/M^2			

First compare the quantum mechanical action at two levels, the Planck scale and the much lower level proposed above and repeated below. Either level could be a candidate for defining quantum gravity since the action is 1 in both cases.

Planck energy E (mev)		1.2200E+22
L=Planck length (meters)		1.62E-35
Planck momentum	p=E/C	4.07E+13
p*L		6.58E-22
qm action= p*L/\h		1.00E+00

Proposal	**(** cell d305 "unified")			
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time (t)	1.54E-21		1.54E-21	sec
Proposal p	(p=E/C)		8.95E-09	mev-sec/m
p*R/h			1.00	
qm test	M/C^2R^2/t		6.58E-22	mev-sec
qm test/h	M/C^2R^2/t/l		1.00	

The proton mass (1.67e-27 kg) is analogous to the Compton mass, i.e. proposed mass is 938.27 mev, not 1.22e22 mev (1.67e-27 kg, not 2.17e-8 kg). Compare the calculation for gravitational constant for the Planck scale and the proposed mass level and note that they differ by the large factor.

Compton mass 2.18e-8 kg
G=hC/M^2
G=(6.58e-22*3e8/(2.18e-8)^2*1.603e-13)
6.66E-11 nt m^2/kg^2

G=hC/M^2
Proposed mass 1.67e-27 kg
G= (6.58e-22*3e8/(1.67e-27)^2*1.603e-13)/exp(88.03)
6.66E-11 nt m^2/kg^2

The large factor required for the same G does not agree with the proposed coupling constant exp(90). Next consider why exp(90) is useful.

Fundamentals of Scaling Cellular Gravitation Values to Large Scale Gravitation

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. Fill a large spherical volume with exp(180) small spheres. We are considering the surface of many small cells as a model of the surface of one large sphere. For laws to be uniform throughout the universe there can be no preferred position. A surface offers this feature but many small spheres also offer this feature as long as we don't distinguish an edge. As such a many small sphere surface cosmology model helps us understand. These geometric relationships give the cell "cosmological properties".
In general relativity the metric tensor is based on (ds^2). The surface area of a 2-sphere would 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 on the surface of each cell. The total energy will be that of one protons/cell plus a small amount of kinetic energy. *At a particular time in expansion*, we will evaluate G for 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/(r^2*exp(180)
R^2=r^2*exp(180)
r=R/exp(90) surface area substitution
M=m*exp(180) mass substitution

For gravitation and large space, we consider velocity V, radius R and mass M as the variables (capital letters for large space) that determine the geodesic. With G constant, M=m*exp(180) and the surface area substitution equal to 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):

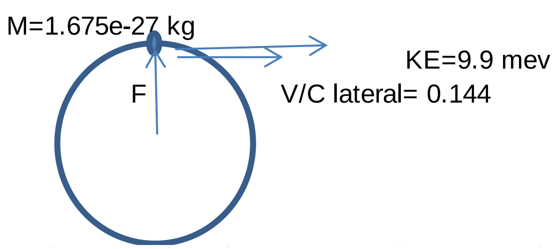
At any particular time in expansion:

Large space		Cellular space
		with substitutions
RV^2/M=	G=G	r*exp(90) *v^2/(m*exp(180))
		(rv^2/m)/exp(90)

Note the factor 1/exp(90). When measurements are made at the large scale as must done to determine G, the above derivation indicates that we should multiply cell scale (rv^2/m) by 1/exp(90) if we expect the same G.

There is a historical perspective to this understanding. When physicists dealt with one electron and its field energy, they knew they were working with the quantum scale and it was reasonable to assign a Compton mass and wavelength with the above relationships. However, very early physicists may not have yet understood that gravity is the geometry of space time. It was reasonable, as a working assumption, to assign a Compton wavelength to mass and calculate Planck scale energy. However, it now must be recognized that for equal gravitational constant the radius of curvature and mass are vastly different between the large and small scale. Also, it was unfortunate that the great physicists of the 1900's did not have the advantage of WMAP [5] and Cmagic [6] expansion models, nor did they have the advantage of knowing the approximate number of protons in the universe. Perhaps they couldn't compare cellular scale space to large space because they lacked information.

Cellular expansion model



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

The initial lateral velocity is associated with a proton moving in an orbital fashion (this is idealized since kinetic energy is in the form of temperature as discussed below). The proton has kinetic energy from its fall from 19.3 mev of potential energy. The initial condition is identical to the proposed source of gravity above, i.e. it has 9.8 mev of lateral kinetic energy (lateral because we are dealing with surfaces). The proposed expansion model above allows an evaluation of the kinetic energy during expansion. The derivation below is based on the gravitational constant remaining at the value G (small g below stands for the relativistic term gamma).

RV^2/(M/g) G=G rv^2/(M/g0)
But the universe expands and r=7.35e-14 meters is scaled up by time^(2/3)
R space becomes r*time^(2/3)
what happens to v^2 so that G=rv^2/M remains constant when r expands?

RV^2/(M/g)=rv^2/(M/g0)	RV^2/M=rv^2/m	9.75 ke	ke=.5 (m/g)v^2
RV^2*g=rv^2*g0	RV^2=rv^2		ke0=.5 (m/g0)V^2
(v/V)^2=(r/R)*g0/g	(v/V)^2=(r/R)	velocity falls ↓	ke/ke0=(m/g)v^2/((m/g0)V^2)=r/R
(v/V)=(r/R)^.5*(g0/g)^.5		0	ke/ke0=(g0/g)(v/V)^2
			ke=ke0*(g0/g)(r/R)

Although decreasing kinetic energy keeps the gravitational constant at the value G, gravity itself is maintained by the proposal above under "Hierarchy of Interactions". Expansion is outward and is driven by time. The expansion equations are given in reference 3 and provide the same expansion history identified by WMAP [5]. Note that for volume we are considering a filled sphere and big volume V is proportional to R^3 and this is equal to small volume v with exp(180)*r^3. This makes R=r*exp(60) the equation for determining large R from small r. The velocity associated with each cell will be sub-luminal.

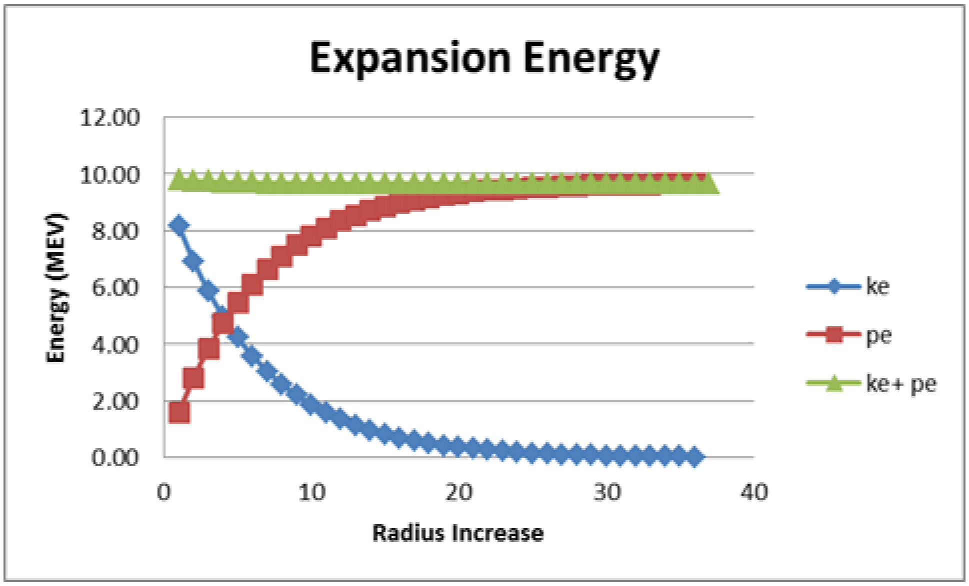
Predictions of the cellular expansion model

Inflation: Inflation in the proposed expansion model is duplication of cells. Post inflation the radius of the universe would be 8.4e12 meters (exp(60)*7.35e-14 meters). Since the physics of each cell is identical, the horizon imposed by the speed of light is non-meaningful. This could explain observations indicating uniformity (the cosmological principle and temperature uniformity).

Time: Fundamental time quoted above is 1.54e-21 sec. In the author's view it both repeats and adds to the previous cycle. Expansion equations depend on time of course but if one prefers to use dimensionless time in the equations a value that matches the correct expansion history is 1.54e-21 sec*exp(N)/0.0538 sec where N starts at 45 and progresses.

Expansion energy

Since the expansion history is known [5][6], incremental calculations can be carried out on a cell by cell basis. With 7.35e-14 meters as the cell radius and the radial velocity decreasing, the inertial force can be calculated for each increment. As the cell expands the force changes and the increasing potential energy can be determined. Calculation of kinetic energy at the beginning can't be carried out with universe size space because the velocity is greater than the speed of light; hence the wisdom of using a cellular model. Incremental calculations [2][3] are carried out until the Hubble's constant matches the measured value 2.3e-18/sec [5]. Using cellular calculations involving 1/exp(90) to determine force, incremental calculations give potential energy (integral of Fdr). Detailed calculations of kinetic energy changes show that 9.8 mev of kinetic energy is just enough energy for expansion and that kinetic energy is just converted to potential energy with the total conserved. Here is the result:



Dark energy

The cell radial velocity of 17.2 m/sec represents a reasonable "now" condition for expansion. There are two components to expansion, the first component is proportional to time^(2/3) and the second component is called late stage expansion and causes the apparent acceleration observed. In fact calculations for energy consumed by the second component expansion are on the order of 2e-12 mev because late stage expansion is only resisted by small forces. (Stated the other way, when the radius is low forces are high and kinetic energy is rapidly consumed but there is very little late stage expansion in this part of the curve). The value 2e-12 mev is a small portion of 9.7 mev and is negligible. One cannot make a case for missing energy (dark energy) based on these results.

Traditional derivations that end with (v/r)^2=8/3 pi G rho start with the assumption that initial kinetic energy will become potential energy as expansion occurs.
The author believes that the equation v^2=4/3*pi*G*rho*r^2 assumes too much and should not be relied upon to "back-calculate" critical parameters. It assumes that the second component of expansion (the author's R3 and WMAP's cosmological constant) consumes a large amount of kinetic energy and it doesn't. In addition the equations do not include the right function of time (not R=r*t^(2/3) and r*t^(5/3)).

Current kinetic energy per proton

Recall that each cell scales to universe size radius by the factor r*exp(60) at both the initial and final radius. Each cell (small r) is now about 0.46 meters and large R is about 5.25e25 meters. With the initial ke=9.8 mev, after expansion current value of kinetic energy has diminished by the ratio of initial radius to current radius (7.35e-

14/0.46=1/exp(29.5)) and is now 9.8/exp(29.5) mev=1.5e-12 mev/proton. This kinetic energy is associated with a velocity of v=17.2 m/sec.

Time dilation in special relativity

An expanded cell of 0.46 meters with a velocity of 17 meters/sec gives a special relativistic time shift of 1.66e-15 seconds (calculated from velocity, KE=2.46e-12 mev, gamma=(938/(938+KE), time shift =1-gamma, but since KE is low the time shift is approximately KE/(2*938)=1.66e-15 seconds.
The Schwarzschild time shift is a key general relativity prediction. The time shift calculated below is for one cell undergoing expansion at a radius of 0.46 meters. Note again that the factor exp(90) is used. Agreement (the factor of 2 is Schwarzschild 2 in 2GM/(C^2*R)) indicates that special relativity and general relativity make the same prediction when the large factor is included.

	dti=dt/(1-2GM/(C^2*R)^.5		
	dti=1/((1-EXP(90)*2*6.67e-11*1.67e-27/(3e8^2*0.458)))^0.5		

dti/dt	dti
1.0000000000000033	3.331E-15

This is not just coincidence at the present state of expansion; calculations show that it is true throughout expansion. Dti starts at 0.01 sec and decreases throughout expansion to the present value of 1.7e-15 seconds for both GR and SR.

What type of kinetic energy decreases?

Very early in expansion, plasma exists and we should not expect a neat orbit with kinetic energy 9.8 mev. Using the Boltzmann constant, temperature can be assigned to kinetic energy as follows:

KE temperature relationship			Beginning		Current expansion state	
ke=1.5 B T			9.80	mev	1.55E-12	
T=ke/(1.5 B)			7.58E+10	K	0.012018048	K
Boltzmann B	8.61952E-11	mev/K				

The temperature 7.6e10 K agrees with production of Helium (Sakharov) and is more reasonable than the 1e13 K temperatures associated with scaling the current radiation temperature 2.725 K all the way back to a low radius (cosmologists use the expansion ratio z to scale temperatures). However, starting with 7.6e10 K and scaling the other way gives the surprising present temperature of 0.012 K. Isn't the present temperature 2.725 K? Recall that production of electromagnetic waves occurs throughout expansion and accumulate. This radiation heats protons above the temperature related to expansion only. Incremental calculations were carried out for a cell based on the proton producing radiation energy, passing that radiation energy forward in time but reducing the value by expansion. The resulting radiation temperature was close to 2.7K at the end of expansion and followed the accepted temperature history. This is important because temperature affects the radius at equality and de-coupling.

Gravitational range

Since the four interactions have similar form, each with a characteristic radius based on the proton mass model, we would expect all four interactions to be short range. Gravity is known to be not only weak but very long range.

One way to evaluate this might be the Heisenberg uncertainty principle (dh proportional to dx*dp, where dx is the radial scale and dp is the momentum scale or de is the energy scale and dt is the time scale). If the factor 1/exp(90) is applied to the momentum scale, dx would be multiplied by exp(90) and gravity would be long range. However, the author tried to determine which of the variables dx, dp, de or dt should be changed by exp(90). Dividing dx makes the most sense and this is based on the replacement small r=large R/exp(90) *at any stage of expansion* described in the heading "Fundamentals of Scaling Proton Size Gravitation to Large Scale Gravitation". Other choices give surprising results, i.e. 7.35e-14*exp(90)=7.98e25 (the beginning predicts the end?) and 1.5e-21 sec*exp(90) gives a time of 60 billion years.

What about G=(\h C/m^2)?

Should the foundational relationship G=(\h C/m^2) be preserved? In the author's opinion it would require the correction G=(\h C*exp(90)/m^2). G would be associated with a mass close to the proton (350 mev) but this difference from the proton (938.27 mev) makes one suspicious of the relationship altogether.

Examples 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 earth orbit (meters)		6.39E+06		4.582E-01	r is the cell radius		
	R' geodesic (meters)		6.40E+06		4.582E-01	r' is the cell size geodesic (m)		
	Velocity of orbit (m/sec)		7897.71		17.25	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 is only 464 m/sec. Since the velocity is low we experience acceleration of 9.8 m/sec^2. Gravitation is simply acceleration.

	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.

Example 2: The geodesic is universe size when expanded proton positions regain kinetic energy by falling into deep orbits.

Assuming only that G is constant, the approximate radius of "the universe" (big R) can be estimated. First review how orbits are formed. The diagram below shows that there was about 20 mev of potential energy (Appendix 1 and reference 1) available (a) and the proposed model for expansion is based on an orbiting proton with approximately 10 mev of kinetic energy (b). Since the proton is attracted to and separated from the center of the field, there was also 10 mev of potential energy when the orbit is established. As expansion occurred (process (b)→(c) below), 10 mev of kinetic energy was converted to 10 additional mev of potential energy. At a much later point in expansion (c), although there is motion (temperature) of the proton on the surface of the expanding cell, there is no motion between cells (protons) except for and expansion. With V between protons nil the geodesics will be extremely flat (on the order of 5e38m) compared to the radius established by big R. This causes acceleration of particles toward one another (process 2 below) and external kinetic energy (between protons) increases as protons fall back toward the geodesic (d)→(c). The expanded cells cannot change their internal kinetic energy or radius because expansion is driven by time. Theoretically, 10 mev of external potential energy could be reconverted to10 mev of kinetic energy as particles fall toward one another. Overall, process (b)→(c)→(d)→(e) converts potential energy inside cells to external energy between cells.

		Process 1		Process 2		
		Internal Kinetic Energy (MEV)	Potential Energy (MEV)	External Potential Energy (MEV)		
a	Start	0	20			
		↓	↓			
b	Orbit	10	10	10	Orbit with 10 MEV KE	e
↓	Expansion	↓	↓	↑	Fall back to geodesic	↑
c	Expanded	0	20	20	Expanded condition	d

What actually happens during process (d)→(e) is that as protons fall toward each other, a transition occurs and acoustic waves break the total mass into about 27000 clusters. The fall back to a geodesic eventually occurs and we see these as clusters of galaxies, galaxies, etc.

During expansion, the kinetic energy of the proton in a cell decreased by KE/ke = exp(29.5) as small r expands by exp(29.5)). Since ke is proportional to v^2:

KE=ke*(R/r)
R/r=exp(29.5)
(Ke scales downward by exp (29.5)
KE=const*V^2
(V/v)^2=exp(29.5)
V=v*exp(14.7) Initial velocity

Velocity at the edge of the proton scale geodesic is 17.2 m/sec after expansion. But the protons themselves are far from a geodesic and could potentially regain 4.3e7 m/sec by falling. At this velocity theoretically a geodesic could be established. Big R is calculated to be 9e25 meter. It should not be surprising that big R for the large sphere is approximately the geodesic. Note again the large factor 1/exp(90) is used in the calculation.

		Scaling the geodesic to universe sized space at External KE=9.8 MEV						
R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the cell size geodesic		
			G from m=1.67e-27 kg					
		M=m*exp(0)	2.49E+51		1.67E-27	kg		
R'=r*(v/V)^2*(M/m)*1/exp(90)		R	8.998E+25		4.58E-01	r'	5.23E+25	meters
		V (meters/sec)	4.30E+07		17.25	v (meters/sec)		
		G	6.67E-11		6.67E-11			

Initial Velocity (4.29e7 m/sec) is associated with kinetic energy of 9.8 mev and calculations shows that the original energy is enclosed in the volume, just spread out. The original energy is conserved and it agrees substantially with Kauffmann (Appendix 2) [3] on a per particle basis. Since there are 3 particles per meter, the energy per particle is 9.8 mev.

As an engineer one cannot help but be impressed with the approximate energy conservation of combined processes 1 and 2. These processes represent the largest construction project in nature and almost no energy is consumed. The “trick” seems to be cells that expand, on average don’t re-contract and are able to move and fall relative to each other after they are far apart.

Example 3: Agreement with the Schwarzschild radius.

It is demonstrated below that scaling with 1/exp(90) in the denominator exactly matches the Schwarzschild radius (S) calculation. Of course, regular mass rather than Compton mass in used in the S equation below. The equation for S is:

1=1/(2*(Metric)-r)	term in solution
2*(Metric)-r=1	
r=2*(Metric)	
Metric=G M/C^2	M is mass
S=2G M/C^2	singularity radius

This equation is twice the Compton wavelength r=G M/C^2. With G=r C^2/M this is the same equation in the box below G=RV^2/M when V=C.

Note that in this case, the velocity at the surface is the speed of light.

		Scaling the cell size geodesic to Schwartzchild's S						
R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the cell size geodesic		
			G from m=1.67e-27 kg					
		M=m*exp(0)	1.67E-27		1.67E-27	kg		
R'=r*('v/V)^2*(M/m)*1/exp(90)		R	1.238E-54		4.58E-01	r'	5.23E+25	meters
		V (meters/sec)	3.00E+08		17.25	v (meters/sec)		
		G	6.67E-11		6.67E-11		1.000E+00	3.331E-15

R above equals 1.24e-54 meters. And below, the same calculation from Schwarzschild S=GM/C^2=1.24e-54 meters.

	m	1.66E-27
S=2GM/c^2=1.48e-27*m		2.45E-54
My Geodesic at C and High M		1.24E-54
S=2Geodesic		2.49E-54

For one solar mass in universe sized space. In these calculations, big V=C and the result is the Schwarzschild radius (S) for the proton mass and the solar mass and the divisor exp(90) is utilized. The result is S=1.48e3 meters.

	m
S=2GM/C^2=1.48e-27*m	2.96E+03
My Geodesic at C and High M	1.50E+03
S=2Geodesic	3.00E+03

The G=G scaling procedure with 1/exp(90) used as a multiplier for the expanded cell matches the accepted Schwarzschild result (1.5e3 meters).

Summary

A new quantum scale source for the gravitational constant was proposed that agrees with general relativity and extends our understanding of gravity. Fundamentals were presented that relate low scale values to large scale observables. The fundamentals indicate that the low coupling constant for gravity is in fact the small factor 1/exp(90). The author used an information based approach to identify basic energy components and reviewed an energy model of the proton comprised of these components. Stating that the nucleons are a manifestation of fundamental laws, information was extracted from the model that appears to help unify interactions. Although the focus of this paper was gravitation, a hierarchy of fundamental interactions was reviewed.

With a better understand of gravity and knowledge from WMAP regarding the approximate number of protons, results from a cellular model of expansion were reviewed. The cellular approach avoids calculation on the large scale when expansion velocity is super-luminal. As one would suspect kinetic energy conversion to potential energy indicates overall energy conservation. This has implications for the ongoing dark energy search since it appears that the second (accelerating) component of expansion requires minimal energy. Calculations show that special relativity time dilation is equal to Schwarzschild general relativity time dilation throughout expansion when the factor 1/exp(90) is used.

Examples were presented utilizing the small factor 1/exp(90) at the cellular scale. The purpose of this was to show that a low energy scale gravitational scale works and perhaps replaces current fundamentals. It is the author's view that the radius and time associated with field energy 2.683 mev define space and time.

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Appendix 1

Information from the proton mass model is used to understand fundamental interactions. The energy values in the box add to the exact mass of the proton (938.2703 mev). There are three main components, each with a mass and kinetic energy. The total mass and kinetic energy on the left side of the box (959.56 mev) is balanced by fields on the right hand side of the box. There is 20.3 mev of potential energy available for expansion and 10.15 mev of kinetic energy associated with binding energy.

ell g228	CALCULATION OF PROTON MASS			Mass and Kinetic Energy					Field Energies	
mass	Energy-mev	strong field	Energy-mev	Mass	Difference ke	Strong residual ke	Neutrinos	Expansion ke	Strong & E/M	Gravitation
ke		grav field		mev	mev	mev	mev	mev	field energy	Energy
15.432	101.947	17.432	753.291	101.947	641.880				-753.29	
12.432	5.076	10.432	0.687							-0.69
13.432	13.797	15.432	101.947	13.797	78.685				-101.95	
12.432	5.076	10.432	0.687							-0.69
13.432	13.797	15.432	101.947	13.797	78.685				-101.95	
12.432	5.076	10.432	0.687							-0.69
		-0.296	-2.72E-05			10.151		20.303	expansion pe	
charge		equal and opposite charge						0.000	expansion ke	
10.408	0.67	0.075		0.000	0.000	-0.671	0.671	v neutrino		
-10.333	0									
rates here to form proton and electron				129.541	799.251	**938.272013**	**PROTON MASS**			
10.136	0.51	10.333	0.62	**0.511**	0.111				5.44E-05	-0.622
0.197	2.47E-05	0.296	2.72E-05	**ELECTRON**			2.47E-05	e neutrino		
				130.052	0.111		0.671	20.303	-957.185	-2.683
90.000		90.000				1.673E-27		Total m+ke	Total fields	
								Total positive	Total negative	
								959.868	-959.868	0.00E+00

Some may notice that the quark masses are higher than the accepted values associated with down and up quarks. The author believes based on reference 10 that quarks can transition to lower energy, converting some of their mass to kinetic energy but the total of mass plus kinetic energy remains the same. This process is observed in mesons and baryons as they decay.

Note the values extracted from the model above:

	Mass (m)	Ke	gamma (g)	R	Field (E
	(mev)	(mev)		meters	(mev)
Gravity	938.272	10.151	0.9893	**7.3543E-14**	-2.683
Electromagne	0.511	1.36E-05	0.99997	**5.2911E-11**	-2.72E-05
Strong	129.541	799.251	0.1395	**2.0928E-16**	-957.18
Strong residu	928.792	10.151	0.9892	**1.4292E-15**	-20.303

Some may notice that the author uses 9.7 or 9.8 mev instead of 10.15 above. Coupling constants quoted in the literature are for protons and protons were used herein to allow direct comparison. Based on neutrons, the subject ke is closer to 10 mev.

Appendix 2

S.K. Kauffmann [3] gives the following value for energy.

Radius	1.21E+26	
	2(c^4/g)r	
	2.93E+70	
	m^4/sec^4(kg^2/(nt m^2))*m	
	m^4/sec^4kg^2/(nt m*m)*m	
	4.69E+57	
	m^4/sec^4kg^2 m/(mev*m)	
	1.48E+117	
	m^4/sec^4 mev^2 m/(mev*m)	
	m^4/sec^4 mev	
Energy	1.82E+83	mev
Volume	7.35E+78	m^3
	2.48E+04	mev/m^3
number protons		1.49E+78
	4.93E+00	mev/proton

If the above energy value is divided by exp(180) protons, the result is about 5 mev/proton. The value 9.9 mev/proton [1][2] and the value above compare favorably.