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November 2013
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The case for a low energy gravitational scale

Abstract

Arguments are presented that current difficulties with gravitational theory are resolved at a lower energy scale. 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 above the energy of a proton and the space surrounding each proton after inflation is much above the Compton wavelength. Literature states that the Compton wavelength is nature's response to geometry and mass at the quantum scale. The quantum scale has so far been incorrectly identified and the large difference causes difficulties with gravitational theory including infinities and quantum foam like space.

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			

A possible candidate for gravitational energy scale

First compare the quantum mechanical action at two levels, the Planck scale and a much lower level and note that 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

Barbee E (mev)		2.683144792
Barbee r	(meters)	7.354E-14
Barbee p	p=E/C	8.95E-09
p/hc		1.00E+00

			cell d305 "unified"		
Gravitational Action			E	2.6831E+00	mev
			const HC/(2pi	1.97E-13	mev-m
			R=const/E	7.3543E-14	m
			t	1.54135E-21	sec
			Field side	R side E'=m/g	
	E=Hv		H/E	2*pi*R/V	
	t=H/E=2piR/V		1.541E-21	1.541E-21	sec
			1.54135E-21		
1		qm test	m/c^2x^2/t	6.5821E-22	mev-sec
		qm test/h	m/c^2x^2/t/h	0.999999999	

Next, compare the calculation for gravitational constant for the Planck scale and the much lower level above and note that they differ by the large factor natural log e to the power 90; 1/exp(90).

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

G=hC/M^2
Proton mass 6.24e-28 kg (proton mass w/o ke)
G=(h*3e8/(6.24e-28)^2*1.603e-13)/exp(90)
6.66E-11 nt m^2/kg^2

Next consider why 1/exp(90) is required for the same G. (later, the value 6.24e-28 kg is questioned and the relationship is replaced with a different source for G).

Consider large mass M broken into exp(180) cells, each with the mass of a proton. Fill a large spherical volume with exp(180) small spheres. 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 may either consider the energy density of the whole or the energy density of the many cells. We will evaluate the energy density of large sphere and compare it with the energy density of many small cells. 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) for the volume substitution.

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)
M=m*exp(180)

For gravitation, we consider velocity V, radius R and mass M as the variables that determine the geodesic. With G constant, M=m*exp(180) and R=r*exp(90) the gravitational constant would be calculated for large space and proton size space as follows:

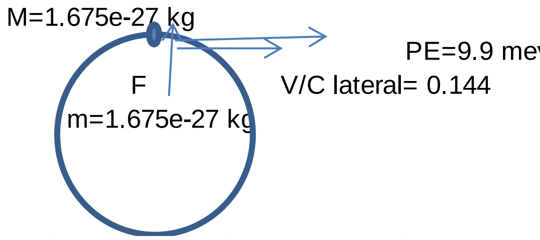
at any particular time in expansion

large space		proton size 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 to determine G, the above derivation indicates that we should apply the factor 1/exp(90) to the quantum scale 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, early physicists did not understand that gravity is the geometry of space time and furthermore could only make large scale measurements. 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 and that the Planck scale is a historical tool. A full analysis of this is included [2]. 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 number of protons in the universe, which we can estimate at exp(180) from the mass part of WMAP critical density.

Proposed model for expansion



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

M=1.675e-27 kg
v/C lateral=0.144
(KE lateral=9.9 mev)
m=1.675e-27 kg

The initial lateral velocity is associated with a proton with 9.9 mev moving in a circular fashion. Expansion is outward. The radius of this circle is the geodesic radius, R. With G constant at 6.67e-11 nt m^2/kg^2, the radius is:

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

Energy considerations

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.

Current kinetic energy per proton

The proton orbit model allows an evaluation of the kinetic energy during expansion. The derivation below is based on the gravitational constant remaining at the value G.

	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	9.9	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)		

With the initial ke=9.9 mev, the current value of kinetic energy would be 9.9*7.35e-14/.46 mev=1.6e-12 mev/proton associated with v=17.8 m/sec since the appropriate expansion values are 7.35e-14 m at the beginning and the expanded scale is 0.46 meters. Recall that each cell scales to large radius by the factor r*exp(60).

Argument #1: The cell radius 0.46 m scales to the current size of the universe

Below is the first of several arguments that exp(90) must be used as a correction factor at the quantum scale.

Assuming only that G is constant, big R can be estimated as follows. The current velocity at the perimeter of each cell is 17.83 m/sec but for the whole universe, this scales up by exp(15) to 5.64e7 m/sec (this agrees substantially with the Hubble constant*5.2e25 (2.3e-18*5e25=1e8 m/sec) . Small r (0.46) is scaled up by the velocity ratio and mass ratio in the two columns below and the result is divided by exp(90). This gives the geodesic radius R for the universe of 5.2e25. Recall that small r*exp(60) estimates the current size of the universe (0.46*exp(60)=5.23e25 meters. It should not be surprising that big R for the large sphere is equal to the geodesic. (Also recall that everything is placed conceptually on the surface of the sphere since there can be no preferred position).

		Scaling the geodesic to universe sized space at velocity C						
R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the proton size geodesic		
			G from m=1.67e-27 kg					
		M=m*exp(0)	2.49E+51	1.67E-27	1.67E-27	kg		
R'=r*('v/V)^2*(M/m)*1/exp(90)		R	5.221E+25	4.29E-14	4.58E-01	r'	5.23E+25	meters
	4.30E+07	V (meters/sec)	5.64E+07	4.30E+07	17.25	v (meters/sec)		
		G	6.67E-11	3.87E-11	6.67E-11			

Initial Velocity (4.29e7 m/sec) is associated with my kinetic energy of 9.9 mev and the following calculation shows that the original energy is enclosed in the volume, just diluted.

total ke	9.9*exp(180)	1.47E+79	mev
Vol	4/3 pi*5.2e25^3	6.00E+77	m^3
		2.46E+01	mev/m^3

The same calculation for small r is as follows, but this time for original energy.

total ke	9.9	9.90E+00	mev
Vol	4/3 pi*0.46^3	4.03E-01	m^3
		2.46E+01	mev/m^3

Note that the original energy is conserved and it agrees substantially with Kauffmann [3] on a per particle basis. Since there are 3 particles per meter, the energy per particle is 9.9 mev.

The scaling estimate for R is repeated below except it does *not* include exp(90) as a divisor.

		Scaling the geodesic to universe sized space at velocity C						
R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the proton size geodesic		
			G from m=1.67e-27 kg					
		M=m*exp(0)	2.49E+51	1.67E-27	1.67E-27	kg		
R'=r*('v/V)^2*(M/m)*1/exp(90)		R	4.89E+25	4.01E-14	3.51E-40	r'	4.01E-14	meters
	4.30E+07	V (meters/sec)	5.83E+07	4.30E+07	17.83	v (meters/sec)		
		G	6.67E-11	3.62E-11	6.67E-11			

To match G with G, the radius r=0.46 was divided by exp(90) to maintain the original energy density of about 30 mev/particle. There are at least two problems here. First, the radius of the universe *currently* can be only 4e-14 meters (3.5e-40*exp(60)). Second, the energy density is too high (5.4e118 mev/m^3).

Argument #2: Agreement with the Schwartzschild radius

It is demonstrated below that scaling with 1/exp(90) in the denominator exactly matches the Schwarzschild calculation. Note that in this case, the velocity at the surface is the speed of light.

R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the proton size geodesic		
			G from m=1.67e-27 kg					
		M=m*exp(0)	1.67E-27	1.67E-27	1.67E-27	kg		
R'=r*('v/V)^2*(M/m)*1/exp(90)		R	1.238E-54	1.51E-15	4.58E-01	r'	5.23E+25	meters
	4.30E+07	V (meters/sec)	3.00E+08	4.30E+07	17.25	v (meters/sec)		
		G	6.67E-11	1.37E-12	6.67E-11			

	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.

R' is the universe size geodesic			R'V^2/M	G=G	r'v^2/m	r' is the proton size geodesic		
			G from m=1.67e-27 kg					
		M=m*exp(0)	2.00E+30	1.67E-27	1.67E-27	kg		
R'=r*('v/V)^2*(M/m)*1/exp(90)		R	1.483E+03	1.51E-15	4.58E-01	r'	5.23E+25	meters
	4.30E+07	V (meters/sec)	3.00E+08	4.30E+07	17.25	v (meters/sec)		
		G	6.67E-11	1.37E-12	6.67E-11			

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. This indicates that the values 17.8 m/sec and r=0.43 are special. Of course, regular mass rather than Compton mass in used in the S equation below. The equation for S is:

1=1/(2M-r)	term in solution
2M-r=1	M is metric
r=2M	
M=G m/C^2	m is mass
S=2Gm/C^2	singularity

This equation is twice the Compton wavelength r=GM/C^2 (M is mass here, not the metric above). With G=r C^2/M this is the same equation in the box above G=RV^2/M.

	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

Argument #3: Gravity is long range because of 1/exp(90)

There is a third argument that the energy scale is low related to gravity being long range. To understand this argument, a source of gravity is proposed as follows:

An attempt to understand nature and its energy components with the use of information theory [1] has been the focus of the author. The analysis shows that a total mass and kinetic energy of 959.6 mev is balanced against 959.6 mev of field energy. One of the models developed is entitled the “proton mass model” [1] and is included as Appendix 1. Constants for four fundamental forces (interactions) come from the table. The proton mass model gives a value of 20.3 mev for a kinetic energy associated with a proton but not part of its mass. This can be associated with expansion with the remaining positive energy making up the neutron that decays to a proton. (The 20.3 mev becomes 10.15 kinetic and 10.15 potential as the orbit forms and then 20.3 mev potential energy again after expansion occurs). The radius 7.35e-14 meters is calculated from the fundamental radius model values for gravity. It is proposed that this is the source of the gravitational constant G and it approaches the value accepted value 6.67e-11 during expansion.

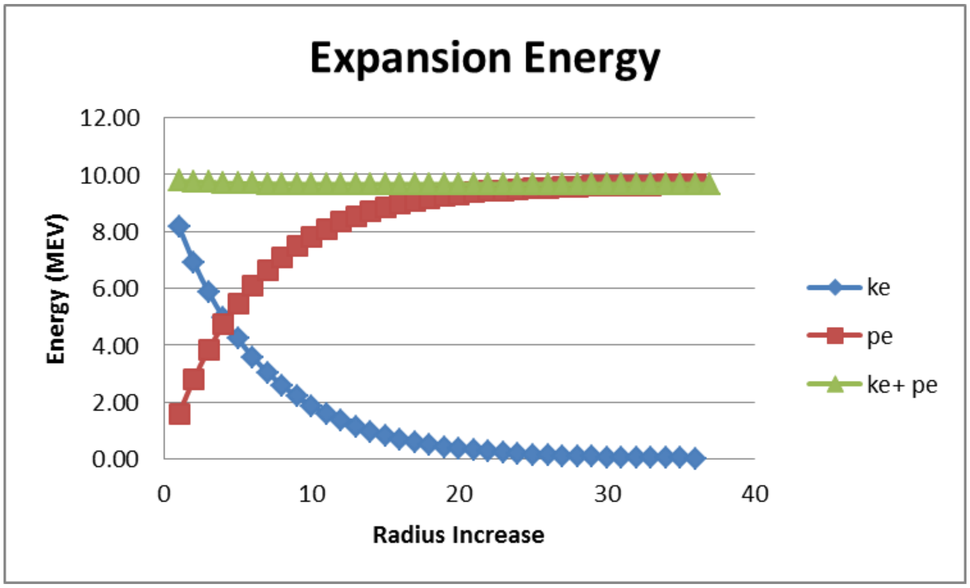
				GRAVITY
				mass only
				proton+elec
Particle Mass (mev)				938.272
M (kg)			1.001E+00	1.673E-27
Field Energy (mev)				2.683
Kinetic Energy (mev)			0.318	9.833
Gamma (g)=m/(m+ke)				0.9896
Velocity Ratio		v/C=(1-(g)^2)^.5		0.1437
Scale Factor G				1.00E+00
"R equation"	**R=((HC/(2pi)/(E*m/g)^0.5)*G^(2/3)**			**7.3543E-14**
1.973E-13	**F=M/(g*G^(2/3))*(V/c*C)^2/R/exp(90)**			3.456E-38
Calculation of gravitational constant from Inertial Force				6.682E-11
Inertial Force=(m/g*C^2/R)*1/EXP(90)				3.456E-38
Radius R (Meters)				7.3543E-14
Mass (kg)		1.673E-27	9.109E-31	1.674E-27
Gravitational Constant (g=F*R^2/M^2=nt m^2/kg^2)				6.6746E-11
fundamental time				1.5414E-21

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. The Heisenberg uncertainty principal can be written dh proportional to dx*dp, where dx is the radial scale and dp is the momentum 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.

If this is the true source of gravity, it would also be considered the source of space itself. Its radius would be small at the beginning but now large.

Argument #4: Expansion kinetic energy comparisons are correct

Since the expansion history is now known [5][6], incremental calculations can be carried out on a particle by particle basis. With 7.35e-14 meters as the cell radius, the force is calculated to be 1.7e-36 Newtons. As the cell expands (driven by time^(2/3) and time^(5/3), the force changes and an integration of the increasing potential energy can be easily carried out.



Now v^2 (m^2/sec^)			Beginning v^2 (m^2/sec^2)	
2.601E-37	v^2=(8/3piGrho)*r^2	0.50	1.517E-24	1.289E-24
2.60E-37	correct v^2		1.51E-24	1.29E-24

Based on this the potential energy per particle is now 2.6e-37 mev. (The initial radius of the sphere containing the particles was initially 8.4e12 meters, the radius now is 5e25 meters. Derivations that end with (v/r)^2=8/3 pi G rho start with the assumption that initial kinetic energy will become potential energy as expansion occurs. Calculation of kinetic energy at the beginning can't be done with big R because the velocity is greater than the speed of light; hence the wisdom of carrying this out on a proton by proton basis (small r that is R/exp(60)). These calculations are carried out for a final Hubble's constant of 2.3e-18/sec. Detailed calculations of kinetic energy changes show that 9.9 mev of kinetic energy is just enough energy to expand the R1 part of the expansion. Here is the actual final result:

V cell	V R1 (m/sec)	Hubble R1			
expansion	expansion	only			
16.20	5.64E+07	9.38E-19			
V expansion curve			1.12E+00	enough ke to lift R1	
3.447E-18	5.023E+07	8.36E-19			

The velocity 16.2 m/sec for each cell corresponds to 5.6e7 m/sec at the “edge of R” and this corresponds to a Hubble constant of about 1e-18/sec. A result only 12% lower is the calculated Hubble constant for the R1 portion of the simulated expansion curve. Note that this is about half the accepted Hubble’s constant of 2.3e-18/sec. Expansion component R3 expansion “rides” on R1 expansion. In fact calculations for energy consumed by R3 expansion are on the order of 2e-12 mev because late stage expansion is only resisted by small forces. This is a small portion of 9.9 mev and is negligible.
The author believes that the equation v^2=4/3*pi*G*rho*r^2 assumes too much and cannot be relied upon to “back-calculate” critical parameters because rho critical is incorrect. It assumes that the second component of expansion (the author’s R3 and WMAP’s cosmological constant) consume a large amount of kinetic energy. These equations do not include the right function of time (not R=r*t^(2/3)). One cannot make a case for a large amount of missing energy (dark energy).

Argument #5: A lower limit on radius is established

What about expansion from 0 to 7.35e-14 meters? By keeping G constant and expanding according to a geodesic nature limits the lower radius of a single cell. R=Gm/V^2 is a minimum at V=C with m fixed, somewhere around 7e-14 meters.

A low energy scale is problematic for inflation and it proposed that inflation is simply duplication on one cell by the large number exp(180). Post inflation the radius of the universe would be 8.4e12 meters (exp(60)*7.35e-14 meters).

Summary

Arguments were presented that a low energy gravitational scale is reasonable. Should the foundational relationship r=(\h G/C^3) be preserved? It would require the correction r=(\h G*exp(90)/C^3)^.5. The wavelength would be associated with a mass close to the proton (350 mev) but this difference from the proton (938 mev) makes one suspicious of the relationship altogether. A new source for the gravitational constant G was proposed and using this as a foundational principle sheds new light on the origin of space time itself. At the low energy scale it would be trouble free.

References:

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5. Bennett, C.L. et al. *First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Results*, Astrophysical Journal, 2001
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7. Private communication.

Appendix 1

ll 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	Gravitationa
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 ke	
harge		equal and opposite charge						0.000	expansion pe	
10.408	0.67	0.075		0.000	0.000	-0.671	0.671 v neutrino			
-10.333	0									
ates 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						Total m+ke	Total fields	
								Total positive	Total negative	
								959.868	-959.868	0.00E+00

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