Kinetic and potential energy during expansion

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Abstract

Gravity is known to be the geometry of spacetime (general theory of relativity). It is generally accepted that the gravitational constant remains constant as the universe expands. This paper shows how the curvature of space and time (described by geodesics) changes to keep G constant as the universe expands. WMAP [3] analysis led to expansion curves that are now generally accepted. The author's expansion curves agree with WMAP but equations that are thought to be more fundamental are developed and used. A unique cellular approach is used that allows the kinetic energy and potential energy to be accessed and compared with WMAP equations. The comparisons show that the concept of critical density (H=(8/3 pi G rhoC)^.5) is misused, although the general concept of Euclidian geometry is correct. It is demonstrated that there is probably no missing energy (dark energy) but a possible candidate for dark matter is discussed.

Overview

It is generally accepted that expansion involves the conversion of kinetic energy to potential energy. In the derivation below Mu (mass of universe) is the total mass and rho is the density at each point in the expansion. The result is for expansion of a small cell, labeled r that is duplicated exp(180) times to fill the overall volume. Using a small cell of radius r to evaluate big R is critical to understanding the universe. In this model, the universe is filled with the surface of many small cells and this is equivalent to the *surface* of one large sphere. This is important conceptually because we can be inside the universe (something we all observe) at the same time each surface is absolutely identical (a critical understanding of cosmology is that there is no preferred location). It will be shown that the expansion of each small sphere involves kinetic and potential energy changes that exactly balance each other with one proton on the surface of each cell (indicating no missing mass). Also crucial is the concept that our universe is Euclidian and cells are placed adjacent to other cells without energy differences between the cells. There is a perfect geometrical relationship between many small cells and one large sphere and we do not observe the blending of small to large. This paper will demonstrate that maintaining the gravitational constant and establishing geodesics (curved space time) are the overarching considerations that allow a deeper understanding of cosmology.

Derivation of expansion equations

Nomenclature

(all calculations are MKS)
v-velocity (m/sec)
M-mass (kg)
R-radius (meters or m)
G-gravitational constant (nt m^2/kg^2)
c-constant of integration
dt-delta time
t-time
H is Hubble's constant
R3 radius due to cosmolgical constant

Derivation showing that r expands as t^(2/3)		
Mu=rho*4/3*pi()*R^3=rho*4/3*pi()*r^3 exp(180)		
R^3=r^3*exp(60)^3		
r^3 increases as t^2 (will be time^(2/3) in next step)		
R^3=(r)^3*t^2*exp(180)		
R=r*t^(2/3)*exp(60)		
r=k/(EE)^).5=1.93e-13/(2.683*2.683)^.5=7.35e-14		
R=(7.35e-14)^3*t^(2/3)*exp(60)		
R=(7.35e-14)*t^2/3*exp(60)		
v=H*R where H is Hubble's constant		
dR=H*R*dt (dt=alpha dg)		
g is a time ratio= time/alpha time		
dR=H*alpha*R *dg		
int (7.35e-14)*g^2/3*dg =Rf-7.35e-14*g^2/3		
Rf=(7.35e-14)*g^(2/3)+(7.35e-14)*g^(5/3)*H1*alpha/1.666		

Note that a constant of integration is included in the derivation and it is evaluated with the Hubble constant H. This is Einstein's controversial cosmological constant that is now included in documents such as the WMAP and Cmagic analysis [3][5]. The cosmological constant adds a term that expands with time, after integration, raised to the power (5/3). The author will use time^(2/3) and time^(5/3) for the two terms but prefers to consider the proton as a center for expanding cells. Note that author also prefers making time dimensionless by dividing time by alpha. It will be shown that alpha has a special relationship to the Higgs particle. The full expansion equations are shown below in the heading "Making proton size space into universe size space".

Identifying small r and time ratio g in the expansion equation

The following table from reference 1 identifies the field energy associated with gravity as 2.683 mev.

Mass and Kinetic Energy					Field Energies	
Mass	Difference ke	Strong residual ke	Neutrinos	Expansion ke	Strong & E/M	Gravitation
mev	mev	mev	mev	mev	field energy	Energy
101.947	641.880				-753.29	
						-0.69
13.797	78.685				-101.95	
						-0.69
13.797	78.685				-101.95	
						-0.69
		10.151		20.303	expansion ke	
				0.000	expansion pe	
0.000	0.000	-0.671	0.671	v neutrino		
129.541	799.251	**938.272013**	**PROTON MASS**			
0.511	0.111				5.44E-05	-0.622
ELECTRON			2.47E-05	e neutrino		
130.052	0.111		0.671	20.303	-957.185	-2.683

The above excerpt is part of the proton mass table. Reference 1 "cracked" a logarithmic code that leads to components of the proton. The proton mass is exactly simulated and is 938.27 mev or 1.67e-27 kg.

Fundamental radius

The energy 2.683 mev underlies the quantum mechanics for fundamental radius r and time.

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	1.00	

convenient constant:	HC/(2*pi)		1.973E-13	mev-meters

r=1.973e-13/(2.683*2.683/1)^.5=7.35e-14 meters.

Fundamental time

Identify the fundamental unit of time for expansion is the gravitational orbit described above/(time around radius)						
	Fundamental radius=1.93e-13/(2.68*2.68)^.5=7.354e-13					
	Fundamental time=7.354e-14*2*PI()/(3e8)=h/E=4.13e-21/2.68					
	Fundamental time	1.541E-21	seconds			

Define alpha as initial time and omega as final time. The ratio g=time/alpha is the parameter in expansion equation, i.e. R=r*g^(2/3). Reference 1 identifies the Higgs particle with N=22.5. It is notable that dimensionless time is exactly twice the Higgs N value and fundamental to the theory of reference 1.

Identify alpha based on Reference 1 and WMAP best fit				
	dimensionless time			
	1/exp(45)	2.863E-20	sec	
	alpha=fund time/dim time=1.54e-21/2.86e-20			
	alpha	0.0538	sec	

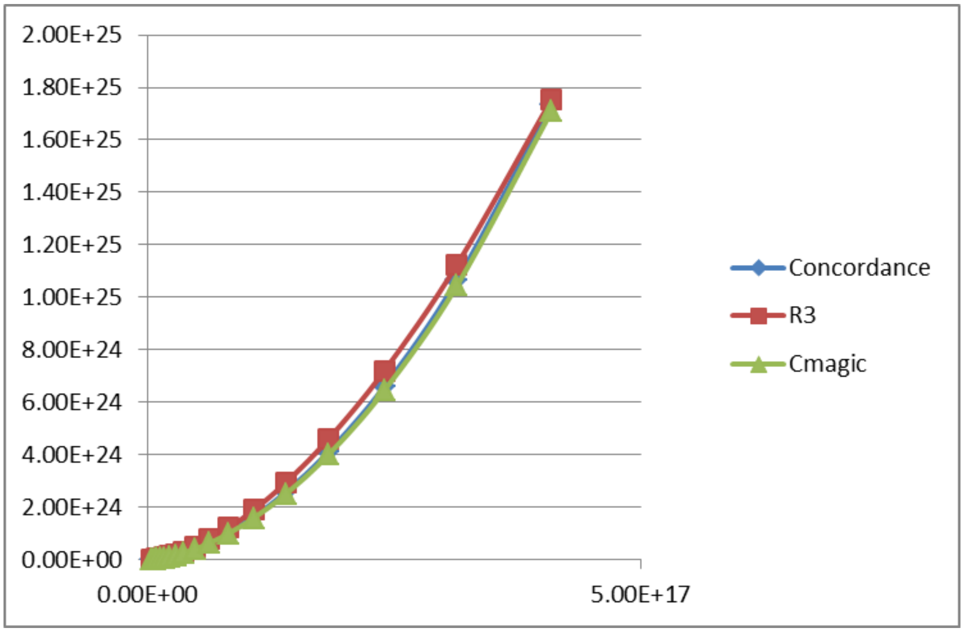
Find expansion constant H1:

Rf=7.35e-14*g^(2/3)+7.35e-14*g^(5/3)*H1*alpha/1.66

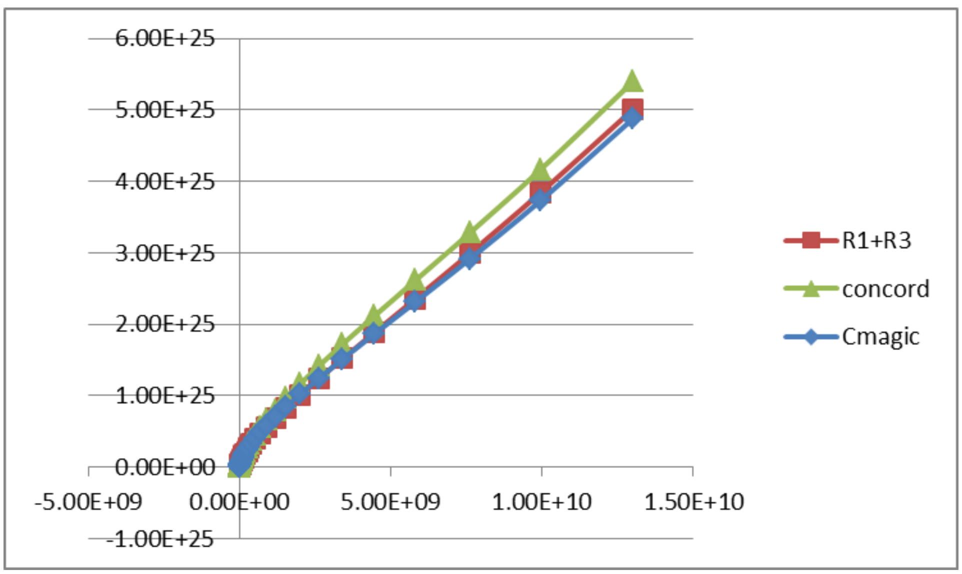
Call the first component of Rf (total radius), R1 and the second part R3. Note in the equation above that there are no unknowns in the equation R1=7.35e-14*g^(2/3) but the second part R3=7.35e-14*g^(5/3)*H1*alpha/1.666 contains alpha and one unknown, H1. Alpha is known but H1 must be evaluated from WMAP and C-Magic correlations for the second component. Time of expansion is alpha*g and in the range of 13 billion years, we look at H1. A "Hubble's constant" H1 can be calculated for R1 expansion only and its value is 2e-18/sec. If this value is used as the unknown H1 the resulting expansion curve compares favorably with both the WMAP concordance model and the Cmagic model as shown below [1],[3]. Using these values the equation for R3 is: R3=7.35e-14*g^(5/3)*2.0e-18*0.053/1.666.

R is calculated with increasing G until overall H is 2.3e-18. The match gives R= 5.3e25 meters at 4.08e17 seconds (14 billion years). R3 is 0.30 of the total radius but of course expanding faster (power is 5/3).

Expansion Comparison



With all the unknowns identified, the results can be compared with the concordance and Cmagic models.



Gravity in expanding space

Universe size space

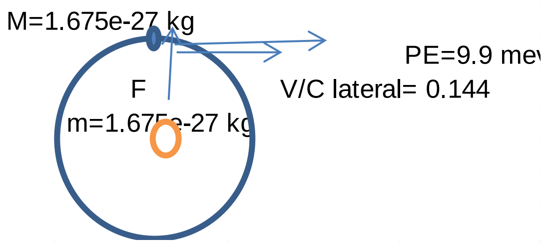
Note: Big G below stands for gravitational constant, not time ratio. The gravitational constant G=rV^2/M depends on r, V^2 and M, but V and r both change as the universe expands.

F=GMM/r^2		M is central mass, M orbits		
F=MV^2/r=GMM/r^2		G is the gravitational constant		
MV^2=GMM/r		V is velocity around central mass		
G=rMV^2/MM				
G=rV^2/M				
r=GM/V^2				
V=(GM/r)^.5				

The following diagram describes expansion of one cell. The orbital kinetic energy (9.83 mev) causes lateral velocity V/C=0.147. Expansion is upward in the diagram below and is caused by time and expansion kinetic energy. Outward inertial force M V^2/r balances the gravitational force F=GMM/r^2 between the two particles of mass 938.27 mev (1.67e-27 kg).

				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

Proton size space



Using inertial force, the gravitational constant G can be calculated at the size of the proton:

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

Proton + elect	6.6746E-11	0.00004	calculated accuracy
Published PDG	6.6743E-11	0.0001	published accuracy

Note the factor exp(90) is explained in reference 1. The gravitational constant G is held constant by the values r and M in the equations above, since V, r and M fix the geodesic.

Making proton size space into universe size space

The universe will be considered as expanding cells surrounding protons. Using WMAP data, reference 1 estimated that there are approximately exp(180) protons (reviewed later). In three dimensions each radius will be multiplied by exp(60) to estimate the full radius. The reason to consider the universe as many expanding cells is that the proton and its associated gravitational orbit (described in reference 1) define space at the proton level. The other reason to do this is that it places protons in the universe in a uniform manner. The universe is known to be very uniform overall but of course the protons can move around in space.

Radius of each cell rcell=r*g^(2/3) +r*g^(5/3)*H*alpha/1.666
Lower case r in the equation above becomes universe size space (R) when rcell is multiplied by exp(60).

How orbital kinetic energy falls as space expands

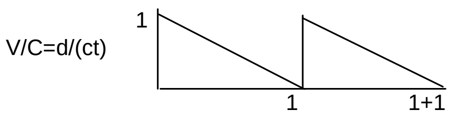
The following analysis shows what happens to orbital kinetic energy as G=rV^2/M remains constant and r expands to R. Lateral velocity of the orbiting proton V falls to v as r becomes R.

	space		fundamentals				
	RV^2/(M/g)	G=G	rv^2/(M/g0)				
	But the universe expands and r=1e-14 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	10.15	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)		

The result is that orbital kinetic energy falls in proportion to expansion.

The geodesic

The geodesic is the space-time curvature partially dependent on gamma (g) that matches the orbit in a way that no forces are experienced by a particle on the geodesic. The equations for the geodesic are from relativity.



gamma (g)=t/T=tc/cT

This diagram repeats with time flow 1,2,3 etc. ⟶
As it repeats, the universe expands

gamma represents a shift in a time ratio (t/T)
V/C represents a shift in the distance ratio
Defined orthagonally:
(V/C)^2+(g)^2=1
(sides make a right triangle)
This leads to the famous Einstein relationship:
g=(1-(v/c)^2)^.5 v/c=(1-(g)^2)^0.5
1=1/g*((1-(v/c)^2)^.5
(1/g)^2(1-(v/c)^2)=1
(1/g)^2-(1/g)^2(v/c)^2=1
(1/g)^2=1+(1/g)^2(v/c)^2
(m/g)^2=(m)^2+(m/g)^2(v/c)^2
(m/g)^2c^4=m^2c^4+(m/g)^2v^2c^2
(mc^2/g)^2=(mc^2)^2+(m/g)^2v^2c^2
With p=momentum, E=m'c^2 and m'c=p below
E^2=(mc^2)^2+p^2c^2

Comparing the proton scale geodesic to gravity

Our understanding of gravity is not complete until we see how the geodesic changes in expanding space. The understanding given by the theory of general relativity was that the path is a geodesic (R) when the particle does not feel forces (equivalency principle). However, it is possible that the position and velocity of a particle does not place it on the geodesic. With M constant, R depends on velocity in the geodesic equation, but gamma (g) is also dependent on V.

Geodesic radius: r=GM/V^2

v/c=(1-(g)^2)^0.5

G=rV^2/M	
G=rC^2(V/C)^2/M	
(V/C)^2+(g)^2=1	
(V/C)^2=1-(g)^2	
G=r/MC^2(1-g^2)	

In the equation above one can see that a very specific relationship between r and gamma must be maintained to be on the geodesic radius. For example, standing here on earth our velocity is too low to be in orbit. The radius that would be determined for a Newtonian orbit does not match the geodesic radius. Our radius is too curved for our velocity (it is determined by the radius of the earth) and we are being accelerated by the equation a=G

M earth/R earth^2. If we could gain about 5000 meters/sec (and go above the earth to keep from hitting things) we could attain an orbit that would match the geodesic and we would not feel 9.75 m/sec^2 of acceleration (see heading below "Using the geodesic in universe size space).

Relationship between Quantum Scale Gravitational Fundamentals and Universe Size Space

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 r represent the radius of each small cell and R represent the same surface area of one large sphere containing exp(180) cells. Position a proton on the surface of each cell (and one in the center?). The total energy will be that of 1 (or 2) 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 V is proportional to R^3 and this is equal to small 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 be done 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. This may be surprising. 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. However, gravity is known to be the geometry of space time. It is reasonable that there might be a simple explanation at a small scale that scales through geometry. One should note that this would allow gravity to be defined at a low radius, low energy scale and solve many problems with “quantum gravity”.

The geodesic in an expanding universe

The following table puts the derivations above into action. There are many results in tables below for the start of expansion and the end of expansion. The simulation starts at the fundamental radius and progresses to the right as time advances. The time axis is dimensionless (starts with 1) but is also shown in seconds. Note primarily that the calculated gravitation constant G is constant throughout expansion. The second table shows that the inertial force and gravitational attraction are balanced with the same radius R. This indicates that the R is the geodesic radius. There are slight differences at the beginning due to effects of g, but forces are balanced throughout the majority of expansion. This shows how G remains substantially constant throughout expansion. I suspect that this might not be true in cosmological calculations that do not use this cellular approach.

Expansion Table (first 3 time steps)

alpha (initial time in sec)		0.0538	Start	45=LN(0.0538/1.54e-21)			
logarithm used to increase time (LN)				45	45.2724	45.5168	45.7612
time--seconds		EXP(LN)*1.54e-21	time	0.053845966	0.070705792	0.090281	0.115275797
		1.54E-21	**1.54E-21**	1.54135E-21	1.54135E-21	1.54E-21	1.54135E-21
g time ratio	1	time/alpha	1	1	1.313112141	1.676654	2.140843692
		2 pi R/C	1.54E-21				
Cell radius	**7.35E-14**	**R=R1+R3**	**7.35E-14**	**7.35E-14**	**8.82E-14**	**1.04E-13**	**1.22E-13**
		R1	7.35E-14	7.3543E-14	8.819E-14	1.038E-13	1.222E-13
		R3		4.52E-33	7.11E-33	1.07E-32	1.61E-32
R universe	5.03605E+25	(R1+R3)*exp(60)	8.39868E+12	8.39868E+12	1.00712E+13	1.19E+13	1.39509E+13
	938.27	mass mev	938.272	938.272	938.272	938.272	938.272
0.987	0.9897	gamma (g)	0.9897	0.9897	0.9914	0.9927	0.9938
ke orbit	9.781270135	mev	9.781270135	9.781270135	8.16	6.92	5.87
V/C orbit	0.1433		0.1433	0.1433	0.1310	0.1208	0.1113
velocity	3.00E+08	m/sec	4.30E+07	4.30E+07	3.93E+07	3.62E+07	3.34E+07
Fgravity (nt)	1.69E-36	F=M V^2/R/exp(90)	3.44E-38	3.44E-38	2.40E-38	1.73E-38	1.25E-38
G at end	6.678E-11	G=F/M^2*R^2/exp(9	6.65E-11	6.65E-11	6.66E-11	6.67E-11	6.67E-11
G at end	6.6743E-11	G=rV^2/M/exp(90)	6.57E-11	6.57E-11	6.60E-11	6.61E-11	6.62E-11
G at end	6.678E-11	G=r/M*C^2*(1-g^2)/e	6.6434E-11	6.6434E-11	6.6605E-11	6.6622E-11	6.6645E-11

Expansion table (last few time steps)

R universe is estimated to be about 5e25 meters at 13 billion years. This is dependent also on the cosmological constant calculation (R3 below). When the slope of the integration ends we would look for H to be the measured value 2.3e-18/sec. It does in the calculation shown below.

alpha (initial time in sec)		0.0538 ⟵	Start	45=LN(0.0538/1.54e-2	Last few steps	⟶	~~NOW~~ ⟶		⟶
logarithm used to increase time (LN)			45	45	88.0144	88.2588	88.5032	88.7476	90
time--seconds		EXP(LN)*1.54e-21	time	0.053845966	2.58E+17	3.3E+17	4.21069E+17	5.38E+17	1.88107E+18
		1.54E-21	**1.54E-21**	1.54135E-21	1.54E-21	1.54E-21	1.54135E-21	1.54E-21	1.54135E-21
g time ratio	1	time/alpha	1	1	4.8E+18	6.12E+18	7.81987E+18	9.98E+18	3.49343E+19
		2 pi R/C	1.54E-21				Now		
							1.483E+03		
Cell radius	**7.35E-14**	**R=R1+R3**	**7.35E-14**	**7.35E-14**	**2.84E-01**	**3.58E-01**	**4.58E-01**	**5.94E-01**	**2.83E+00**
1.395E-18		R1	7.35E-14	7.3543E-14	2.092E-01	2.462E-01	2.897E-01	3.410E-01	7.859E-01
		R3	7.35E-14	5.47E-33	7.46E-02	1.12E-01	1.68E-01	2.53E-01	2.04E+00
R universe	5.23232E+25	(R1+R3)*exp(60)	8.39868E+12	8.39868E+12	3.24E+25	4.09E+25	5.23232E+25	6.78E+25	3.22831E+26
							3.31E+25		
	938.27	mass mev	938.272	938.272	938.272	938.272	938.272	938.272	938.272
0.987	0.9897	gamma (g)	0.9897	0.9897	1.0000	1.0000	1.0000	1.0000	1.0000
ke orbit	9.781270135	mev	9.781270135	9.781270135	2.51E-12	1.99E-12	1.55E-12	1.20E-12	2.52E-13
V/C orbit	0.1433		0.1433	0.1433	3.40E-12	2.89E-12	2.46E-12	2.09E-12	9.06E-13
velocity	3.00E+08	m/sec	4.30E+07	4.30E+07	21.92	19.51	17.25	15.15	6.94
Fgravity (nt)	1.69E-36	F=M V^2/R/exp(90)	3.44E-38	3.44E-38	2.32E-63	1.46E-63	8.90E-64	5.29E-64	2.34E-65
G at end	6.678E-11	G=F/M^2*R^2/exp(9	6.65E-11	6.65E-11	6.68E-11	6.68E-11	6.68E-11	6.68E-11	6.68E-11
G at end	6.6743E-11	G=rV^2/M/exp(90)	6.57E-11	6.57E-11	6.67E-11	6.67E-11	6.67E-11	6.67E-11	6.67E-11
G at end	6.678E-11	G=r/M*C^2*(1-g^2)/ε	6.6434E-11	6.6434E-11	6.6779E-11	6.6779E-11	6.6779E-11	6.6779E-11	6.6779E-11

Note that the initial orbital kinetic energy is reduced to the current value (labeled NOW) of 1.55e-12 mev. It is important to note the current geodesic radius of each cell (0.441 meters) and the current relativistic time shift (1-gamma) is very near 1.0. This combination gives the gravitational constant in terms of the geodesic for the mass of one proton. This is the curvature of space-time but velocity (17.6 m/sec) and radius (0.441 m) from the simulation above are the keys to calculating current geodesics of space-time. Proof that they characterize a geodesic is that they give the gravitation constant G.

proton size at current expansion			
rv^2/m	r is the cell radius		
r'v^2/m	r' is the proton size geodesic		
1.00E+00	gamma		
1.72E-15	1-gamma		
4.41E-01	r is the cell radius		
4.410E-01	r' is the proton size geodesic (m)		
17.58	meters/sec		
1.67E-27	kg		
6.67E-11	0.44*17.58^2/1.67E-27/EXP(90)		

Using the geodesic in universe size space

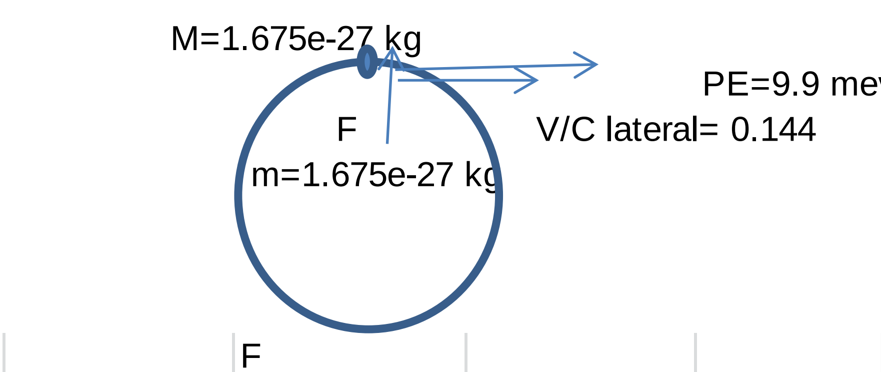
Calculating the geodesic in large space depends on velocity, mass and radius. It has often been stated that mass bends space and bodies follow the curvature. The table above shows equality between the proton size Newtonian radius and the proton size geodesic radius. The work below shows how the geodesic is calculated for universe size space and demonstrates that the calculated geodesic for an earth orbit matches the Newtonian orbital radius. This calculation depends on the values above (r=0.44 m,V=17.8 m/sec and 1.67e-27 kg).

		Mass (earth)	5.98E+24		0.441	This is an intrinsic radius due to expansion		
		earth R (m)	6378100					
	a=gm/r^2	m/sec^2	9.80					
	m	orbit R (m)	6.39E+06					
	a=gm/r^2	m/sec^2	9.75					
		V=(aR/m)^.5	7897.71	meters/sec	17.56	velocity required to achieve geodesic		
			9.75E+00			but the particles we experience have		
		Scaling the geodesic to universe sized space				lost this so they give us g		
			space		proton size at current expansion			
R is the universe size R			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 proton size geodesic		
			R'=r*('v/V)^2*(M/m)*1/exp(90)					
					1.00E+00	gamma		
					1.72E-15	1-gamma		
	R earth orbit (meters)		6.39E+06		4.41E-01	r is the cell radius		
	R' geodesic (meters)		6.40E+06		4.410E-01	r' is the proton size geodesic (m)		
	Velocity of orbit (m/sec)		7.90E+03		17.58	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	0.44*17.58^2/1.67E-27/EXP(90)		

Note that the proton size calculation for G contains a divisor of 1/exp(90) explained above under the heading "Relationship between Quantum Scale Gravitational Fundamentals and Universe Size Space" and references [1][2][6].

Expansion kinetic energy and potential energy

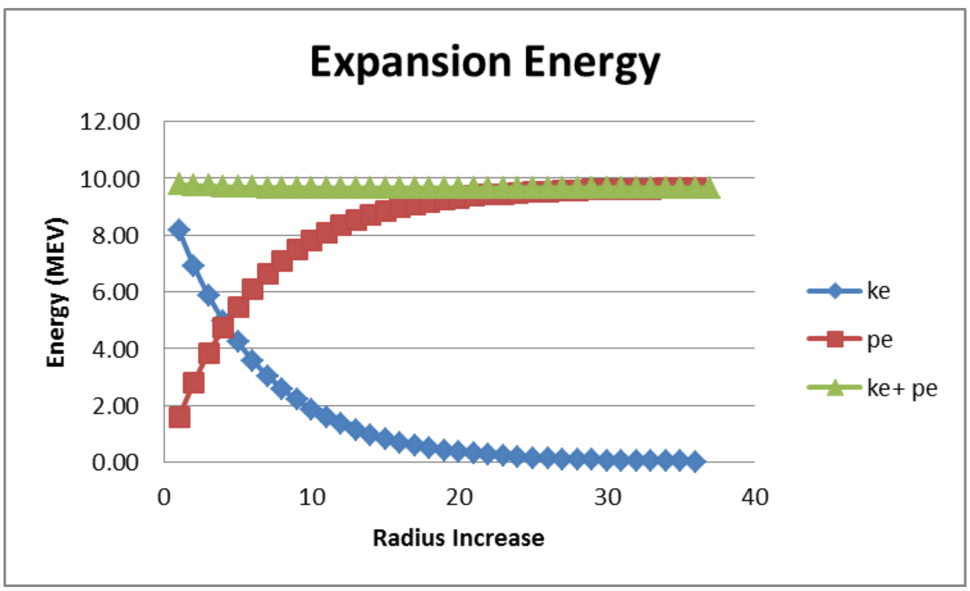
The first line of the derivation (reference 4) for the 8/3 pi G rhoc equation is kinetic energy (ke) = potential energy (pe). Since expansion is well characterized by WMAP (and agrees with the author's calculated expansion), one can simply calculate expansion kinetic energy and expansion potential energy as a function of time and determine if initial ke is in fact turned into final pe. A calculation can be carried out for the expansion of each cell containing one particle and the following diagram:



Comparison of expansion kinetic with potential energy in the author's expansion model is shown below.

alpha (initial time in sec)		0.0538	← Start	45=LN(0.0538/1.54e-2	Last few steps		NOW		→	
logarithm used to increase time (LN)			45	45	88.0144	88.2588	88.5032	88.7476	90	
time--seconds		EXP(LN)*1.54e-21	time	0.053845966	2.58E+17	3.3E+17	4.21069E+17	5.38E+17	1.88107E+18	
		1.54E-21	**1.54E-21**	1.54135E-21	1.54E-21	1.54E-21	1.54135E-21	1.54E-21	1.54135E-21	
g time ratio	1	time/alpha	1	1	4.8E+18	6.12E+18	7.81987E+18	9.98E+18	3.49343E+19	2.217E-18
		2 pi R/C	1.54E-21				Now			
							1.483E+03			geodesic
Cell radius	**7.35E-14**	**R=R1+R3**	**7.35E-14**	**7.35E-14**	**2.84E-01**	**3.58E-01**	**4.58E-01**	**5.94E-01**	**2.83E+00**	2.217E-18
1.395E-18		R1	7.35E-14	7.3543E-14	2.092E-01	2.462E-01	2.897E-01	3.410E-01	7.859E-01	1.395E-18
		R3	7.35E-14	5.47E-33	7.46E-02	1.12E-01	1.68E-01	2.53E-01	2.04E+00	
R universe	5.23232E+25	(R1+R3)*exp(60)	8.39868E+12	8.39868E+12	3.24E+25	4.09E+25	5.23232E+25	6.78E+25	3.22831E+26	2.217E-18
							3.31E+25			
	938.27	mass mev	938.272	938.272	938.272	938.272	938.272	938.272	938.272	
0.987	0.9897	gamma (g)	0.9897	0.9897	1.0000	1.0000	1.0000	1.0000	1.0000	
ke orbit	9.781270135	mev	9.781270135	9.781270135	2.51E-12	1.99E-12	1.55E-12	1.20E-12	2.52E-13	
V/C orbit	0.1433		0.1433	0.1433	3.40E-12	2.89E-12	2.46E-12	2.09E-12	9.06E-13	
velocity	3.00E+08	m/sec	4.30E+07	4.30E+07	21.92	19.51	17.25	15.15	6.94	
		FINAL PE Mev	v=dr/dt=3/2*k/t	1.1025E-12	6.58E-12	7.05E-12	7.77E-12	8.83E-12	1.79E-11	KE (mev)
Pe+Ff Dr/2	Ff=E R0/r^2	10.73	0	0.00E+00	1.07E+01	1.07E+01	1.07E+01	1.07E+01	1.07E+01	
Pe+Fg dR/2	Fg=GmM/r^2	9.68	0	0.00E+00	9.68E+00	9.68E+00	9.68E+00	9.68E+00	9.68E+00	
Pe+Fi dR/2	Fi=MVo^2/r	9.66	0	0.00E+00	9.66E+00	9.66E+00	9.66E+00	9.66E+00	9.66E+00	

The kinetic energy per particle is 9.78 mev at the beginning of expansion. The calculations for potential energy compare three alternate forces resisting expansion. The correct resisting force is the inertial force Fi=MV^2/R where V is the lateral orbital velocity V/C=0.14 that decreases with increasing R. Final potential energy (integrated over expansion but finalized at the column labeled NOW) is 9.66 mev. The ratio of initial kinetic energy to final potential energy is 0.99. In other words all of the initial kinetic energy is converted to potential energy at the end of the expansion history shown. The following plot shows how kinetic energy is converted to potential energy as each cell expands, leaving overall energy unchanged.

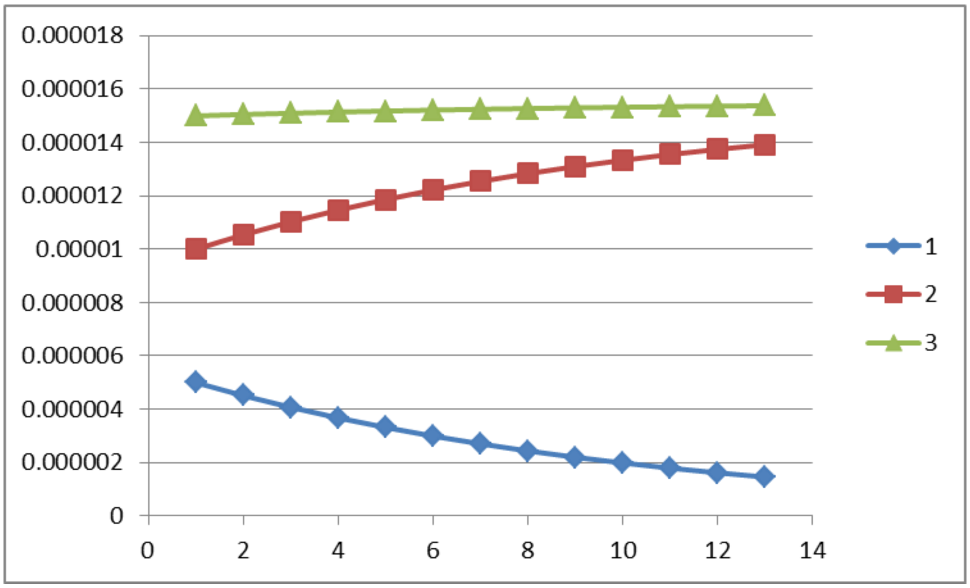


The above plot is based on the assumption of one proton mass per cell.

Comparison and analysis of the equation H=(8/3 pi G rho)^.5

The equation H=(8/3 pi G rho)^.5" can also be written v^2=8/3 pi G rho *r^2. Hubble's constant is simply v/r and the final v/r has been carefully measured as 2.3e-18/sec.

Correction for lateral velocity:
The following "demonstration calculations" are for a body with kinetic energy circling a central body and potential energy is the change from the central force outward along the radius. These calculations show that as kinetic energy falls, potential energy increases with the total remaining the same. KE is ½ mv^2 but PE =1/2 F dR. Note that the ½ in potential energy is required for the exchange of kinetic energy for a circling object.



End of expansion

Note that the discussion below is for the author's replication of the accepted expansion curves and a final Hubble's constant of 2.3e-18/sec (v^2=1.03e-36 m^2/sec^2).

The calculated value v^2 value 2.6e-37= 4/3 pi G *rho r^2 agrees and gives the same value as v^2 from the author's energy analysis. Rho for this calculation is based on one proton per cell and an initial lateral kinetic energy of 9.8 Mev.

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

One proton per cell								
Expansion curves that match concordance model				expansion ratic	6.23E+12			
Final Rf=R1+R3=3.3e25+1.92e25		5.232E+25						
	Final KE	Corresponding	H=v/Rf	Corresponding	density/critical	R1 KE	R3 KE	R1+R3 KE
	(Mev)	v^2 m^2/sec^2	1/sec	density (kg/m^3)		converted to P	converted to P	converted
Author's KE	1.55E-12	2.44E-37	2.30E-18	4.15E-27		9.9	5.77E-12	9.90E+00
(9.9 mev initial)								
v^2=(4/3 pi G rho)*r^	1.55E-12	2.434E-37	2.30E-18			9.9		
Concordance	7.08E-12	1.11047E-36	2.30E-18	9.467E-27	0.439	9.9	34.19	44.09
model	(calculated)			(critical)				

There is a discrepancy between the accepted Hubble's v^2 (1.1e-36 m^2/sec^2and 2.4e-37 m^2/sec^2 that must be explained. Recall that the WMAP conclusion was the 0.73 of the total energy was missing and a search for "dark energy" was launched. This discrepancy can also be stated in terms of a critical density (9.5e-27 kg/m^3) that corresponds to the accepted Hubble's constant. The one proton per cell density is only 1.67e-27 kg/vol=4.15e-27 kg/m^3 (the density in the column labeled NOW). WMAP analysis explained this discrepancy by stating that 0.27 of mass in the universe was missing. In other words, they concluded that one proton per cell is too low by about a factor of 0.27 at the end of expansion with rho based on R equal to 5e25 meters. The author's analysis reproduces the discrepancy and the table above describe the discrepancy in terms of kinetic energy, v^2, density and v/R (Hubble's constant) since they are related.

Explaining the discrepancy

The formula 8/3 pi G rho r^2 assumes that the driving force for expansion is kinetic energy (density and pressure) throughout expansion. When time to the (2/3) power is used for the expansion curve, kinetic energy is the cause. The author's R1 expands as the power (2/3) but the R3 portion of the expansion curve expands as (5/3). The R3 portion may be kinetic energy driven but a need exists to analyze the kinetic energy change. When this calculation was done, it was found that R3 (cosmological constant) type of expansion requires very little kinetic energy (on the order of 6e-12 out of 9.8 mev). The reason for this is R3 is very low in the first part of expansion when the resisting force is high. When R3 becomes significant, the resisting force (mV^2/R) is low because V is low and R is high. The table above shows a back calculation for the energy consumed for R3 if it were to follow the incorrect power^(2/3). The energy would be 34 mev instead of the correct 7e-12 mev.

In the author's view, there is no reason to use the equation 8/3 pi G rho r^2 since the second part of expansion (the cosmological constant part of expansion) follows a different energy relationship and the resisting forces are low while R3 is low. The problem is the calculation of critical parameters from rho critical.
Note that these calculations are for one small cell expanding. This is a different approach from conventional cosmology but the result is exactly the same. The expansion curves match and H=2.3e-18 /sec at the current point in expansion at 13 B years. In the author's view the author's fundamental R defines space, time and expansion correctly, including kinetic and potential energy.

The cellular model gives a Euclidian geometry by duplication of each cell and the geometrical similarity of many small cells and one large sphere. In the cellular model, initial lateral velocity is converted to potential energy while geodesics are maintained in a way that the gravitational constant remains the same throughout expansion.
Note that the kinetic energy to expand each cell is on the order of 9.8 mev. Particles that fall into orbits as mass accumulation occurs often have kinetic energy/particle on the order of several mev. Once they accumulate and leave the geodesic particles they fall toward each other and potential energy is once again converted to kinetic energy.

The model above identifies an orbit that establishes and maintains gravity at G. That orbit is established when 20.3 mev protons fall into an orbit with 9.8 mev of kinetic energy and 10.15 mev of potential energy. That orbit has a high velocity (0.14C) that gives an outward centrifugal force that balances the crushing F=GMM/R^2 at small r. As the smaller kinetic energy of expansion and time drive expansion, r becomes larger but the kinetic energy of 9.8 mev quickly falls and is converted to potential energy. It is this energy that we see when orbits are established around galaxies and planetary systems. It is also this energy that provides pressures and temperatures high enough to initiate fusion.

Baryonic Matter

WMAP used the difference in time between two important transitions to determine the size of the acoustic spots detected by radiometers. Those two transitions were 1) equality of energy and mass when acoustical waves develop and 2) decoupling where the universe becomes transparent as the plasma clears. The following table is from Reference 2.

		Equality=1, Decoupling=.5 and h=2.302e-18 are the matches required.									
						1.000		t=alpha*G		1.90E-18	"Universe"
						Expanded	R1			R2	R1+R2
				G	G^(4/3)	radius per	Time^2/3	Time (sec)	Time (years	Time^(2)	
						particle (m)	meters			meters	meters
	End of inflation		1	1.00E+00	1	**7.3543E-14**	8.3987E+12	5.385E-02	1.707E-09	**8.3987E+12**	1.6797E+13
R1+R2 z	(progress at 46 years)		28	1.44626E+12	1.63554E+16	**9.4053E-06**	1.0741E+21	7.788E+10	2.469E+03	**1.0379E+14**	1.0741E+21
3191.3374	Equality	1.310E+00	32.06	8.38458E+13	3.670E+18	**1.4088E-04**	1.6089E+22	4.515E+12	1.432E+05	**8.2849E+16**	1.6089E+22
1090.9907	Decoupling	2.7929E+00	33.67	4.19464E+14	3.13998E+19	**4.1210E-04**	4.7062E+22	2.259E+13	7.162E+05	**1.2123E+18**	4.7064E+22
0.053846	Now	2.2711E-18	h	8.199E+18	1.65339E+25	**2.9904E-01**	3.4151E+25	4.41504E+17	1.400E+10	**1.7195E+25**	5.1346E+25
		2.301E-18	h wmap	8.281E+18	1.67547E+25	**3.0103E-01**	3.4378E+25	4.459E+17	1.414E+10	**1.7483E+25**	5.1861E+25

		0.025		8.61952E-11	
"Universe"		2.393E-28			
R1+R2	Temperatu	Mass	Radiation		Saha
		density	density		
meters	T=Rnow/R*2.725				
1.6797E+13		1.795E+10			
1.0741E+21	1.303E+05	6.8658E-14		1.35E-12	
1.6089E+22	8696.4	2.0427E-17		2.68E-17	9.4582E-15
4.7064E+22	2972.9	8.1613E-19		3.66E-19	2.7929E+00
5.1346E+25	2.7	6.2849E-28		2.58E-31	
5.1861E+25	2.7	6.0995E-28		2.48E-31	

Mass density is compared with radiation density and when the ratio is close to unity, equality has occurred and acoustic waves remain undampened. In the table above mass density of about 2e-17 kg/m^3 matches the radiation density. The mass density in the above calculation is based on Mu/volume (kg/m^3)=exp(180)*(1.67e-27/7)/(4/3*pi()*5e25^3). Note that the equality mass value is 1/7 of the proton or about 2.4e-28 kg but again review the following excerpt from the proton mass model of reference 1:

Mass	Difference ke	Strong residual ke
mev	mev	mev
101.947	641.880	
13.797	78.685	
13.797	78.685	
		10.151
0.000	0.000	-0.671
129.541	799.251	**938.272013**

Note that there is actually a mass of 129 mev (2.43-28 kg) in each proton. The remainder, making up the total proton mass of 1.67e-27 kg is kinetic energy. True mass matches radiation, not mass plus kinetic energy.

Conclusion

Using a cellular approach to estimate the size of the universe allows one to understand what space is, what time is and how expansion occurs, including the origin of the kinetic energy that drives expansion. Equations were developed based on space expanding as time to the (2/3) power and a cosmological constant integration yielding a second expansion term proportional to time to the (5/3) power. The results agree with the WMAP expansion curve.

The cellular approach indicates that there is one protons/cell giving us the cosmological principle. Space is created by exp(180) cells of about 7.35e-14 meters each expanding to universe size space.

An approach to calculating the geodesic radius was presented for both proton size space and universe size space which shows that the geodesic changes appropriately during expansion to keep the gravitational constant G constant. The geodesic radius matches big R (the "radius" of the large volume) as space expands.

The kinetic energy of expansion and the conversion to potential energy was examined with the cellular approach. From the author's analysis, there is enough kinetic energy to "lift" 1 proton to the final cell radius 0.44 meters against a resisting force based on F=mV^2/R for the expanding geodesic. The second component of expansion consumes a negligible amount of kinetic energy. The author believes that dark matter estimates from the equation containing 8/3 pi G rho cannot be relied upon. Based on WMAP reanalysis, equality (of matter and energy at z=1080) was achieved with the true mass portion (129.5 mev) of exp(180) normal protons and the volume calculations from the expanded radius.

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4. Peebles, P.J.E., Principles of Physical Cosmology, Princeton University Press, 1993.
5. A. Conley, et al, (THE SUPERNOVA COSMOLOGY PROJECT), Measurement of Omega mass and Omega lambda from a blind analysis of Type1a supernovae with CMAGIC.
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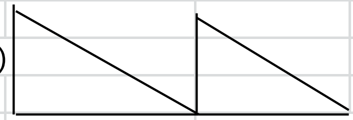
Appendix 1 In a relativistic universe is anything constant?

Why is the speed of light a constant?

1

V/C=d/(Ct)



1 1+1

gamma (g)=t/T=tC/CT

d in the diagram above is distance

Light is shifted totally into the vertical axis at C/C.

Light energy is not lost as time ticks to 1, 1+1, etc.

In a moving time frame it travels to the next 1

on the horizontal axis.

The vertical axis can also be written V=dC/(Ct)

At the next 1 light travelled dC*t/(Ct)*t=Ct=d

So in time t light travelled d and d/t=C

The vertical axis is d

The horizontal axis is t

Light speed is just the ratio between dimensions that

are equal and orthogonal.

Finally, 4 dimensional space is described by Minkowki. Minkowski space would be slightly changed by the general theory of relativity since curvature is not part of the Minkowski analysis.