Gene H. Barbee
September 2014

Cosmology, Thermodynamics and Time

Abstract

The first law of thermodynamics is straightforward. It states that energy can be converted from one form into another but not created or destroyed. The author's work on the subject indicates that net energy is zero [6][7][13] but separated into two different types of energy that balance one another. The second law is not as straightforward. A quantity called entropy describes the probability of energy states for systems with many particles. The second law states that more probable energy states become filled over time and energy differences that can be used to carry out work become less available. The source of a high original state that can continually "run down" has been difficult to identify.

There is a strange situation in fundamental physics regarding time. Well respected physicists [Julian Barbour for example] point out that all quantum mechanical equations are cyclical with time. Common sense tells us that time advances and tension exists between fundamentals and what we observe. This situation extends to fundamentals of space as well as fundamentals of time. Special relativity and curvature of space time is known to be the source of gravity at the large scale but the author's approach to quantum gravity is not generally known [7]. Further, the concept that velocity is relative seems to be accepted but velocity is related to kinetic energy that is conserved.

The author uses a cellular model that describes gravity, space, time, expansion, kinetic and potential energy at the quantum level [6][7]. Using cosmology as a platform, the present paper explores time and the thermodynamic laws. It concludes that elapsed time enters physics through cosmology. If we believe that the universe expands we must also believe that time advances. Further, the gravitational coupling constant converts quantum behavior to large scale behavior. Although pressure expands the universe, gravitational accumulation begins to dominate locally. The expanded state and the many available thermodynamic states available as particles fall related to gravitational accumulation explain how everything can "run down" as time progresses.

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

Cellular Cosmology

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

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

	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)			
Large space G		cellular size G		
RV^2/M	G=G	rv^2/m	r is the cell radius	
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)				
	RV^2/M=	r*exp(90) *v^2/(m*exp(180))		
		G=(r *v^2/m)*1/exp(90)		

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

Fundamentals of space and time

Reference 6 identifies the source of the gravitational constant at the quantum level. The gravitational field energy 2.683 MeV from the Proton Mass model (Appendix) underlies the quantum mechanics for a fundamental radius r and a fundamental time t. In the equation below, the value 1.93e-13 meters-MeV is HC/(2*pi) where H is Heisenberg's constant 4.136e-21 MeV-sec and C is light speed, 3e8 meters/sec. The radius r is the radius of a quantum circle for gravity with 2.68 MeV field energy.

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

Gravitation

If radius r for the conventional physics (Wiki) force calculation is 7.35e-14 meters, as proposed above, the force in Newtons (NT) is:

F=(5.9068e-39)*hC/R^2				
	hbar		6.5821E-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				
3.453E-38	NT			

This result agrees with the simple Newtonian force for particles separated by 7.35e-14 meters.

F=Gm^2/R^2 (NT)=6.67428e-11*1.6726e-27^2/7.35e-14^2=3.452e-38 NT where m is proton mass and R is meters.

Using values for the proton mass model that the author believes unify nature's forces (6), the gravitational constant is calculated below and agrees with the published constant, G=6.674e-11 NT meters^2/kg^2. The gravitational coupling constant 1/exp(90) derived above appears in the fundamental calculation for the inertial force in a cell that has cosmological properties.

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)^0.5			0.1428
R (meters) =(HC/(2pi)/(E*E)^0.5			**7.354E-14**
F (NT)=M/g*(v/C*C)^2/R/exp(90)			3.452E-38
HC/(2pi)=1.97e-13 mev-m			
Calculation of gravitational constant G			
Inertial Force=(M/g*C^2/R)*1/EXP(90)			3.452E-38
Radius R (Meters)			7.354E-14
Mass M (kg)			1.673E-27
G=F*R^2/M^2=NT m^2/kg^2			**6.674E-11**
Published by Partical Data Group (PDG			6.674E-11
PE fall MeV			19.34
Ke fall MeV			9.720
F =PE/R *1.6022e-13 NT			3.4524E-38
PE/R=(19.34*1.603e-13/7.3543e-14/exp(90))			

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

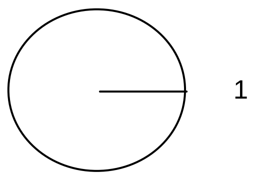
Defining gravity, time and distance together allows nature to use the general theory of relativity at the quantum level. The coupling constant 1/exp(90) scales the quantum level to the large scale we observe around us. This is called cellular cosmology.

Relative Motion

Some would point out that special relativity indicates that simultaneity is dependent on motion and therefore, since motion is relative, time is relative. They use the Lorentz transformation to calculate how time is changed by velocity relative to some other particle. If velocity is relative there is tension between this statement and kinetic energy. How can the first law of thermodynamics be satisfied (no destruction of energy) if velocity is relative but kinetic energy is not relative? Particles have kinetic energy related to conservation of PE+ke=9.72 MeV/particle. Velocity can be calculated from kinetic energy. However, there is a new understanding of space and time in cellular cosmology. What must be considered is that general relativity extends to the quantum level and is united with special relativity. We are walking around in space that has expanded from the quantum level and rules that exist at the cellular level apply to large scale space. Below we review the rules:

Nature's Rules

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



Energy is defined by a quantum circle
E=H *1/t where C=3e8 m/sec and t is time around the circle
H is Heisenberg's constant
t=H/E
Time is measured around a circle of radius r
t=2pir/C
d=2pir
The speed of light is the ratio distance/time
C=d/t

2. The fundamental radius of a cell is given by the proton model field energy 2.68 MeV and time to move around the cell circumference is 2 pi R/C.

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

3. Applying these fundamentals to point 1 above: "At the next 1 light traveled d=2piR=2*pi()*7.354e-14=4.62e-13 meters". It took t=1.54e-21 seconds and d/t=3e8 m/sec. After one cycle all energy has been passed along to the next cycle including protons because they contain the fundamentals.
4. Elapsed time enters physics through cosmology. If we believe **(r/r0)^3 increases we must believe that time advances (t/alpha)^2.** Nature counts cycles and elapsed time is cycle count*fundamental time because the universe expands. Elapsed time is the same for all cells because they are identical and none occupy a preferred position in space or time.
5. Large scale observables are related to many quantum scale cells defined by gravity. Gravity is defined at the quantum scale by the energy 9.72 MeV/particle and gravitational field energy 2.68 Mev at Radius =7.354e-14 meters with exp(180) cells. There are two types of gravitational energy (9.72 MeV=kinetic energy + potential energy). Potential energy is converted to kinetic energy as expansion occurs. The expansion equations are in the section entitled "Expansion" below. As the cell

expands from r fundamental to r’ it is not quantum because the surface contains a particle with mass.

6. All mass is associated with the surface of a cell. Mass with kinetic energy travels slower than the velocity of light. According to special relativity time also runs slow for this particle (gamma=m/(m+ke) and v/C=(1-gamma^2)^.5). Time will be 2*pi*r’/V/gamma for a particle with velocity V moving around the expanded cell circle 2pir’. The particle will traverse only a segment of the circle in time 1.54e-21 seconds. The author calls this segment time. The following example compares fundamental time with segment time during expansion.

E (MeV)		**E (MeV)**		
2.683	7.3543E-14	2.683	3.136E-12	r' cell
Velocity	3.00E+08		6.60E+06	v/C*C
			0.9998	gamma
Field side	R side	Field side	R side	
H/E	2*pi*r/C	H/E	Segment time-sec	
1.54E-21	**1.54E-21**	**1.54E-21**		
			0.0220	v/C
			2.99E-18	2*pi*r'/V/gamm
p=E/C	**8.94E-09**		0.00024202	dt=1/gamma-1
pR/h	**1.0E+00**		**2.99E-18**	2*pi*r'/V
ke*r mev-m			7.121E-13	

The quantum test pR/h=1, where p is momentum is maintained by the left side of the diagram above. H/E=4.13e-21/2.68 seconds equals 2*pi*r/C=1.54e-21 seconds (fundamental time). The right side of the diagram shows that as the cell expands from r to r’ velocity decreases. Slow segment time 2*pi*r’/V/gamma (slow segment dt is 1/gamma-1) and time 2*pi*r’/V are both longer than 1.54e-21 seconds. Large scale velocity and particle cellular velocity are identical because kinetic energy/particle is identical. At the end of each cycle (exactly 1.54e-21 sec) everything moves forward and the cell kinetic energy is maintained at the same value for the next cycle. This allows slow segment time to be additive and be a little longer (the twin paradox). Segment time is truncated at 1.54e-21 seconds and the next cycle starts with the new present (the younger twin is standing there talking to the other twin at the end of his journey).

> The twin paradox has been proven with atomic clocks in satellites. The clock that is in motion does run slower and when they are brought together they read differently. Since they are together in time and space this proves that fundamental time truncates segment time.

7. Special Relativity and General Relativity are united in cellular cosmology. This means that gravity’s constants listed below are forever related through relativity and G.

Show that gamma for General Relativity is derived
from gamma fromSpecial Relativity
(Derivation for Schwarzschild equation for cellular cosmology)
constants from gravity above:

ke	9.719690164	MeV
m	1.67262E-27	kg
m	938.272013	MeV
r	7.35432E-14	meters
G	6.67428E-11	
C	299792458	

gravitational coupling constant 1/exp(90)
gamma=m/(m+ke)
gamma=938.272/(938.22+9.72)
0.9897 gamma
dt=1/gamma-1
0.0104 dt
dt=1/((1-(v/C)^2)^.5-1
G=Rv^2/m
v=(Gm/R)^.5
dt=1/((1-G*m/(R*C^2)))^0.5-1
G=G*exp(90)
dt=1/((1-EXP(90)*G*m/(R*C^2)))^0.5-1
dt=1/((1-EXP(90)*6.7e-11*1.67E-27/(7.35e-14*3e8^2)))^0.5-1
0.0105 dt
gamma=1/(1+dt)
0.9896 gamma

ke=m/gamma-m
ke=m/(1/(1+dt))-m

dt is called time dilation in general relativity. The derivation above starts with gamma for special relativity and shows equivalence with the Schwarzschild equation that gives dt and gamma for general relativity.

8. Energy is conserved. This is the first law of thermodynamics.

Discussion of Nature's Rules

The author believes that the space we walk around in is defined by gravity at the quantum level (r=7.35e-14 meters) by cells that expanded to a present radius of about 0.55 meters/cell. In three dimensions exp(180) cells give large R=0.55*exp(60)=6.3e25 meters. Further, the author believes that the time we experience is the cycle time 1.54e-21 seconds repeated many times since the beginning. In other words, a quantum mechanical fundamental time is defined that cycles *and* counts forward (fundamental time*exp(N)). With the understanding that the large scale we observe is made of cells defined by gravity and the further understanding that fundamental time cycles, counts and moves everything forward we can simplify our understanding of nature. Further, we understand that the first law of thermodynamics is conservation of energy and totals 9.72

MeV for gravitation. The only change is that potential energy is converted to kinetic energy and back over time. Cells have a specific kinetic energy depending on their history. Ordinary mass takes more time to travel and only completes a segment of the cellular circle against the standard 1.54e-21 seconds. This cycle is established by the quantum mechanics of the gravitational field inside each proton (the proton model in the Appendix) and each proton is identical and none occupy a preferred position. All protons advance in elapsed time simultaneously ready for the next count. Each particle participates in expansion of the universe and during expansion 9.7 MeV/particle of potential energy is being converted to kinetic energy. Elapsed time is the primary variable for the expansion equations and they determine r' and how much kinetic energy has been converted to potential energy. During expansion the gravitational constant G is maintained by rv^2/m i.e., it is on a geodesic (orbit). We will call this the expansion determined geodesic.

As accumulation occurs particles always start their fall from the expansion determined geodesic. In general they fall into an obit around a central body. The large scale behavior of an orbiting particle is directly related to the small scale behavior of a cell (through 1/exp(90). A large scale geodesic is determined by G=RV^2/M. R is a measure of its potential energy and ke=1/2mV^2 is a measure of its kinetic energy. A large scale orbit is cellular radius*M/m where M is the mass of the central body and m is proton mass. Since kinetic energy/particle for large scale orbits can be determined from observations, the cellular radius can be determined from gamma. The following equations are from the Schwarzschild equations above for cellular cosmology solved for r based on knowing gamma for the moving particle.

Equation that gives cellular radius from ke

gamma=938.272/(938.272+ke)
gamma=938.272/(938.272+9.72)
gamma 0.9897
r=EXP(90)*m*G/(C^2)/((1/g)^2-1)*(1/g)
r=EXP(90)*1.67e-27*6.67e-11/(3e8^2)/((1/0.9897)^2-1)*(1/0.9897)
7.354E-14

Large Scale Orbital radius = r*M/1.67e-27

Expansion

Consider why the universe expands. Kinetic energy (ke) must be turned into gravitational potential energy (pe=Fr) over *time*. Time enters physics through cosmology! The derivation below indicates that the increasing radius of the universe and increasing time are related through expansion.

ke	pe
ke	F r

1/2M(v)^2	GMM/r
1/2M(r/t)^2	GMM/r
1/2Mr^3/t^2	GMM
1/(2GM)*r^3	t^2
(r/r0)^3 increases as (t/t0)^2	

The above derivation contains only radius and time. If we believe that expansion occurred we must believe that time advances.

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

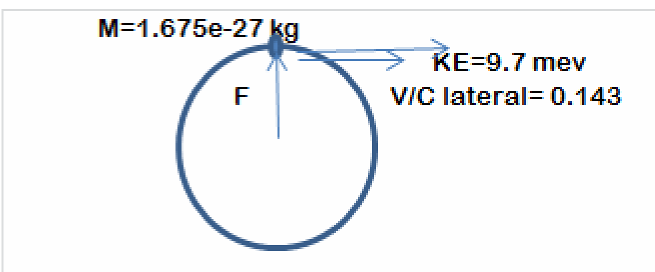
Expansion of each cell involves the kinetic energy of a proton like mass on the surface of each cell. The model's geometrical and numerically similarity allows many small cell surfaces to represent large scale cosmology.

Cell diagram

Initial cell radius is 7.35e-14 meters. Initial forces in the cell are balanced and are 3.45e-38 Newtons. With an initial kinetic energy of 9.72 MeV, the initial expansion velocity can be calculated.

Gamma (g)=938.27/(938.27+9.8)=0.9897

V/C=(1-0.9897^2)^.0.5=0.143.



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

Cell diagram showing tangential kinetic energy

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

G remains constant G=rv^2/(M)		
RV^2/(M/g)=rv^2/(M/g0)	**RV^2/M=rv^**	**9.75 ke**
RV^2*g=rv^2*g0	**RV^2=rv^2**	
(v/V)^2=(r/R)*g0/g	**(v/V)^2=(r/R)**	
(v/V)=(r/R)^.5*(g0/g)^.5		
ke=ke0*(r/R)	**Ke decreases with r**	

Kinetic Energy decreases with Expansion

Important values originate in the proton model. The model shows protons with about 20 MeV that fall into "orbits" with 9.7 MeV of kinetic energy and 9.7 MeV of potential energy. Initially the mass on the cell surface has high velocity (0.14C) that gives an inertial force equivalent to gravity. Tangential kinetic energy (diagram above) decreases directly with expansion ratio and defines an orbit that maintains the gravitational constant at G. This "orbit" is again a model since it will be shown below that temperature and pressure associated with kinetic energy drive expansion. After expansion, potential energy allows protons to fall (accelerate) toward each other and establish orbits as mass accumulation occurs. It is this energy that we see when orbits are established around galaxies and planetary systems. It is also this energy that provides pressures and temperatures high enough to initiate fusion.

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

Nomenclature

(all calculations are MKS)
t-time
g=dimensionless time=time/alpha time
Lower case r is a cell radius
Upper case R=r*exp(60)
R1 radius is first expansion component
R3 radius is second expansion component
H3 is Hubble's constant for R3

First expansion component; R1
(r/r0)^3 increases as (t/alpha)^2 (kinetic energy requirement)
r=r0*g^(2/3)
R=r0*exp(60)*g^(2/3)
r0=1.93e-13/(2.683*2.683)^.5=7.35e-14 m
R1=(7.35e-14*exp(60))*g^(2/3)

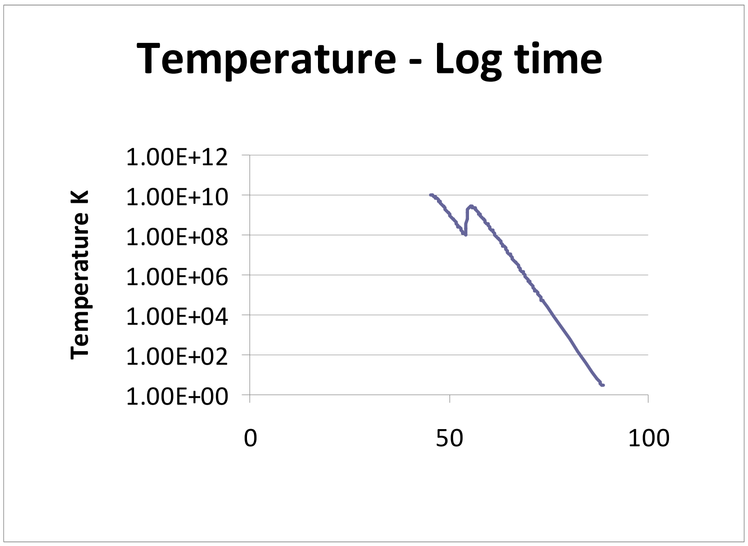
Second expansion component: R3
dr/(r*dt)=H3
dr=H3*r*dt
dr=H3*alpha*r *dg (dt=alpha dg)
dr=H3*alpha*r0*g^(2/3) *dg
r=H3*alpha*r0*g^(5/3)/1.6666
R3=H3*alpha*(7.35e-14*exp(60))*g^(5/3)/1.666

r1+r3=(7.35e-14)*g^(2/3)+(7.35e-14)*g^(5/3)*H1*alpha/1.666
R1+R3=r1*exp(60)+r3*exp(60)

Integral dr adds a late stage term that expands with time, after integration, raised to the power (5/3). The equations are consistent with the cold dark matter cosmology model described by Pebbles [4] with constants determined by the COBE, WMAP [5] and PLANCK missions.

Thermodynamics and expansion

The Boltzmann relationship T(K)=ke/(1.5*B) with B=8.62e-11 MeV/K assigns a temperature to kinetic energy. Cosmologists use the expansion ratio z to scale temperatures and the x axis is the natural logarithm 45 progressing to about 90. Large scale time progresses from exp(45)*1.54e-21=0.0538 seconds to approximately exp(88.5)*1.54e-21seconds= approximately 14 billion years presently.



The discontinuity in temperature is explained in reference 12, but the temperature is 2.73K at the current stage of expansion.

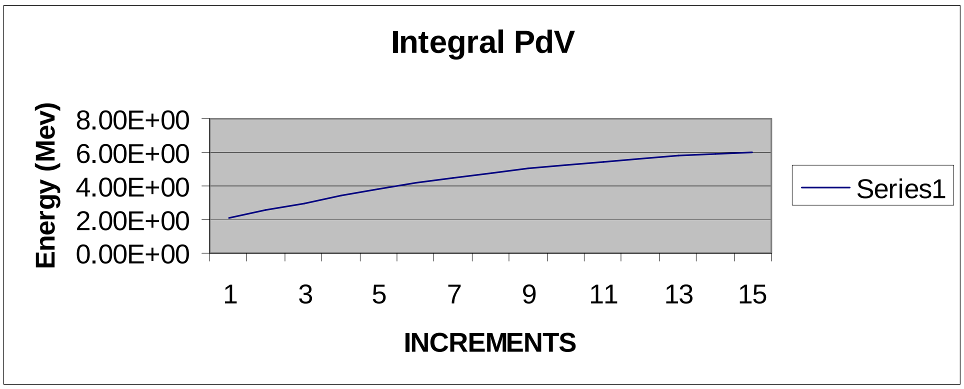
There is a critical concept at stake that needs our understanding. If the expansion kinetic energy is temperature, it is no longer limited to a surface. Particles with kinetic energy bounce off of one another and create pressure. Is it this pressure that expands the universe? Can the particles fill all of space or are they quantum like and limited in their travel. If we calculate what a gas would do perhaps we can answer the above two questions.

The gas constant R, is 8.317 Joule/K/Mole. (Joule=NT-m and 1000 Mole/Kg for H). If we assume an ideal gas for hydrogen the gas constant R=8317 NT-m/K/Kg and the pressure would be:

P=8317*density*temperature (NT-m/K/kg*kg/m^3*K=NT/m^2) where density is kg/m^3 and temperature is degrees Kelvin (K).

With density based on one proton for half the cells (the other half is probably cold dark matter [7]) and an initial radius of 7.35e-14 meters, the above initial pressure is 2.97e26 NT/m^2 where initial temperature=7.58e10 K. The following table models PdV for the first few steps in expansion.

Volume/cell (m^3)		1.67E-39	2.72E-39	4.43E-39	7.24E-39	1.18E-38
Density (kg/m^3)		5.02E+11	3.08E+11	1.89E+11	1.16E+11	7.09E+10
Temperature (K)		7.56E+10	1.01E+10	1.08E+10	1.05E+10	9.84E+09
Pressure (NT/m^2)		2.97E+26	2.44E+25	1.60E+25	9.54E+24	5.46E+24
Pressure (lb/in^2)			3.54E+21	2.32E+21	1.38E+21	7.92E+20
Pdv (MeV)			2.11E+00	4.33E-01	4.47E-01	4.28E-01
Integral Pdv (MeV)	6.6		2.11E+00	2.55E+00	2.99E+00	3.42E+00



The integral of Pdv quickly saturates at a level consistent with the initial kinetic energy of 9.8 MeV (the gas is not ideal and the constant is somewhat uncertain). Overall, *pressure* can be considered the driver for expansion. The net affect is the proton receives gravitational potential energy against a resisting gravitational force.

Transition from quantum behavior

In quantum mechanics, particles move in circles and are statistically "everywhere" at once on a surface and movement into the interior of the sphere that defines them is very limited. For example, the electron does not normally move inside the sphere 5.29e-11 meters and if it is forced to, it is called relativistic or de-generate. Pressure is the collective action of particles with kinetic energy (temperature) that collide with each other in all directions. The fact that protons are colliding and able to move throughout the space created by expanding the fundamental radius 7.35e-14 meters indicate that a critical transition has occurred. Protons enter the radius that defines gravity and pressure expands space itself. Particles now exhibit non-quantum behavior (perhaps because the force is now very low and it is easy to force particles into the interior of the volume). Apparently the transition is associated with 1/exp(90) that weakens and extends the gravitation force.

For expansion, the kinetic energy term is initially 9.7 MeV [9] of kinetic energy but decreases as PdV increases. Defined this way, we expect the equation 9.8=ke+Pdv to be satisfied [1]. Although quantum mechanics, the proton model and cellular cosmology define kinetic energy for the cell, it is pressure and temperature that expand the universe. Rather than being limited to a quantum mechanical orbit, particles are free to move throughout space because the coupling constant 1/exp(90) reduces and extends the force between particles. After two early transitions (equality of photon and mass density and decoupling of electrons [11]), gravitation is locally able to dominate gas pressure. This gas does not act like the one that thermodynamics normally describes. The particles are gravitationally "sticky" and small accumulations of matter grow and eventually form clusters, galaxies, stars and planets [8][13].

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

Expanded particles do not reverse expansion as they fall due to gravitation. Normally gravity is not an important force in pressure and temperature changes considered by thermodynamics (it can be important in the thermodynamics of weather). Again, pressure is the collective action of particles with kinetic energy (temperature). At about 200K years after the beginning a condition known as equality [4][5] of photon density and matter density occurred and gravity became an important force determining their behavior. Initially, gravitational accumulation was aided by acoustic waves but as particles collided, their gravitational attractive forces started to dominate and particles no longer behaved like gases that we are familiar with. The pressure at equality was about 5e-8 psi (pounds per square inch) and the temperature was 9100 K. The gas was low pressure plasma. A later critical juncture in thermodynamics occurred as the plasma cleared (this condition is called decoupling and electrons assume orbits around protons). The temperature at this point was about 3300 degrees K and the pressure was 6e-14 psi. At the present time it is 3.7e-27 psi and 2.7 K.

The universe also contains cold dark matter. In the author's work [13], cold dark matter is proton like (one hot matter proton for every cold dark matter proton) except it does not interact like normal matter. However, it is gravitationally active and this aids accumulation. Apparently it never acts like a gas and is free to accumulate earlier than normal matter.

Finding the origin of cells that have fallen without friction

The fundamental calculation for gravity shows that a particle often falls into an orbit and the orbit defines the curvature of space time just like it does on the large scale. A cell is related to large scale by the coupling constant 1/exp(90). The fundamental radius 7.35e-14 meters expanded to define the space we are standing in. At a particular time in expansion, expanded cells have a certain amount of energy and below we will attempt to account for energy changes by considering cells.

Firstly, astronomers can determine the velocity of stars within galaxies by using red-shift. They can also estimate the mass of the galaxy and the position of the star from the center. Newtonian calculations as follows give the kinetic energy/particle of the orbiting body. (Note: we are assuming that the galaxy does not have much kinetic energy induced by the cluster it is in but this assumption is examined below.)

Example for sun orbiting in Milky Way			cell r (meters)	cell ke (MeV)
M	1.17E+42	Kg		
R	2.51E+20	Meters	4.37E-10	1.63E-03
V=(GM/R)^.5	5.58E+05			1.63E-03

There are two ways to determine the kinetic energy of the cells. With known M and R, V=(GM/R)^.5 and ke/cell=5.25e-15*V^2=1.63e-3 Mev. If we do not know anything but r, and can still find ke. Cell r will be determined by R large scale orbit*1.67e-27/central mass. The equation is obtained by solving the Schwarzschild equation for gamma and combining it with ke=938.27/gamma-938.27.

ke=938.27/(1/(1+(1/((1-exp(90)*G*m/(r*C^2)))^.5-1)))-938.27
ke will be in MeV with small r in meters and m=1.67e-27 kg

If a particle does not encounter friction it will fall to one-half its original height, i.e. it falls from a radius twice the measured R above (2.51e20 meters) as it establishes an orbit. The reason for this is that as it falls, it follows a curved path and normally "misses" the central mass. An orbit has balanced inertial and gravitational forces. As the fall velocity increases, the inertial force outward increases and balances the gravitational force at one-half the original height. I call this the reach of the galaxy. The volume of space v originally occupied by the galaxy mass mg is related to the mass and size of the universe by v/V=Mg/Mu, where Mu=2.49e51 kg. This makes reach=Runiv/(Mu/Mg)^(1/3). From this we can determine the radius of the universe at the point that the mass fell. Below we calculate R1=6.45e23. If the cell is one the expansion determined geodesic we can divide R1 by exp(60) to find the cellular radius. It is R1/exp(60)=6.45e23/exp(60)=r1=0.0056 meters. Again, the Schwarzschild equation is used to get cell ke.

			cell r (meters)	cell ke (MeV)
Fell from 2*R=reach	5.02E+20	meters	8.74E-10	8.13E-04
MU	2.49E+51	Kg		
M Galaxy	1.17E+42	Kg		
reach=R1/(M/m)^(1/3)				
R1=reach(M/m)^(1/3)				
R1	6.45E+23	meters	5.65E-03	1.26E-10

The other interesting thing we can tell from the fall model for our Milky Way is when the particles started to fall. Expansion equations have two components R1+R3 (above in section entitled Expansion), R3 is very small during this period and we can calculate the time associated with r1=0.006 meters. We are at about 8.3 kiloparsec from the center of the galaxy and ideally all particles near us fell 4e7 years after the beginning. Remember that the fall model is starting with zero kinetic energy from the geodesic determined by expansion equations. There is original expansion kinetic energy that must be added and at 5e7 years after the beginning the residual expansion energy was 2.7e-8. At this particular time in expansion the universe was 6.45e23 meters radius.

R1=(7.35e-14*exp(60))*g^(2/3)

t=alpha*(R1/7.35e-14)^(3/2)

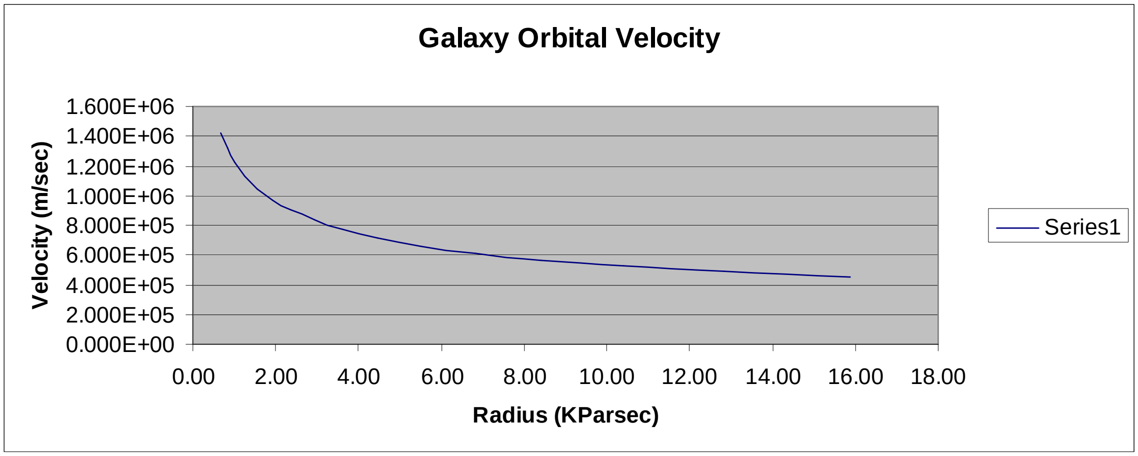
alpha	5.38E-02	seconds
t (seconds)	**1.14754E+15**	
t (years)	3.64E+07	

Peebles indicates on page 611 that spheroid of galaxies are observed were first observed at 1.5e8 years. The ideal case calculated above is a bit early.

There is something else that should be pointed out for this ideal case. The cellular kinetic energy times the cellular radius is always the same. In this case ke*r=7.1e-13 mev-meters.

An Ideal Galaxy similar to the Milky Way

The author uses a model called fallmodel.xls combined with an expansion model. For our Sun in the Milky Way and ideal conversion of potential energy to kinetic energy the fall model gives the velocity profile for orbits from the center of the galaxy out to the sun. The chart below shows what happens to “ideal mass” as it falls. Ideal mass is mass that does not lose kinetic energy from collisions. It could be “cold dark matter” or just particles that don’t happen to collide.



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

The non-ideal case for normal matter is that collisions occur that cause particles to lose some of their kinetic energy to "friction" between particles. The equation that applies is 9.7=(ke+dQ)+PdV. The term ke and PdV are converted back and forth but the term dQ contains the friction energy (heat) and we expect to find this energy in the temperature of the planets and the stars. All particles that form a central mass like a star or planet fall are limited in their fall. The electron orbit is 5.29e-11 meters and is almost incompressible. The gravitational kinetic energy at 5.29e-11 meters follows:

Put small r into the following equation with m=1.67e-27 kg
ke=938.27/(1/(1+(1/((1-exp(90)*G*m/(r*C^2)))^.5-1)))-938.27
ke will be in MeV with small r in meters and m=1.67e-27 kg

r meters	dt	gamma	ke/particle MeV
5.29E-11	**1.433E-05**	0.9999857	0.0134

Friction, heat and entropy

Thermodynamics is the physics of groups of particles. Entropy, S is defined as follows [1] and helps characterize the second law of thermodynamics.

The cyclic integral of change in heat energy/divided by temperature is equal or less than S where S is defined as entropy, i.e. cyclic integral of dQ/T< or = dS.

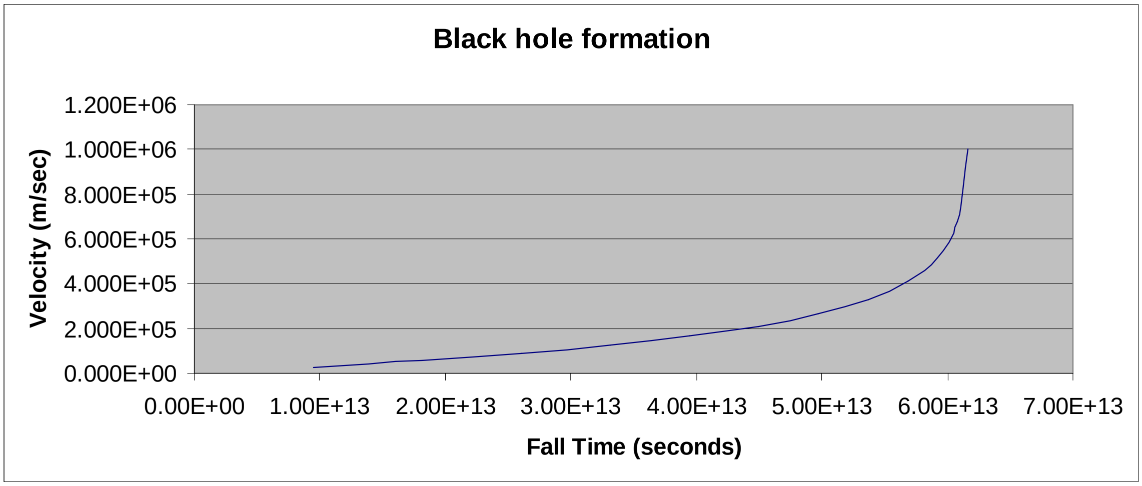
The change in the entropy of a system as it undergoes a change of state may be found by integrating: S2-S1= integral (dQ/T) from state to 1 to state 2 [1]. The overall change in dQ/T will always be less than entropy dS. In other words entropy, defined this way, always increases. There is a limiting (ideal or reversible) condition where entropy might be equal.

The thermodynamics of a gravitational potential has not been developed to the author's knowledge. Think about it this way. The protons can fall from the geodesic determined by expansion equations and gain kinetic energy. Accretion will occur and bodies will fall into orbits around other bodies. As they fall, collisions will occur. This friction causes heat and the temperature rises. As particles form large bodies the temperature and pressure can become so high that they fuse, subsequently explode spewing out elements [10] that can combine into molecules and life [13]. Conventional thermodynamics describes the behavior of gases that gathers around planets and stars. There are a lot of potential states awaiting particles that fall and collide due to gravitation potential. As particles transfer heat the ratio of dQ/T is entropy. Entropy dS will increase from the low state where dQ is zero and T is low. This is the origin of the universe's initial low entropy state. The "zeroth" law of thermodynamics states that entropy is zero at absolute zero. Clearly this statement is not talking about the sky temperature (CMB) but it might be better to state the "zeroth" law in term of heat. Entropy is zero at absolute zero heat. A particle that has expanded but not fallen from its geodesic contains zero heat energy. If it has fallen but not collided it still may contain zero heat energy.

Non-ideal Gravitational Accumulation

Of course some cells fell from the geodesic established by the expansion equation but the only thing that changed was that potential energy was reconverted to kinetic energy (ke) and heat dQ. The overall energy is 9.7=(ke+de+dQ)+PE for particles that have transferred or stored de energy between particles, gained ke by falling and gained heat (dQ) through friction. If a particle gains ke by falling it will normally establish a new geodesic or accumulate in a body like the sun or a planet. If it has stopped falling but is not on its geodesic it will register as acceleration. Kinetic energy lost by friction will show up in dQ. DQ is unknown until we measure the temperature. The particles we experience on earth, even if they are trains moving relative to each other are all "off their geodesic". After falling and gaining some kinetic energy they lost kinetic energy through friction involved with falling on our planet. Because of this they experience gravitational acceleration. Acceleration is a measure of how off their geodesic they are.

Of course each particle has a certain kinetic energy but we don't know its value. However, we can estimate what happens overall using fallmodel.xls. Starting at equality of matter and radiation acoustic waves develop and concentrate mass. WMAP measured the red shift of (spots) that we can now associate with clusters. When the universe was about 1e22 meters in size waves started travelled until they were spots of about 3e21 meters. This dividing matter into approximately 2.6e4 clusters of about 1e46 kg mass. The Jeans length is a natural wavelength associated with temperature and the state of matter. At decoupling the plasma cleared and the Jeans length transitioned to a much lower value. It went from Jeans high 5e22 meters to Jeans low 3e19 meters. This low Jeans number is listed as "empirical" in reference 8. The low speed Jeans length divided the WMAP spot size of 3e21 meters into about 1e6 smaller spots. The smaller spots contained about 1e42 kg mass. According to the fall model, some mass fell quickly inward and formed a black hole. The black holes were the seeds for the galaxies. The reason the first masses form black holes is that their fall velocity becomes the speed of light if they are not deflected into orbits. Below the fall velocity as a function of time is shown from fallmodel.xls:



A black hole is an attractor that brings mass into the galaxy. As the new mass falls, it falls into orbits around the black hole. The galaxy builds mass from the inside out. As later mass falls, it develops less velocity from the fall.

Kinetic energy Accounting

Below we account for kinetic energy for orbits associated with earth. On earth we feel acceleration. We want to know the kinetic energy of an object orbiting earth since kinetic energies are referenced to geodesics (orbits). To find the kinetic energy we put the measured acceleration in the following equation:

R	orbit R (m)	6394767	
M	Earth Mass	5.98E+24	
	Earth R	6378100	meters
a=gm/r^2	m/sec^2	9.75	m/sec^2
	V=(aR)^.5	7897.71	meters/sec

Its kinetic energy is 5.32e-15*7898^2=3.3e-7 MeV. The special and general relativity gamma is shown below for our orbits. Gamma is ke/(938.27+ke). The cell radius and associated orbital radius is listed from equations given in the section above entitled Nature's Rules. From cell r above, the large scale geodesic is scaled up by the ratio of the central mass/proton mass. For example, for the earth, the geodesic is:

earth geodesic=2.14e-6*5.98e25/1.67e-27=6.4e6 meters.

Orbit		Vel m/sec	ke (mev)		gamma	cell r (m)	Mass M	Orbital R (m
P/earth		7.90E+03	3.27E-07	ke from 7898	0.9999999997	**2.169E-06**	5.98E+24	6.364E+06
earth surface		4.64E+02	1.13E-09	ke earth spin				
earth/sun	1.55E+11	2.92E+04	4.48E-06	ke in earth orbit	0.9999999952	**1.583E-07**	1.99E+30	1.542E+11
sun/galaxy	2.51E+20	5.58E+05	1.63E-03	ke from 8.29 kps galaxy c	0.9999982590	**4.345E-10**	1.17E+42	2.497E+20
	cluster	5.58E+05	1.00E-06	ke cluster	0.9999999989	**7.098E-07**		
	8.29		1.64E-03	total ke	0.9999982528	**4.330E-10**		

Above we add earth orbit that should have 3.3e-7 mev adding to that the kinetic energy of the earth orbit around the sun and adding to that the kinetic energy of the sun's orbit around the galactic center. The sun's kinetic energy in a flat galaxy velocity profile is included from the graph below in the topic entitled "Flat Galactic Velocity Profiles". The Milky Way galaxy is part of a cluster but the cluster kinetic energy is quite low. The WMAP project gives us information regarding the kinetic energy of clusters. WMAP measured temperature spots of 75 micro-degrees out of the CMB of 2.73 K. This suggests a kinetic energy difference from the background kinetic energy on the order of 7e-10 MeV but there has been gravitational development since decoupling and a value of 1e-6 Mev/particle was estimated. A possible reason that galaxies do not move in orbits around a cluster may be that galaxies have mass all around them and the forces are balanced. This condition may date back to the high to low Jeans length transition that forms the galactic centers on almost equal spacing. Only if a galaxy moves toward another galaxy does gravitation force start the galaxy moving (this appears to be the case for Andromeda and the Milky Way that are moving toward one another).

Adding together the kinetic energies contributions from earth orbit, solar orbit, galactic orbit and cluster kinetic energy we can identify only 1.6e-3 MeV. However, earth atoms are compressed to approximately the electron orbit 5.29e-11 meters. We learned above in the section entitled "Non-ideality involved in reconversion of kinetic energy to potential energy" that the gravitational kinetic energy associated with this compression is 0.0134 MeV. This means that most of the re-converted gravitational kinetic energy is in the central body, not the orbits. Compare this to the Potential Energy 9.72 MeV. Only a small amount of potential energy has been converted back to kinetic energy by falling. (The exception is the black holes that develop kinetic energy of about 9.72 MeV if they can crush the electron orbit to 9.3e-14 meters before particles disappear behind the black hole horizon).

Accounting for friction dQ

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

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

We "found" 1.1e-3 MeV of heat/temperature. But the atoms are compressed and should contain 0.0134 MeV. This energy is the pressure that the core of the planet must exert upward to support the weight above it. This causes the average radius between protons in the earth to be compressed from 5.29e-11 to 4.1e-11 meters. They resist this compression and store energy. Originally the core was hotter but a lot of the heat has been radiated away. Overall there is good evidence that formation of our planet, sun and galaxy were not ideal, i.e. there were collisions that caused pressure, friction and heat. We also know it is not ideal because the velocity profile of the galaxy falls with radius and measurements (Rubin) show flat velocity profiles.

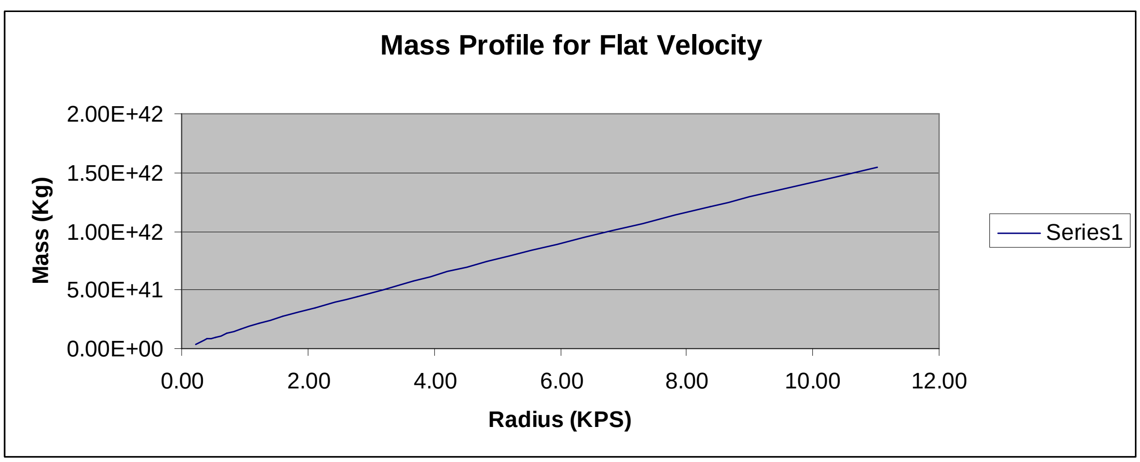
Above we accounted for additive kinetic energy in orbits regardless of the direction of the velocity vector. To this we added gravitational energy re-gained as the earth was compressed slightly more than the electron radius.

r meters	dt	gamma	ke/particle MeV
5.29E-11	**1.433E-05**	0.9999857	0.0134

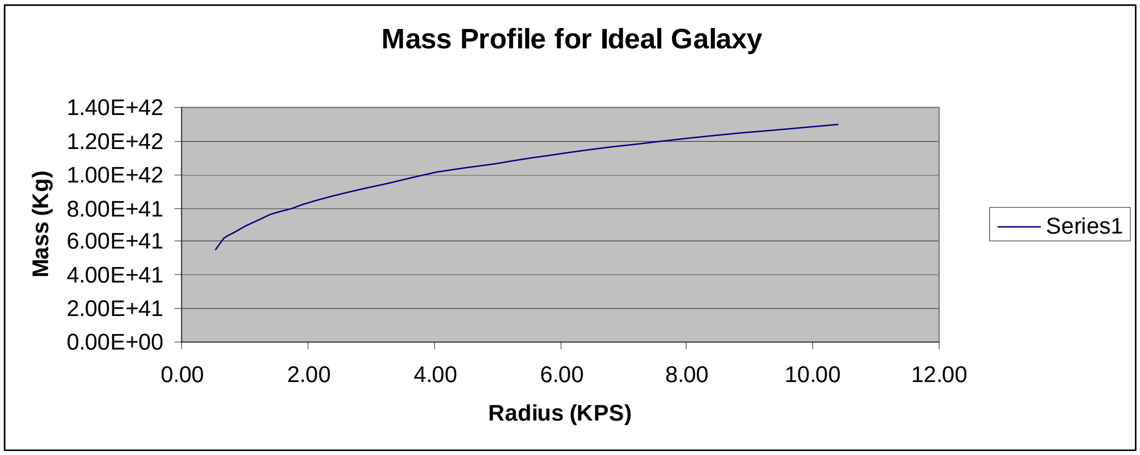
If our total energy is 1.34e-2 MeV/particle, the gamma associated with it equals ke/(939.27+ke)= 0.999986. Time runs slightly slow for particles in our vicinity that have this kinetic energy. Time dilation dt=1/gamma-1=0.000014 for particles in our vicinity.

Flat galactic velocity profiles

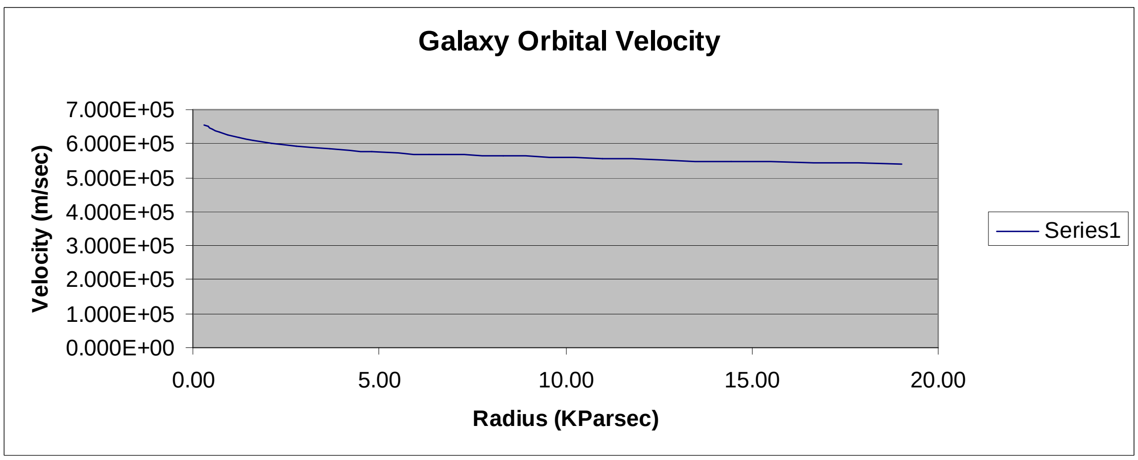
This is a simulation of a galaxy like the Milky Way that has 5.58e5 m/sec orbital velocity of a 2e30 kg sun at 8.29 kiloparsec from the center.



Compare this to the “ideal” similar galaxy presented above under the heading “An Ideal Galaxy Similar to the Milky Way”. The main difference is that the flat profile galaxy starts with 1e40 Kg and the ideal galaxy starts with 5.5e41 Kg. Both end up with 1.19e42 Kg at the position of the sun.



The velocity profile for this galaxy is below:



Galaxies contain cold dark matter and this "hidden" mass exists in a halo and causes the velocity to be approximately 5.6e5 m/sec from near the center to the edge. This galaxy will be a combination of cold dark matter and hot matter. The normal matter lost considerable kinetic energy by friction as it fell into the galaxy. The only way that the mass distribution for the flat profile could have developed was interaction with another galaxy (see studies of barred spiral galaxies).

This completes the accounting of our current energy on earth. Overall, 1.34e-2 MeV of the 9.7 MeV of potential energy has been converted back to kinetic energy for the galaxy, solar and earth orbit but the earth itself has 0.013 MeV that is stored and resists the gravitational force of the mass above it. All thermodynamics starts with 0.013 MeV/proton of energy until nuclear fusion starts.

Geodesics of Cold Dark Matter

There appears to be another way ideal particles behave gravitationally. In the author's work, cold dark matter is the Proton Mass Model except that dark matter does not interact except gravitationally. The particles fall with gravity but their fully expanded geodesic only changes based on conservation of PE and ke. The expansion equations apply to them as well so there is always a fully expanded geodesic and some CDM cells may not have fallen at all and they are now about 0.55 meters in size and have about 16.7 m/min velocity. The theory that they do not interact means that there can never be any compression, heat (dQ) or transfer of energy between particles (de). Fully expanded cells are the general case or we would calculate a lower Hubble's constant and derive different expansion equations.

Conclusions

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

Conservation of energy (the first law of thermodynamics) holds for cosmology and time enters physics through cosmology. If we believe **(r/r0)^3 increases we must believe that time advances (t/alpha)^2.** Particles have kinetic energy in the beginning that is converted to gravitational potential energy over time. Time cycles at the quantum level and counts forward for all particles. The cycle time for one count is the fundamental time defined by quantum gravity. Elapsed time, expansion equations and conversion of potential energy to kinetic energy define geodesics. As cells expand, time is counted around a larger circle but because velocity is low only a segment of the circle can be completed before everything moves forward at 1.54e-21 seconds/cycle. We can account for energy and find out interesting things about our history using cellular cosmology. Each particle in nature has a specific energy and a cellular level related to the observables around us. Deviation from expansion determined geodesics occurs as particle fall. Large scale orbital radius can give us kinetic energy and we can measure acceleration and temperature.

Expansion and critical transitions create conditions for the second law of thermodynamics. Firstly, although quantum mechanics and the proton model define kinetic energy in the gravitational orbit, it is pressure and temperature that expand the universe. Rather than being limited to a quantum mechanical orbit, particles are free to move throughout space because the coupling constant 1/exp(90) reduces and extends the force between particles. After two early transitions (equality of photon and mass density and decoupling of electrons [11]), gravitation is locally able to dominate gas pressure. This gas does not act like the one that thermodynamics normally describes. The particles are gravitationally "sticky" and small accumulations of matter grow and eventually form clusters, galaxies, stars and planets [8][13]. During expansion there are many potential states for particles to fall into. Particles that have not fallen have maximum potential but are very improbable. As they falls collide and produce heat, the second law of thermodynamics describes their behavior.

What about the argument that velocity is relative? It is the author's view that velocity is not overall relative and should be viewed as an incomplete description of kinetic energy because energy obeys the first law of thermodynamics. Expansion potential energy can be re-converted to compression energy, orbital kinetic energy and heat. Velocity can be calculated from kinetic energy and gamma (v/C=(1-gamma^2)^.5) once motion related kinetic energy is known. It can be misleading to compare one velocity with another. The Lorentz transformation is correct for segment time but fundamental time*n counts must be used to understand why time advances uniformly for all particles.

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Appendix

The Proton Mass Model

Mass and Kinetic Energy					Field Energies	
Mass mev	Difference ke mev	Strong residual ke mev	Neutrinos mev	Expansion ke mev	Strong & E/M field energy	Gravitationa 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 pe	
				0.000	expansion ke	
0.000	0.000	-0.671	0.671	v neutrino		
129.541	799.251	**938.272013**	**PROTON MASS**			
0.511	0.111	e neutrino			5.44E-05	-0.622
ELECTRON		2.47E-05				
130.052	0.111		0.671	20.303	-957.185	-2.683
		1.673E-27		Total m+ke	Total fields	
				Total positive	Total negative	
				959.868	-959.868	0.00E+00

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

	Mass (m) (mev)	Ke (mev)	gamma (g)	R meters	Field (E (mev)
Gravity	938.272	9.800	0.9897	**7.3543E-14**	-2.683
Electromagnetic	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 residual	928.121	10.151	0.9892	**1.4297E-15**	-20.303

Alternative definition for entropy and comments

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

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

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

Time dilation dt for General and Special Relativity

The table below shows what happens to dt (dt=1/gamma-1) for Special Relativity and dt for General Relativity as particles fall into orbits and gain kinetic energy. All values in the table below are on a geodesic but there are two cases. In the first case, labeled R, ke, dt SR and dt GR are for a expansion determined geodesics, i.e. the kinetic energy has not changed from the orbit established by expansion. Note that dt SR=dt GR throughout expansion. The second case, labeled R/2, ke*2, dt SR2 and dt GR2 are for an orbit that contains 2 times the kinetic energy (the particle has gained kinetic energy by falling) of the expansion determined orbit but since G=RV^2/m proportional to R*ke=R/2*2*ke both cases are on a geodesic but the geodesics are different. Note that dt SR=dt GR and dt SR2=dt Gr2 but that the higher ke orbit has a larger dt.

				hidden cells	hidden cells				now
R	8.81E-06	1.04E-05	1.22E-05	1.44E-05	1.66E-01	2.07E-01	2.59E-01	3.29E-01	4.24E-01
ke	8.08E-08	6.87E-08	5.83E-08	4.95E-08	4.28E-12	3.45E-12	2.75E-12	2.16E-12	1.68E-12
R/2	4.40E-06	5.18E-06	6.10E-06	7.18E-06	8.32E-02	1.03E-01	1.30E-01	1.65E-01	2.12E-01
ke*2	1.62E-07	1.37E-07	1.17E-07	9.91E-08	8.56E-12	6.89E-12	5.49E-12	4.32E-12	3.36E-12
dt SR	**8.615E-11**	**7.318E-11**	**6.216E-11**	**5.280E-11**	**4.562E-15**	**3.674E-15**	**2.927E-15**	**2.304E-15**	**1.789E-15**
dt GR	**8.594E-11**	**7.300E-11**	**6.201E-11**	**5.267E-11**	**4.441E-15**	**3.553E-15**	**2.887E-15**	**2.220E-15**	**1.776E-15**
ratio SR/GR	1.002E+00	1.002E+00	1.002E+00	1.002E+00	1.027E+00	1.034E+00	1.014E+00	1.038E+00	1.007E+00
dt SR2	**1.723E-10**	**1.464E-10**	**1.243E-10**	**1.056E-10**	**9.123E-15**	**7.348E-15**	**5.855E-15**	**4.608E-15**	**3.579E-15**
dt GR2	**1.719E-10**	**1.460E-10**	**1.240E-10**	**1.053E-10**	**9.104E-15**	**7.327E-15**	**5.773E-15**	**4.663E-15**	**3.553E-15**
ratio SR/GR	1.002E+00	1.002E+00	1.002E+00	1.002E+00	1.002E+00	1.003E+00	1.014E+00	9.882E-01	1.007E+00