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Galaxy Formation Study

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Abstract

A mass model of a proton and a new expansion model provide values of interest to unification and gravitational theory. This goal of this study is to determine if these two models provide insight into cosmology issues. To accomplish this goal, a detailed galaxy and star formation simulation was developed. The proton model has a particle with dark matter properties that accumulates soon after equality into 1e11 black holes that average 1e40 kg each. The galaxy simulation is based on normal matter gas falling into orbits around the black hole over the period $Z = 500$ to $Z = 18$ resulting a galaxy of mass 2e40 kg. Unstable gas clouds are divided by a Jeans radius into volumes that accumulate into stars. The stars that form average 2e30 kg each. This sets the average number of stars/galaxy at 1e10 that is equal to 2e40 kg/2e30 kg. Flat galaxy rotation curves have been observed for centuries. They are unexpected observations because they conflict with Newtonian gravity. If the measurements are correct, mass is proportional to radius and there must be hidden matter halos inside galaxies. The galaxy formation simulation is able to simulate the anomaly. It turns out that time has shifted differently for the orbits because they formed over an extended period. Redshift measurements obscure Newtonian fundamentals and no hidden matter is required. Luminosity measurements across galaxies indicate that most stars are near the center of a galaxy. Astrophysics uses an empirical power law to describe this behavior. Galaxy simulation implies a similar mass distribution.

Keywords

Astrophysics, Cosmology, Flat Rotation Curves, Luminosity Distribution, Galaxies

1. Background

The volume of space per proton is called a cell. Four values from a model [1] of the proton are required to understand cells.

1) Initial kinetic energy of the proton orbiting the cell radius = 10.15 MeV/proton.

2) Gravitational field energy = 2.801 MeV.

3) Radius of the cell r where h = reduced Planck constant = 6.626e−24 Mev sec.

4) Number of protons in nature = exp(180). This is based on a probabilistic argument from the proton model. Mass of universe = exp(180)*1.67e−27 = 2.49e51 kg.

$$r = hC/E = 1.97\text{e}{-13}/2.801 = 7.045\text{e}{-14} \text{ meters} \quad (1)$$

The size of expanding cells is based on gravitational G remaining constant throughout expansion. A proton mass on the surface of the cell orbits as:

$$G = rV^2/m$$

$$G/G = 1 = (r_0 * ke_0)/(r * ke)$$

With r_0 = 7.045e−14 m and initial ke = 10.15 MeV/proton.

$$r = 7.045\text{e}{-14} * 10.15/ke \quad (2)$$

2. Straight-Line Expansion Model

A new radius vs time expansion model was developed based on cells that maintain C across their radius. Because it is based on initial kinetic energy/proton = 10.15 MeV, it allows properties like temperature and density to be simulated over time. Table 1 provides equations for the reader to construct a straight-line model [1]-[3].

$$\text{Photon density} = 8 \times \text{pi}/(1.24\text{e}{-12})^3 \times (1.5 \times 8.617\text{e}{-11} \times T)^4 \times 1.87\text{e}{-30} \text{ kg/m}^3 \quad (3)$$

Table 1. Equations for straight-line expansion.

Expansion ratio Z = Rfinal/R − 1	1.57E+13
exponent N	60
kinetic energy (ke) = 7.04e−14*10.15/cell radius (MeV)	10.15
Radius R at Z = 7.045e−14*EXP(N) meters	8.04E+12
Temperature = ke/(1.5*8.602e11)*65.5 K	7.87E+10
Temperature high K = low T*70	7.87E+10
Time = 1.476e−21/(2pi)*exp(N) seconds	2.7E+04
mass density = 2.49e51/(4/3*pi*R³) kg/meter³	2.487E+51
cell radius (meters) = R/exp(60)	1.14E+12
mass density high = low*4 (Kg/meter³)	**7.04E−14**
photon density (Kg/meter³)	**2.51E+11**
photon density/mass density	2.20E−01
Mass = constant = 1.6724e−27*exp(180) kg	

It is compared to the Lambda CDM (LCDM) model below.

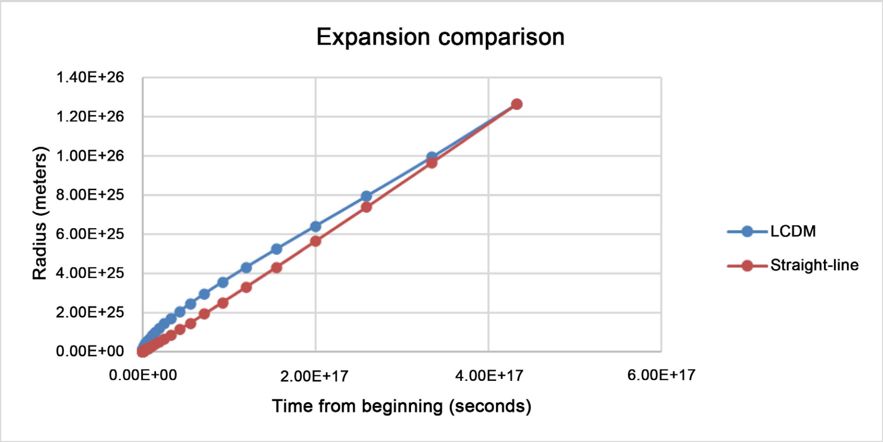

Figure 1. Comparison of two expansion models.

Inflation and Expansion History Review

The sequence of events after the beginning is listed below [4].

1) Information operations separate the logarithmic value 90 into components identified by N values that add to 90. Values of N are a pattern [1] we recognize as neutrons, protons, and electrons but their associated fields are equal and opposite energy. Each particle has probability = 1/exp(180).

2) Inflation in straight-line expansion consists of duplicating particles exp(180) times. After inflation neutrons are adjacent to one another at radius $R = hC/2.801 = 7.045e-14*exp(60)$. This occurs at 2.68e4 seconds.

3) There are two types of particles [1]. One is a normal neutron that decays to a proton, but the second neutron has zero kinetic energy. Its properties suggest it is dark matter with no pressure to resist accumulation.

4) Each cell has an orbiting proton [1] on its surface that initially has 10.15 MeV/proton of expansion kinetic energy (ke). Expansion reduces the kinetic energy as N increases. Primordial nucleosynthesis occurs at $N = 64.57$ where kinetic energy 0.11 MeV [1] [5] [6]. This adds 0.28*7.06 = 2.0 MeV to the kinetic energy as H is fused to He4.

5) After equality (expansion ratio $Z = 3.4e6$) waves can propagate because mass is no longer dominated by photons [5]. Dark matter particles start to accumulate into black holes [7]. Normal matter perturbations form Zel'dovich pancakes [5] and the dark matter is swept into webs, filaments, and voids. The Zel'dovich pancakes become the large-scale structure observed by WMAP at the angle 0.0104 radians. This is the origin of the cosmic web.

6) The black holes that form from dark matter become the seeds for 1e11 galaxies. At $Z = 88400$, the 1e11 black holes reach 1e40 Kg. This depletes dark matter.

7) Normal matter clouds fall into orbits around the black holes. The volumes are further divided by a Jeans radius into unstable clouds that accumulate into stars. After stars reach a critical mass at about 1.6e29 kg, they light up with fusion and are observable.

3. Formation of Galaxy Central Black Holes

Mass accumulation into black holes in Table 2 starts at equality. This period of time is dominated by large perturbations. Dark matter accumulates and the mass accumulation centers are being jostled about until about $Z = 8e4$ when most of the dark matter is set in place. There is, according to the proton model, 2.49e51 kg of matter in the universe. The dark matter proportion = 3.3e50 kg [4].

Table 2. Black hole formation after equality.

Dark matter accumulation																	
Condition			Equality													Hidden columns	ang = J/(pi*R)
Angle in radians	A = jeans/(PI()*Ru)		0.0017	0.0019	0.0022	0.0025	0.0029	0.0033	0.0037	0.0043	0.0049	0.0056	0.0064	0.0073	0.0084	0.0096	0.0110
Jeans length*Z			6.63E+23	7.59E+23	8.68E+23	9.93E+23	1.14E+24	1.30E+24	1.49E+24	1.70E+24	1.94E+24	2.22E+24	2.54E+24	2.91E+24	3.33E+24	3.81E+24	4.36E+24
time (million years)			3.86E−03	5.05E−03	6.60E−03	8.64E−03	1.13E−02	1.48E−02	1.94E−02	2.53E−02	3.31E−02	4.34E−02	5.67E−02	7.42E−02	9.71E−02	1.27E−01	1.66E−01
R = Hubble radius during expansion meters			3.65E+19	4.77E+19	6.24E+19	8.17E+19	1.07E+20	1.40E+20	1.83E+20	2.39E+20	3.13E+20	4.10E+20	5.36E+20	7.02E+20	9.18E+20	1.20E+21	1.57E+21
Expansion ratio Z = Rf/R − 1			3.46E+06	2.65E+06	2.02E+06	1.55E+06	1.18E+06	9.03E+05	6.90E+05	5.27E+05	4.03E+05	3.08E+05	2.35E+05	1.80E+05	1.37E+05	1.05E+05	8.03E+04
rho = density of hydrogen gas (kg/m^3)			1.23E−08	5.47E−09	2.44E−09	1.09E−09	4.87E−10	2.17E−10	9.69E−11	4.33E−11	1.93E−11	8.62E−12	3.85E−12	1.72E−12	7.67E−13	3.42E−13	1.53E−13
Sound velocity Cs = 3e8/3$^{0.5}$ (m/sec)			1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08
sound crossing time = R/Cs	shorter to be in equilibrium		2.10E+11	2.75E+11	3.60E+11	4.71E+11	6.17E+11	8.07E+11	1.06E+12	1.38E+12	1.81E+12	2.37E+12	3.10E+12	4.05E+12	5.30E+12	6.94E+12	9.08E+12
gravity free fall time = 1/(G rho)$^{0.5}$			1.11E+09	1.66E+09	2.48E+09	3.71E+09	5.55E+09	8.31E+09	1.24E+10	1.86E+10	2.79E+10	4.17E+10	6.24E+10	9.34E+10	1.40E+11	2.09E+11	3.13E+11
Jeans length = gravity free fall*Cs			1.92E+17	2.87E+17	4.29E+17	6.42E+17	9.61E+17	1.44E+18	2.15E+18	3.22E+18	4.83E+18	7.22E+18	1.08E+19	1.62E+19	2.42E+19	3.63E+19	5.43E+19
Temperature (K)			1.E+06	9.E+05	7.E+05	5.E+05	4.E+05	3.E+05	2.E+05	2.E+05	1.E+05	1.E+05	8.E+04	6.E+04	5.E+04	3.E+04	3.E+04
Black hole mass M (KG)			2.31E−28	2.31E−28	4.10E−07	7.88E+07	3.43E+17	1.20E+24	3.60E+28	4.56E+31	7.03E+33	2.70E+35	4.18E+36	3.60E+37	2.11E+38	9.54E+38	3.62E+39
vol = m/dens (m^3)			1.88E−20	4.22E−20	1.68E+02	7.22E+16	7.05E+26	5.51E+33	3.71E+38	1.05E+42	3.64E+44	3.13E+46	1.09E+48	2.10E+49	2.75E+50	2.79E+51	2.37E+52
F = (G*M*2.3e−28/3.4e−16)^2	4.117E−16	radius r	4.85E−63	2.10E−35	3.73E−14	7.16E+00	3.12E+10	1.09E+17	3.27E+21	4.15E+24	6.39E+26	2.45E+28	3.80E+29	3.27E+30	1.92E+31	8.67E+31	3.29E+32
a = F/M			2.10E−35	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08	9.09E−08
V = a*delta time			6.02E−25	3.41E+03	4.46E+03	5.84E+03	7.64E+03	1.00E+04	1.31E+04	1.71E+04	2.24E+04	2.93E+04	3.83E+04	5.02E+04	6.57E+04	8.59E+04	1.12E+05
R = (3*vol/(4*pi()))$^{(1/3)}$ meters			1.65E−07	2.16E−07	3.42E+00	2.58E+05	5.52E+08	1.10E+11	4.46E+12	6.31E+13	4.43E+14	1.95E+15	6.38E+15	1.71E+16	4.03E+16	8.73E+16	1.78E+17
delta mass = rho*area*velocity*delta time kg		8.5E+39	7.24E−35	4.10E−07	7.88E+07	3.43E+17	1.20E+24	3.60E+28	4.56E+31	6.99E+33	2.63E+35	3.91E+36	3.18E+37	1.75E+38	7.43E+38	2.66E+39	8.46E+39

The simulation for black hole formation is based on small dark matter particles being attracted to one another and they are only $r = hC/(751*2) = 4.1e{-}16$ meters apart. They accumulate according to force F as black hole mass M accumulates.

$$F = 6.67e{-}11 \times M \times 2.3e{-}28/4.1e{-}16 \quad (4)$$

$$\text{Acceleration } a = F/M \text{ and } V = a \times \text{delta time} \quad (5)$$

The area the particles flow through to reach the accumulating surface are calculated from radius R of the growing volume which leads to

$$\text{flow area} = 4\text{pi} \times R^2 \quad (6)$$

$$\text{delta mass} = \text{rho} \times \text{area} \times V \times \text{delta time} \quad (7)$$

The WMAP mission reported the peak cosmic microwave background (CMB) as an angle 0.0104 radians (imagine looking up at an object against the sky). This angle is calculated for dark matter formation at the point that dark matter accumulation reaches 3.6e39 kg. It is Jeans/(pi*1.57e21) = 0.0104 radians where large R = 1.57e21 meters. At this point, the perturbations have been set in place by black hole formation and dark matter has been depleted.

$$\text{Dark matter mass/black hole mass} = 3.3e50 \text{ kg}/3.6e39 \text{ kg} = 1e11 \text{ black holes} \quad (8)$$

This established the number of black holes and eventually determines the number of normal matter galaxies that form around the black hole.

3.1. Crushing Dark Matter into a Black Hole

Equations for star mass accumulation were reported in "Rapid cosmic evolution process" [8]. An equation called the "touch-down equation" is derived below.

$$R = at^2 = 0.5 \times GM/R^2 \times (2R/at)^2 = 2GM/(at)^2$$

$$0.5at^2 = 2GM/(at)^2$$

$$a^3t^4 = RGM$$

$$a = \left(4GM/t^4\right)^{1/3} \quad (9)$$

Mass must travel inwardly distance R to reach the accumulation surface. The derivation indicates that as mass gets closer, its acceleration increases because gravity is an inverse square phenomenon. The acceleration causes mass M to traverse R toward the center in delta time t. Mass inside distance R (volume 4/3*pi*R^3) will accumulate to a point if not stopped (**Table 3**).

Table 3. Crushing mass into a black hole.

		Rapid cosmic evolution process
BH study		pressure Nt/m³
	1	density before accumulation (kg/m³)
5.00E+12	3	delta time (sec)

Continued

1.00E+40	4	Galaxy Accumulation Kg
		Star mass accumulation Kg
		Touch down equation for BH mass
1.62E−07	5	a = (4 Gm/t^4)$^{(1/3)}$ (m/sec^2)
2.71E+20	6	r = 0.5 a t^2 (m)
8.33E+61	7	vol (m^3)
6.49E−14	8	r limit = GM/C^2 meters.
1.14E−39	9	vol/cell at limit (m^3)
5.99E+66	10	Number of cells in star mass = M/1.67e−27
6.86E+27	11	volume limit = vol/cell limit*N (m^3)
1.18E+09	12	radius away touchdown r (m)
2.71E+20	13	radius at limit (m)
1.0	14	fraction toward touchdown
1.5E+12	15	density limit = Mass/vol (Kg/m^3)

Table shows that the unstable 1e40 kg of mass will collapse into black holes in time 5e12 seconds according to the touch down equation. Time 5e12 seconds is time from equality to Z = 8.3e4.

3.2. Galaxy Properties Based on Cells

The expansion models in **Figure 1** are hollow shell models. All of the mass is in a thin shell at radius R. But real galaxies are inside a real 3-dimensional sphere of radius R. The concept of cells (the space associated with a proton) places small volumes of cell radius r throughout the large R sphere with a proton mass orbiting each cell at radius r. Cells that fill the hollow sphere produce a realistic simulation. In the straight-line model large $R = r$*exp(60). Each cell is balanced with gravitational force equal to inertial force throughout expansion. The cells expand from a low radius according to the equations of **Table 1**. Cell radius r is key to understanding accumulation of mass and galaxy formation. The following list of equations from reference 4 describes orbits based on cells and compares results with Newtonian behavior (**Table 4**).

$$R = \text{cell radius } r \big/ \left(\text{Mcentral}/2.49\text{e}51\right) \times \exp(90) \tag{10}$$

Equation (10) indicates that galaxy radius R is related to cell radius r. The value exp(90) [1] [4] is related to quantum gravity and 2.49e51 = exp(180)*1.67e−27 kg. The other equation required to understand galaxy formation is the touch-down equation with the value $4GM$ replaced by the value $2GM$ in Equation (14). The reduced touch down equation results in the velocity V that that balances inertial forces with gravitational forces.

$$a = \left(2GM/t^4\right)^{1/3} \tag{11}$$

Table 4. Gravitation equations.

	r cell = 7.045e−14*10.15/ke m				R orbit = cell r/(Mcentral/2.49E+51)*exp(90) m				
	kg						Fi = 1.67e−27*V²/R		Fnew (N)
Orbit	Central mass M	Vel m/sec	ke (MeV)	cell r (m)	Orbital R	R = GM/V²	Fg = GMm/R²		
earth/sat	5.98E+24	7.43E+03	2.902E−07	2.46E−06	7.22E+06	7.22E+06	1.280E−26	1.28E−26	1.28E−26
sun/earth	2.00E+30	2.97E+05	4.635E−04	1.54E−09	1.51E+09	1.51E+09	9.765E−26	9.77E−26	9.77E−26
galaxy/star	2.00E+41	2.26E+05	2.690E−04	2.66E−09	2.60E+20	2.61E+20	3.289E−37	3.29E−37	3.29E−37
cluster/star	2.00E+46	4.36E+05	1.00E−03	7.15E−10	7.01E+24	7.01E+24	4.545E−41	4.55E−41	4.55E−41
Universe/proton	2.49E+51	4.40E+07	10.15	7.05E−14	8.60E+25	8.60E+25	3.760E−38	3.76E−38	3.76E−38
	2.49E+51	3.90E+07	8.00E+00	8.94E−14	1.09E+26	1.09E+26	2.339E−38	2.34E−38	2.34E−38
proton/proton	1.67E−27	1.26E−12	8.318E−39	8.60E+25	7.03E−14	7.04E−14	3.766E−38	3.77E−38	3.77E−38

Fnew = 2.801/EXP(90)*ke/r/(Mcen/2.49E+51)/10.15*938.27/130*1.602e−13.

4. Galaxy Simulation

A normal matter galaxy develops around the 1e40 kg black holes described in Topic 2. The galaxy was simulated based on straight-line model properties, gravitation fundamental and the Jean's concept that determines when mass becomes unstable.

4.1. Jeans Radius

Thermodynamic pressure is caused by particles with velocity. Jean's analysis indicates that accumulation begins when gravitational pressure overwhelms resisting thermodynamic pressure.

According to Wiki, the approximate value of the Jeans radius may be derived through a simple physical argument. One begins with a spherical gaseous region of radius, mass, and gaseous sound speed. Perturbations compress the gas slightly, and it takes time (called crossing time) for sound waves to cross the region, push back against gravity and re-establish the system's pressure balance. Gravity will contract the system if not stopped and will do so based on free-fall time. When the sound crossing time is higher than the gravity free fall time, the gas cloud is unstable and will collapse (accumulate).

Gravity free fall time is derived below.

$$V = R/t = at$$

$$R/t = (F/M)t = tGM/R^2 = tGR \times \text{density}$$

$$(R/t)/(tR) = 1/t^2 = G \times \text{density}$$

$$\text{free fall time } t = 1/(G \times \text{density})^{0.5} \tag{12}$$

If a particle starts falling it will accelerate and fall a distance R in free fall time t.

4.1.1. Jean's Analysis for Gas Stability as a Function of Z in the Expansion Model

Table 5. Jean's analysis for stability.

Z		1421	1086
Volume in radius R	V = 4/3pi*R^3	2.93E+69	6.56E+69
Volume divided into 1e11 galaxies		2.93E+58	6.56E+58
Radius of galaxy volumn	R = (3*Vol/(4*PI()))$^{(1/3)}$	1.9E+19	2.5E+19
Speed of sound cs = (1.4*8.62e−11*T/density)$^{0.5}$		2.58E+05	3.37E+05
Galaxy R/speed of sound (R/cs)		7.43E+13	7.43E+13
Free fall time = (1/G*density)$^{0.5}$		9.76E+13	1.46E+14
Jeans length = cs*free fall time		2.51E+19	4.92E+19

The gas became unstable at $Z = 1086$ and remained unstable at $Z = 500$ where the galaxy simulation begins since sound speed cannot cross the radius R as fast as the mass can fall (free fall time exceeds R/cs at $Z = 1086$) (Table 5).

The galaxy simulation starts at $Z = 500$. Column 2 is expansion radius R for each Z and column 3 is density for each Z from the expansion model. Number of cells N:

$$N = 1\text{e}40\ \text{kg}/1.67\text{e}{-27}\ \text{kg} = 6\text{e}66 \tag{13}$$

Cell radius r is a function of Z and the final expansion radius.

$$\text{cell } r = 1/Z \times \left(1.26\text{e}26/\exp(60)\right) \tag{14}$$

The radius of the volume that will become the galaxy is $R' = r * N_{\text{cells}}^{1/3}$. Protons at this radius will fall toward the black hole in the center of the galaxy under the influence of gravity.

Table 6. Radius of the volume that forms the galaxy from Z = 498 to 18.

			Num cells	Vol/cell	cell r	Radius for galaxy
Z	R at Z (m)	density	1e40/1.67e−27	m^3	m	R' = r*exp(cell N)$^{(1/3)}$
18	7E+24	1.73E−24	5.99E+66	9.65E−04	6.1E−02	1.1E+21
78	1.615E+24	1.41E−22	5.99E+66	1.19E−05	1.4E−02	2.6E+20
138	9.13E+23	7.80E−22	5.99E+66	2.14E−06	8.0E−03	1.5E+20
198	6.364E+23	2.30E−21	5.99E+66	7.25E−07	5.6E−03	1.0E+20
258	4.884E+23	5.10E−21	5.99E+66	3.28E−07	4.3E−03	7.8E+19
318	3.962E+23	9.55E−21	5.99E+66	1.75E−07	3.5E−03	6.3E+19
378	3.333E+23	1.60E−20	5.99E+66	1.04E−07	2.9E−03	5.3E+19
438	2.877E+23	2.49E−20	5.99E+66	6.70E−08	2.5E−03	4.6E+19
498	2.53E+23	3.67E−20	5.99E+66	4.56E−08	2.2E−03	4.0E+19

Table 6 continues the galaxy simulation. Radius R' encloses the galaxy volume before mass falls into orbits. Column 1 is fall time.

$$\text{fall time} = R'/3\text{e}8 = 1/\left(G \times \text{density}\right)^{0.5} \tag{15}$$

The reduced touch down Equation (11) for acceleration a gives the orbital velocity V.

$$\text{Orbital velocity } V = a \times \text{fall time} \tag{16}$$

Kinetic energy from column 4 velocity is used to calculate cell radius r = 10.15*7.045e−14/ke (Equation (2)) in column 6 and Equation (10) is used to determine orbital radius R (Table 7).

Table 7. The series of galaxy orbital radius and the velocity in each orbit.

		a = (2*6.67e−11*1E+40/fall time⁴)^(1/3)			cell r = 10.15*7.045e−14/ke	
		free fall time		Orbital R = cell r/(2.49E+51/1E+40)*EXP(90)		
Z	R'/3e8 (sec)	a (m/sec²)	V = a*fall time	ke = 0.5 mV²	cell r	Orbital R
18	3.84E+12	1.83E−07	7.11E+05	2.64E−03	2.71E−10	1.33E+18
78	8.87E+11	1.29E−06	1.16E+06	7.00E−03	1.02E−10	5.00E+17
138	5.01E+11	2.76E−06	1.40E+06	1.02E−02	6.98E−11	3.42E+17
198	3.49E+11	4.47E−06	1.58E+06	1.30E−02	5.49E−11	2.69E+17
258	2.68E+11	6.37E−06	1.73E+06	1.56E−02	4.60E−11	2.25E+17
318	2.18E+11	8.41E−06	1.85E+06	1.79E−02	4.00E−11	1.96E+17
378	1.83E+11	1.06E−05	1.96E+06	2.01E−02	3.56E−11	1.75E+17
438	1.58E+11	1.29E−05	2.06E+06	2.21E−02	3.23E−11	1.58E+17
498	1.39E+11	1.53E−05	2.15E+06	2.41E−02	2.97E−11	1.45E+17

Figure 2 indicates that kinetic energy (ke) increases as the mass falls. This increase is offset by potential energy (pe) loss and ke + pe = constant.

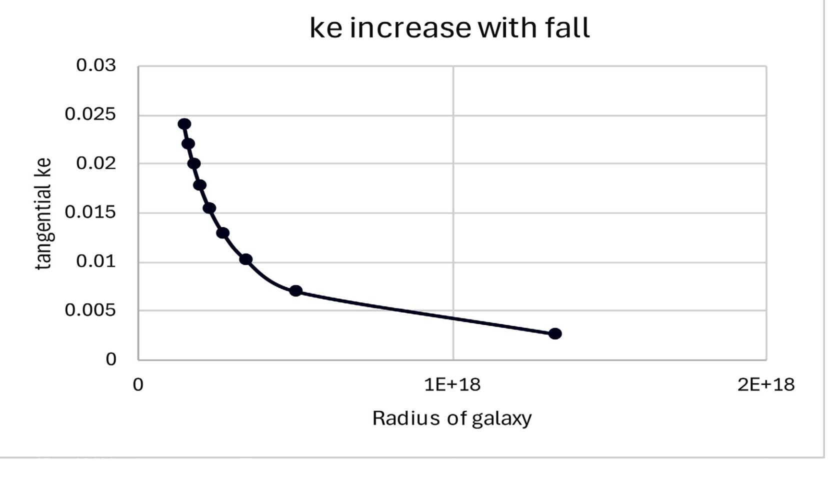

Figure 2. Cell kinetic energy from fall velocity.

5. Flat Galaxy Rotation Curves

All of the following galaxy profiles (search Wiki for velocity curves) are nearly flat (see Figure 3):

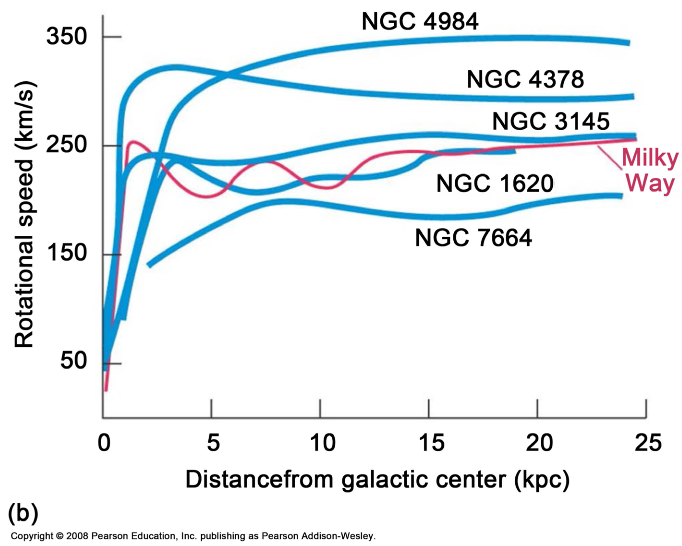

Figure 3. Five galaxies with flat rotation curves.

5.1. Effect of Expansion on Time and Distance

To understand flat velocity profiles, it must be understood that time and distance change with expansion. The velocity across a cell radius is always C but radius r and time across r increase with expansion.

The galaxy simulation in Table 5 and Table 6 continues in Table 7.

Table 8. Simulation of flat galaxy rotation curve.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10
						Zp = 1−1*((3e8−V)/(time/TIME)/(3e8+V)/(time/TIME))$^{0.5}$			
	R shell model	R orbital radius	r cell (m)	r cell (m)	after/before				Simulation
Z	m	m	after fall	before fall	r after/r before	time/TIME	V orbit (m/sec)		V' flat m/sec
18.00	7.01E+24	1.33E+18	3.17E−10	6.13E−02	5.16E−09	3.31E−01	7.11E+05	7.14E−03	2.15E+06
78.00	1.62E+24	5.00E+17	1.19E−10	1.41E−02	8.42E−09	5.39E−01	1.16E+06	7.14E−03	2.15E+06
138.00	9.14E+23	3.42E+17	8.14E−11	8.00E−03	1.02E−08	6.52E−01	1.40E+06	7.14E−03	2.15E+06
198.00	6.37E+23	2.69E+17	6.40E−11	5.57E−03	1.15E−08	7.35E−01	1.58E+06	7.14E−03	2.15E+06
258.00	4.89E+23	2.25E+17	5.36E−11	4.28E−03	1.25E−08	8.03E−01	1.73E+06	7.14E−03	2.15E+06
318.00	3.97E+23	1.96E+17	4.67E−11	3.47E−03	1.34E−08	8.61E−01	1.85E+06	7.14E−03	2.15E+06
378.00	3.34E+23	1.75E+17	4.16E−11	2.92E−03	1.42E−08	9.12E−01	1.96E+06	7.14E−03	2.15E+06
438.00	2.88E+23	1.58E+17	3.77E−11	2.52E−03	1.50E−08	9.58E−01	2.06E+06	7.14E−03	2.15E+06
498.00	2.53E+23	1.45E+17	3.46E−11	2.22E−03	1.56E−08	1.00E+00	2.15E+06	7.14E−03	2.15E+06

Column 1 of Table 8 indicates the center of the simulated galaxy started at Z = 500 and the outer radius formed later at Z = 18. Column 2 of Table 8 gives Large R for each Z for straight-line expansion. This is a hollow shell model of radius vs time that does not have cells inside Large R. The shell model was converted to a 3-dimensional model in Table 5. Before the cells fell into orbits around the central black hole, they had radius r shown in column 5 of Table 8. Each cell is now 1.1 meters (1.262e26/exp(60) according to the expansion model). Before they fall, they are related to Z by the equation below.

$$r = 1.1/Z = 1.1/18 = 0.0613 \text{ meters.} \tag{17}$$

Their Hubble law velocity away from the observer would be measured with $Vh = H^* dR$ as redshift and we would know they are at Z = 18.

After the cells fall, their radii decrease (column 6 of Table 8) by orders of magnitude. This is an extra shift compared to $Vh = H^* dR$ shift for the 0.0613 m cell. The fact that radius and time are both much lower after the extra shift must be considered. Column 6 divides column 4 by column 5 to obtain the ratio = (r after/r before). Each row of column 6 is divided by 1.58e−8 and placed in column 7 labelled (time/TIME). Lower case "time" is shorter than "TIME" because the outer orbit shifted more. Column 8 is the Newtonian velocity of the orbit. The velocity we measure is a combination of actual velocity and a time ratio. It is referenced to "time" because the flat velocity is used to determine the mass of the galaxy. Newtonian velocity $V = r$/TIME is placed in the equation below. The purpose of the equation is to simulate the flat velocity profile from V. The time ratio (time/TIME) is affecting redshift measurements because velocity comparison depends on a common time reference. The simulated profile is labelled V.'

$$V' = (r/\text{TIME})/(\text{time}/\text{TIME}) = r/\text{time} \tag{18}$$

Column 9 uses the peculiar equation called Zp (Wiki) to find redshift for the fallen cells.

$$\text{Zp} = 1 - 1 \times \left(\left(3\text{e}8 + V/(\text{time}/\text{TIME})\right) / \left(3\text{e}8 - V/(\text{time}/\text{TIME})\right) \right)^{0.5} \tag{19}$$

The simulated velocity in column 10 becomes constant at 2.15e6 m/sec. This is the velocity at the galaxy inside radius 1.45e17 meters.

There are two velocity profiles shown (see Figure 4). The blue curve is orbital velocity of the galaxy plotted against the orbital radius. Being able to simulate the anomaly is important to understanding the flat rotation curve.

5.2. Explanation of Flat Velocity Profiles

Our instruments measure a flat redshift. It is an accurate measurement of a real effect. But the result requires interpretation. The "extra shift" described above is the key. Expansion changes time and the calculated time ratio (time/TIME) for the extra shift adjusts the velocity comparison to a common reference. The outer orbits received more of the "extra shift". Velocity V' is what our instrument sees. The value "time" is too low and V' is too high for the outer orbits. This is the cause of anomalous flat velocity profiles. There is no way to measure the cell tangential velocity that formed Newtonian orbits, but the galaxy was simulated with Newtonian equations. Real galaxies obey Newtonian mechanics, and no hidden matter is required.

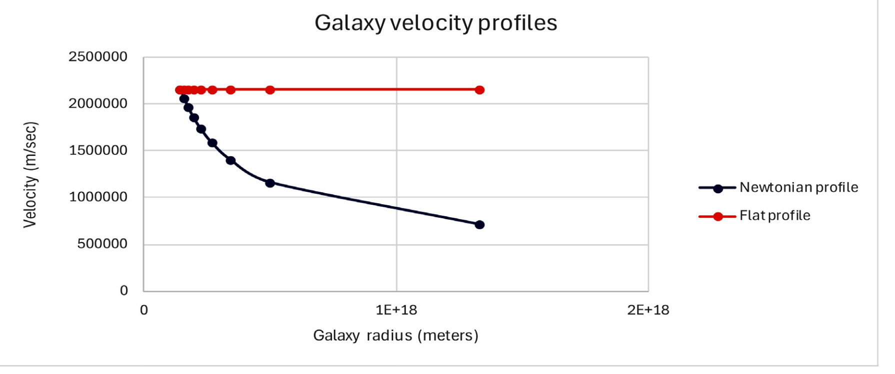

Figure 4. Galaxy velocity profiles.

The flat profiles can be corrected with the model, although this might be difficult for other galaxies unless a good model can be produced that predicts the ratio = (time/TIME) for the galaxy. The alternative is to believe in Newtonian gravity. The correction reduces the outside orbital velocities to their Newtonian values (**Table 9**).

Table 9. Correcting the flat velocity profile.

	R orbital radius	Simulation		Corrected
Z	m	V' flat m/sec	time/TIME	Flat*time/TIME
18.00	1.33E+18	2.15E+06	0.331	7.11E+05
78.00	5.00E+17	2.15E+06	0.539	1.16E+06
138.00	3.42E+17	2.15E+06	0.652	1.40E+06
198.00	2.69E+17	2.15E+06	0.735	1.58E+06
258.00	2.25E+17	2.15E+06	0.803	1.73E+06
318.00	1.96E+17	2.15E+06	0.861	1.85E+06
378.00	1.75E+17	2.15E+06	0.912	1.96E+06
438.00	1.58E+17	2.15E+06	0.958	2.06E+06
498.00	1.45E+17	2.15E+06	1.000	2.15E+06

This extra shift process is different than the simple Hubble shift for distance. The redshift instrument is seeing real expansion velocities referenced to C when it measures distance to galaxies. Based on this analysis, any process that produces extra velocity or odd sized cells may require interpretation.

6. Formation of Stars inside the Galaxy

The galaxy being analyzed is for gas that surrounds a black hole. As the gas becomes unstable and falls into orbits density increases. Continuing the galaxy formation Table, the outside density 3.7e−20 kg/m³ at $Z = 498$. The influence of the black hole determines the density of the gas cloud for each radius. The density is 1e40/volume, where volume = $4/3 * \text{pi} * R_{\text{orbit}}^3$. This is in column 3 of Table 10. Sound speed, free fall time and Jean's radius are calculated in columns 4, 5 and 6 of Table 10.

$$\text{cs} = \sqrt{1.4 \times 8.62\text{e}{-11} \times T/\text{rho}} \tag{20}$$

$$\text{free fall time} = 1/\sqrt{6.67\text{e}{-11} \times \text{rho}} \tag{21}$$

$$\text{Jeans radius} = \text{cs} \times \text{free fall time} \tag{22}$$

The Black hole at the center of the galaxy is 1e40 kg. Gaseous normal matter of mass 2e40 kg will accumulate at the radius of the orbits described above: Normal galaxy mass = star mass*1e10*2e30 = 2e40 kg.

6.1. Mass of Stars and Number of Stars/Galaxy

Although density increased during galaxy formation, the gas cloud temperature decreases due to radiation. The temperature in Table 10 is the bulk temperature around the cloud. This sets the stage for star mass accumulation.

Table 10. Predicting star mass and stars/galaxy.

Mass dist = N_j/N_{j0}*Star mass*stars/gal										
		Temp = ke/(1.5B)								Luminosity = 10*exp(−2r/r0)
	density		Sound		Jeans = cs *free fall time		Star mass (Kg)			Power law
Orbital R	1e40/(4/3piR³)		speed (cs)	free fall time		rs = R/cs (m)	4/3pi*J³*rho	Stars/gal	mass dist	Mass dist
1.33E+18	1.02E−15	6.32E+00	8.66E+02	3.84E+12	3.33E+15	1.53E+15	1.57E+32	6.37E+07	1.00E+40	4.47E+39
5.00E+17	1.91E−14	2.74E+01	4.16E+02	8.87E+11	3.69E+14	1.20E+15	4.02E+30	2.49E+09	1.50E+40	1.55E+40
3.42E+17	5.97E−14	4.84E+01	3.13E+02	5.01E+11	1.57E+14	1.09E+15	9.65E+29	1.04E+10	1.76E+40	1.97E+40
2.69E+17	1.23E−13	6.95E+01	2.61E+02	3.49E+11	9.13E+13	1.03E+15	3.91E+29	2.56E+10	1.95E+40	2.20E+40
2.25E+17	2.09E−13	9.05E+01	2.29E+02	2.68E+11	6.14E+13	9.85E+14	2.02E+29	4.95E+10	2.10E+40	2.35E+40
1.96E+17	3.17E−13	1.12E+02	2.06E+02	2.18E+11	4.48E+13	9.51E+14	1.20E+29	8.36E+10	2.22E+40	2.46E+40
1.75E+17	4.48E−13	1.33E+02	1.89E+02	1.83E+11	3.46E+13	9.24E+14	7.77E+28	1.29E+11	2.33E+40	2.54E+40
1.58E+17	6.01E−13	1.54E+02	1.76E+02	1.58E+11	2.77E+13	9.02E+14	5.38E+28	1.86E+11	2.43E+40	2.60E+40
1.45E+17	7.77E−13	1.75E+02	1.65E+02	1.39E+11	2.29E+13	8.82E+14	3.90E+28	2.56E+11	2.52E+40	2.65E+40
9.15E+00									2.52	5.94

This topic describes star accumulation that occurs based on conditions inside the galaxy. A comparison between the inner orbit and outer is presented. Overall, the simulations predict that stars will form before observations indicate.

6.2. Low-Pressure Volume around the Jeans Collapse

The touch down equation incrementally crunches mass to the density of a star after mass becomes unstable. A low-pressure volume develops around the collapsed mass.

6.3. Backfilling the Low-Pressure Volume

The flow calculated below backfills the low-pressure volume [8]. The accumulation calculation starts with a single proton. The second line is volume = mass/density (density from the straight-line expansion model). Its associated radius R is in line 6. This radius is the basis for the surface area that mass flows through at velocity V to accumulate with the starting mass. The flow velocity is derived from the touch down equation for the free fall time. The mass of the volume that will fall is 2e30 kg and $V = a$*delta time. It is constant across time.

$$a = \left(2 * 6.67\text{e}{-11} \times 2\text{e}30 \Big/ \sqrt[4]{\text{free fall time}}\right)^{1/3} = 6.44\text{e}{-10}\ \text{m/sec}^2 \tag{23}$$

$$V = a \times \text{delta time} = 3.12\text{e}3\ \text{m/sec} \tag{24}$$

For each increment, starting at 1.67e−27 kg mass/density is converted to volume, and its associated radius is used to determine flow surface area (4*pi*R^2). Delta mass (dm) = V*rho*area*velocity*delta time where rho is the density at this point in expansion. Delta time is the interval between step wise mass accumulation calculations. Delta mass (dm) is added to Star mass M for the next increment.

Table 11. Star mass accumulation outer orbit.

Expansion Z	463.0	353.9	270.4	206.7	157.9	120.7	92.2	70.5	53.9
Density (Kg/m^3)	6.42E−16	6.42E−16	6.42E−16	6.42E−16	6.42E−16	6.42E−16	6.42E−16	6.42E−16	6.42E−16
Star Mass Kg in high orbit	1.67E−27	1.67E−27	3.52E−06	7.34E+08	3.30E+18	1.16E+25	3.48E+29	4.36E+32	6.64E+34
radius of star mass		8.61E−05	1.09E+03	6.37E+07	1.04E+11	1.58E+13	4.89E+14	5.26E+15	2.80E+16
dm = rhoAVdt (kg)		3.52E−06	7.34E+08	3.30E+18	1.16E+25	3.48E+29	4.35E+32	6.59E+34	2.45E+36
a = ((2*6.67e−11*2E+30/free fall^4)$^{(1/3)}$)	6.44E−10								
V = a*(delta time)	2.47E+03								

Table 12. Star mass accumulation inner orbit.

Density (Kg/m^3)	4.90E−13	4.90E−13	4.90E−13	4.90E−13	4.90E−13	4.90E−13	4.90E−13	4.90E−13	4.90E−13	4.90E−13
Star Mass Kg of low orbit	1.67E−27	1.67E−27	9.13E−06	3.58E+09	2.46E+19	1.14E+26	4.13E+30	5.87E+33	9.71E+35	3.89E+37
radius of star mass		9.45E−06	1.64E+02	1.19E+07	2.23E+10	3.71E+12	1.22E+14	1.37E+15	7.51E+15	2.57E+16
dm = rhoAVdt (kg)		9.13E−06	3.58E+09	2.46E+19	1.14E+26	4.13E+30	5.86E+33	9.65E+35	3.79E+37	5.79E+38
a = ((2*6.67e−11*2E+30/free fall^4)$^{(1/3)}$)	6.58E−09									
V = a*(delta time)	9.14E+02									

Table 11 and Table 12 indicate that stars accumulate quickly and reach 2e30 kg by $Z = 50$. The high density and early start associated with inner orbits indicate that stars should light up well before $Z = 50$. This is earlier than observations.

7. Distribution of Galaxy Mass around Black Holes

The galaxy model helps understand why observed luminosity and mass are skewed toward the center of the galaxy. Table 12 analyzes the properties and predicts where mass is more likely to reside in the final galaxy. The Jeans length determines the radius of the unstable gas volume. Toward the bottom of the table, Jeans is lower and there are more gas clouds for star development although the mass of each star is lower. The value N_j = (R/jeans radius)$^{1/3}$*mass. Relative number = N_j/N_{j0} is in column 5. Below stars/galaxy = 1e40/star mass.

$$\text{Mass distribution} = N_j / N_{j0} \times \text{star mass} \times \text{stars/galaxy} \tag{25}$$

The column is labelled mass distribution and can be compared with the empirical luminosity distribution equation in the column on the right of Table 13. Luminosity falls from I_0, the inside (R_0) luminosity of the galaxy.

$$\text{Luminosity} = I_0 \times \exp\left(-2 \times R/R_0\right) \tag{26}$$

Table 13. Mass distribution from Jean's analysis.

	Mass dist = N_j/N_{j0}*Star mass*stars/gal				Luminosity = I0*exp(−2r/r0)		
				Star mass (Kg)			Power law
Orbital R	Jeans	$N_j = (r/J)^{(1/3)}$	N_j/N_{j0}	4/3pi*J^3*rho	Stars/gal	mass dist	Mass dist
1.33E+18	3.33E+15	7.36	1.00	1.57E+32	6.37E+07	1.00E+40	4.47E+39
5.00E+17	3.69E+14	11.07	1.50	4.02E+30	2.49E+09	1.50E+40	1.55E+40
3.42E+17	1.57E+14	12.97	1.76	9.65E+29	1.04E+10	1.76E+40	1.97E+40
2.69E+17	9.13E+13	14.33	1.95	3.91E+29	2.56E+10	1.95E+40	2.20E+40
2.25E+17	6.14E+13	15.43	2.10	2.02E+29	4.95E+10	2.10E+40	2.35E+40
1.96E+17	4.48E+13	16.35	2.22	1.20E+29	8.36E+10	2.22E+40	2.46E+40
1.75E+17	3.46E+13	17.16	2.33	7.77E+28	1.29E+11	2.33E+40	2.54E+40
1.58E+17	2.77E+13	17.87	2.43	5.38E+28	1.86E+11	2.43E+40	2.60E+40
1.45E+17	2.29E+13	18.52	2.52	3.90E+28	2.56E+11	2.52E+40	2.65E+40
9.15E+00						2.52	5.94

8. Summary

The purpose of this study was to determine if values from a model of a proton [1] coupled with a straight-line expansion model are useful for the study of cosmology issues. A galaxy model was developed. It produces the following realistic predictions [9]-[14].

1) Dark matter accumulates into 1e40 Kg black holes at the point observed at 0.0104 radians. Dark matter is 1e51 kg and the ratio 1e51/1e40 = 1e11 establishes the number of black holes and the number of galaxies. Later when normal matter accumulates around the black hole seeds, this is also the number of normal matter galaxies.

2) The galaxy simulation reveals why stars average mass of 2e30 kg. Conditions inside the galaxy lead to a Jeans radius that collapses into a star. The volume of the Jeans radius multiplied by the density gives the star mass. The galaxy under study had 1e11 galaxies of average mass 2e40 kg each (50/50 light and dark matter). The stars/galaxy are 2e40/2e30 = 1e10.

3) Flat velocity profiles across galaxies have been observed for centuries leading many to suspect that there must be hidden matter in the galaxy that would make $V = (GM/R)^{0.5}$ constant with M proportional to R. A model of galaxy formation was presented that allows the observation to be explained without assuming hidden matter. The inner portions of galaxies are early and smaller. There is a cell radius shift associated with galaxy formation. This produces a time ratio that affects redshift measurements. The time ratio makes the redshift measurement flat at a value consistent with the velocity of the inner portion of the galaxy. The velocity in the outer portion of the galaxy must be reduced to reveal the galaxy's true Newtonian behavior.

4) A simulation of star formation inside the galaxy indicates that stars can form early compared to observations. The inside of the galaxy is especially conducive to early stars.

5) Cosmologists use an empirical power law to describe the observed excess luminosity (and mass) toward the center of the galaxy. Analysis indicates that inner orbits have more mass.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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