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The Dynamic Case for an Expanding Spinning Black Hole Universe

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Abstract and purpose. We explore a simple classical model of the universe in dynamic equilibrium. Our purpose is to solve the problems of the flat rotation curves of galaxies, prevalence of dark matter in galaxy dynamics and uniformity of the cosmic microwave background. Wiki calls these "unsolved problems of physics." They are shown to be a consequence of this model of the dynamic universe. The age, radius, mass, expansion rate and density of the universe are unambiguously shown to apply to a black hole and are in the range of mainstream values frequently quoted.

Keywords. Spherical universe, black hole universe, rotating universe, black hole formulas, variable gravitational constant, cosmic microwave background, dark matter, flat rotation curves of galaxies.

Introduction

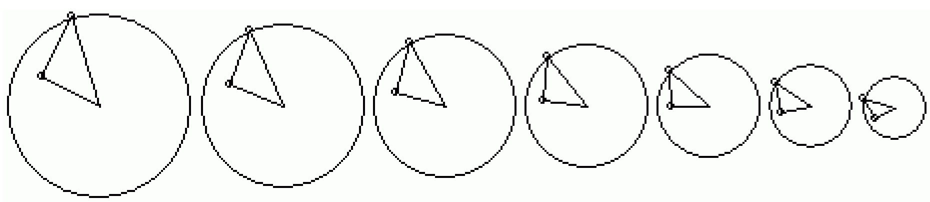
Bohr's planetary atom and the ring electron are examples of tiny machines which illuminate matter. The realm of the tiny machines was extended to the helical electromagnetic wave. Here we explore a simple classical model of the universe in dynamic equilibrium. It is a machine too. Joni Mitchell in "The Circle Game" sees life as a carousel. Our Cosmos is also a carousel. We are looking out from the inside the carousel and as far as you can see, receding into the distance, are painted ponies. We see the carousel expand as the painted ponies drift apart. Can we see the carousel rotate? Our telescopes haven't seen far enough, to see past the carousel, to see any background against which it might rotate. We are still a ship sailing, on the ocean of the Cosmos, out of sight of land. We must use mechanics and the consistency of the picture painted by math, as science has always done, to infer the rotation of the Cosmos from the rules of dynamics, observations of the CMB, alignment of the rotational axis of galaxies and the polarization of the quasars.

There is a lot of math detail so that the ideas are more accessible. The math is written to be copied into a spread sheet or calculator. One may reason as to its correctness. There is no one above you. You are the authority who must decide. The Cosmos has the radius, mass and density quoted for the observable universe. The Cosmos is an entity which rotates and expands with respect to something larger and outside itself. It is a subset of the universe. The universe is the totality of all things that exist and the source of the material for our Cosmos. Our Cosmos continues to expand and slow in its rotation according to the rules of dynamics.

Postulates or Assumptions

1. Our **observable universe** is an **entity**, a **dynamic unit**. Once you see the expanding spinning black hole universe as an entity as a dynamic unit, it has a more local personal character. You are a part of something. You no longer see it in isolation. It is a ball in play in a much larger game. The Cosmos is the universe regarded as an orderly, harmonious whole. The universe is the totality of all things. Cosmos deals with structure, it has more the clockwork dynamic quality which seems to fit an object of study better than the existential term universe. Here **Cosmos** will be the name preferred for our local dynamic unit.
2. It is **rotating** and **blowing up** like a balloon but very slowly in relation to its size. Like a spinning ice skater slows her spin, by extending her arms, the spinning Cosmos slows in its rotation while expanding.

Click image to animate!

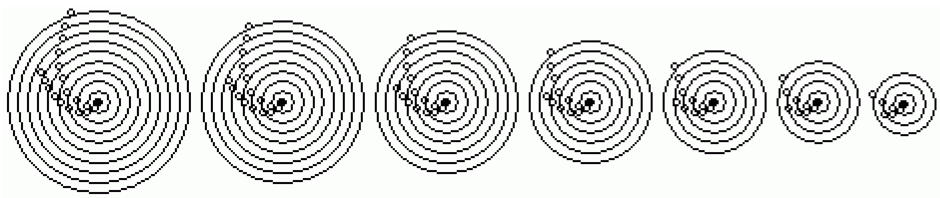


Each circle is a cross section of the Cosmos at a different time. The triangle shows the way it expands and rotates. Light orbits at the perimeter of the Cosmos. As the Cosmos increases in size, light orbits farther out. Most observers would look out in any direction and see the Cosmos expanding faster at greater distances. This is a Hubble expansion. We rotate with respect to that which is very far away and is outside our dynamic unit. The length of the hypotenuse of the triangle **r** is the **radius of the Cosmos**. It is the velocity of light times the age of the Cosmos, at that particular time, or **r = c*age.** The hypotenuse expands and has a tangent velocity of the speed of light, **v = c.** The base of the triangle expands and rotates at its fixed fraction **fr** of the speed of light, **v = fr*c.** This **fraction "fr"** is the cosine of the triangle. We can see that a location, the circled point in the corner of the triangle, where we might be located, expands radially outward and rotates at a constant velocity, proportional to its fraction of the radius of the Cosmos according to the rules of dynamics.

3. Every location within this Cosmos, has a **constant tangent** and **radial velocity** which are **proportional** to its **radius**. Since the velocity is constant, the acceleration is zero, and no force and no power is required for it to continue on its journey. **Energy is conserved**.

4. A location **spirals out** as the Cosmos expands and rotates. The location stays at the same constant **fraction** "**fr**" of the radius of the Cosmos **r = fr*c*age** and a constant velocity **v = fr*c**. Here **fr** at the location is **.7** and the velocity is, **v = fr*c = .7*c.** This is a Hubble expanding Cosmos.

Click image to animate!



This is another way of looking at the triangles. Light really doesn't orbit, it spirals out. ***Everything spirals out***. Everything spirals apart as the Cosmos grows and slows in its rotation. Spiral galaxies are no surprise if they are part of the Hubble expansion. The Cosmos rotates at **c** at a radius of **r = c*age**. Everything has the same tiny **angular velocity = v/r = c/(c*age) = fr*c/(fr*c*age) = 1/age = 2.11E-18_1/s**, radians per second. Age is the **age** of the **Cosmos**. Hubble's constant is also **1/age**. Pluto orbits at **v = 4753_m/s** at a radius of **r = 5.913E12_m**. Pluto's angular velocity **v/r = 8.038E-10 _1/s** radians per second. The Cosmos rotates **831 million** times slower than Pluto. This tiny angular velocity will be very hard to detect. The angular velocity was larger in the past. It is changing with a very small **angular acceleration = -1/age^2 = -4.46E-36_1/s^2** or radians per second squared.

5. ***Our Cosmos has sufficient mass for light to orbit at its perimeter. Orbiting light or energy makes it a black hole Cosmos.***
6. From inside the void, left by the departing perimeter, we see the very nearly uniform microwave background radiation also known as the cosmic microwave background the **CMB**. It is W/m^2 of low energy light or heat. ***The CMB comes from the thin spherical region where light orbits. It is made uniform and emitted by photon-photon scattering.*** The fact that the CMB appears uniform implies that we might be near the center of the CMB and the Cosmos, an unlikely occurrence, which we will revisit later. The glow of the CMB is dimming since the perimeter's area **4*pi*r^2 = 4*pi*c^2*age^2** is proportional to the **age^2** and luminosity to **1/age^2**. The luminosity is decreasing at the same rate as the Cosmos is slowing down in its rotation and increasing in surface area. Its glow is also greatly reduced by the inverse square nature of radiation in its immense travel thru space. It can be described, by the equation for a sphere expanding at the speed of light, like the spherical wave front of an electromagnetic wave with a radius of **r = c*age** so that **$x^2+y^2+z^2 = c^2$*age^2** but this is beyond the scope of our simple dynamics.

Hubble (age, radius and radial velocity of the Cosmos)

Edwin Hubble determined from the linear Doppler red shift of galaxies that they are receding at a rate proportional to distance. It is called Doppler because of the familiar Doppler frequency shift of sound with the velocity of the sound source. Here the frequency shift is in the light toward the red with increasing velocity of recession. Think of a sine wave appearing stretched as it moves away. The peaks of the sine wave seem stretched farther apart as it moves away. There is a longer duration between the peaks as the sine wave moves away. The longer duration is the sum of the natural original duration between the peaks of the sine wave plus the duration between the peaks added by the recession of the sine wave. The sine wave seems to have a lower red shifted frequency. The sine wave is unchanged only our point of view and relative velocity has changed. Does space stretch? How could it? Space is empty. How could we see billions of light years with telescopes unless space is empty? Is it more likely that our point of view has changed or that space has changed by becoming stretched? Some people mistake abstraction for reality.

Edwin Hubble determined from the linear Doppler red shift of galaxies that the velocity of recession at a certain distance, divided by that distance is a constant. Hubble's constant, **Ho**, is about **65 km/(s*Mpc),** kilometers per second per million parsecs. In smaller units, this is **2.11E-18_m/s per meter,** 2.11 times 10 to the minus 18 meters per second per meter or **2.11E-18_1/s.** ***Using these smaller more familiar units may lead you to wonder if the expansion is also local. Does the Hubble expansion extend to the galaxy, to the solar system, to atoms? If it exists, was it missed because the size of the expansion is so small?*** Hubble's constant has units of **1/seconds** which is frequency, angular velocity or **1/age**. The reciprocal of this is **4.74E17_s** or **15 billion years** more or less, hereafter for clarity, called the **age** or the age of the universe.

Four examples are;
130_km/(s*Mpc) = 1/7.5 billion years
65_km/(s*Mpc) = 1/15 billion years
32.5_km/(s*Mpc) = 1/30 billion years
16.25_km/(s*Mpc) = 1/60 billion years

At earlier times, Hubble's constant was bigger and the Cosmos was smaller. Hubble's constant is **1/age = c/(c*age) = c/15 billion light years.** This implies that the Cosmos is expanding at the speed of light, at its current perimeter, at a **radius = 15 billion light years = c*age = 1.42E26_m,** the current radius of the universe. Hubble varies, but the **radial velocity** of expansion **vr** is constant with distance divided by age or **vr = r/age = c*age/age = c.** This is **age** and **radius** *based on* the currently observed **expansion rate**, *not* an affirmation of a creation event 15 billion years ago. A better choice of origin, for our local dynamic unit, our Cosmos, is growth by accretion, accumulation, clumping and merger which are inherently random and how planets are formed. Merger can not predict an exact time of creation or an origin from a point as does the sacrosanct Big Bang. Merger is a choice, in favor of the mundane and more likely, over the miraculous. The more we know, the less we seem to be the center of the universe.

Binary star systems and galaxies show rotational Doppler red shift. The approaching star in a binary system is bluer and the receding star is redder. The approaching side of a galaxy is bluer and the receding side of a galaxy is redder. The color change is due to velocity. Vera Rubin found that in many galaxies the velocity seen in the red shift spectrum in the rotation of the galaxy does not follow Kepler's laws by decreasing with radius but stays the same at greater radius. The galaxies are said to have **flat rotation curves**. Radio telescopes extended these flat rotation curves out to the dust clouds that orbit galaxies. We will extend these flat rotation curves even further when we look at an explanation for **dark matter**.

Non-Doppler red shift is red shift unrelated to the velocity of recession. The much hotter star in a binary system shows non-Doppler red shift. Since the binary stars are receding at a common velocity, the substantial non-Doppler red shift of the hotter star is not due to velocity. The sun also shows non-Doppler solar red shift. There is an unknown ratio between the Doppler and non-Doppler red shift components of Hubble's constant.

- If **1/2** the Hubble constant is due to non-Doppler red shift then the Doppler Hubble constant should be, **32.5_km/(s*Mpc)** not **65_km/(s*Mpc)** and the Cosmos is **30 billion years old** not **15 billion years old**.
- If **3/4** the Hubble constant is due to non-Doppler red shift then the Doppler Hubble constant should be, **16.25_km/(s*Mpc)** and the Cosmos is **60 billion** not **15 billion years old**.

The Cosmos must be much older and larger when non-trivial, non-Doppler red shift is included since the calculated radius is proportional to the age of the Cosmos. If most or all of the red shift is non-Doppler and the CMB is the ambient temperature of the star lighted universe, as in the strong case presented by Marmet and Reber, then the universe is infinitely old, large and massive. I assume for now that some of the Hubble constant is Doppler and that the Cosmos slows in its rotation as it expands. The next section might be clearer after reading Gravity, rosettes, binary systems and inertia.

Orbiting light

$m*vt^2/r = G*m*M/r^2$, this is **centrifugal force** equals **gravitational force**, a common characteristic of orbits. The **mass** of **M** is usually much larger than **m**. Both masses still orbit across from each other around a common center of mass but this center of mass is close to the center of **M**.

$m*c^2/r = G*m*M/r^2$, substituted **c** for **vt**,

Light will orbit with the tangent velocity **vt = c** at the radius of the Cosmos. ***We know that gravity deflects light from numerous cases of gravitational lensing so it is not too big a step to see that a deflection of light with one mass could become an orbit of light with a much greater mass.***

$m*c^2 = G*m*M/r$, multiplied by **r**

This is **rest energy** equals the **gravitational energy** and a clue that we are on the right track. **$m*c^2$** is energy, as is light. Only light and energy orbit at the perimeter at a radius of **c*age** at the speed of light. Everything else orbits, within the perimeter, at less than the speed of light. **Orbiting light makes this a black hole**. One could see out of our Cosmos because **light can get in**, but **light can't escape** from our Cosmos so it would be black from the outside.

Mass of the Cosmos

$m*c^2 = G*m*M/r$, energy from above.
$c^2*r = G*M$, multiplied by **r/m**
$c^2*c*age = G*M$, substituted for **r = c*age,** the radius of the Cosmos.
$c^3*age = G*Mc$, collected c's, **M** is now **Mc**, the mass of the Cosmos.
This means that either **G**, **Mc** or both increase with **age**.
$G = c^3*age/Mc$, or
$Mc = c^3*age /G = 1.91E53\_kg$ = the mass of the universe. If **G varies with age** the mass is constant.

Cosmic vorticity

$4*pi^2*r^3 = p^2*G*M$, Kepler's third law may be used with **r = c*age**, the radius of the Cosmos and $G*Mc = c^3*age$, the consequence of an expanding Cosmos with enough mass for light to orbit. **p** is the orbital period.
$4*pi^2*c^3*age^3 = p^2*c^3*age$, substituted for $r^3 = c^3*age^3$ and $G*M = c^3*age$
$4*pi^2*age^2 = p^2$, collected terms
p = 2*pi*age = 94 billion years. This is the rotational **period** of the vorticity of the Cosmos. The period increases as the Cosmos gets older. The axis of rotation of most galaxies line up with a pattern in the WMAP CMB called the "axis of evil" in this "New Scientist article or this Goodness in the axis of evil article. This is according to a study of 1660 galaxies in the Sloan Digital Sky Survey. Rotation has been suggested in the analysis of WMAP data and in the polarization of quasars which also tend toward this axis. ***These are evidence for the rotation of the Cosmos.***

Energy at the radius of the Cosmos

Gravitational energy from above with increasing values for **r** and **G** is
$G*Mc *m /r = c^3*age *m /(c*age) = m*c^2$
We see that the **age** cancels and gravitational energy stays constant as the Cosmos expands. Power is the rate of change of energy. If the energy is constant then no power is required for the continual expansion of masses which follow the Hubble expansion.

Forces at the radius of the Cosmos

centrifugal force $= m *vt^2 /r = m *c^2 /(c*age) = m*c/age$
gravitational force $= G*Mc *m /r^2 = c^3age *m /(c^2*age^2) = m*c/age$
Since $E = m*c^2$ then $m = E/c^2$ or $m*c/age = E/(c*age)$
The orbital forces equal the orbiting energy divided by the radius of the Cosmos. The **gravitational energy** $= m*c^2$ is constant as orbital forces decrease with age. This allows orbits to increase and spiral out while orbital periods increase and the tangent velocity stays constant.

Inside a fraction of the radius of the Cosmos

r = fr*radius = fr*c*age = distance from the center of the Cosmos to the orbiting mass **m**. **fr** is the fraction of the radius to the perimeter of the Cosmos.
vt = fr*c = tangent velocity

m $*vt^2/r = G*M*m/r^2$, the centrifugal force equals the gravitational force.
$M = vt^2*r/G$, isolate **M** the mass within the fraction "**fr**"
$M = fr^2*c^2*fr*c*age*Mc/(c^3*age) = fr^3*Mc$, where **Mc** is the mass of the Cosmos and $G = c^3*age/Mc$.
$vt^2*r = G*M$, becomes
$fr^2*c^2*fr*c*age = G*fr^3*Mc$
$fr^3*c^3*age = fr^3*c^3*age$
If **fr = .9** then something orbits with **vt** and **vr = .9*c** at a radius of **.9*c*age** while it encloses a mass of $.9^3*Mc$ or
$.9^2*c^2*.9*c*age = G*.9^3*Mc$
$.9^2*c^2*.9*c*age = .9^3*c^3*age$, which confirms the math.

The gravitational energy = $G*M*m/r = c^3*age/Mc*fr^3*Mc*m/(fr*c*age) = fr^2*m*c^2$
The gravitational energy is constant if **fr** is constant. No power is required for the ongoing expansion.
The centrifugal force = $m*vt^2/r = m*fr^2*c^2/(fr*c*age) = m*fr*c/age$
The gravitational force = $G*M*m/r^2 = c^3*age/Mc*fr^3*Mc*m/(fr^2*c^2*age^2) = m*fr*c/age$
We see that the mass "**m**" will spiral out while the Cosmos expands with the orbital forces decreasing as **m**'s orbital radius increases with the age of the Cosmos. As **fr** increases the gravitational force increases so that there is a gravitational gradient.

Density of the Cosmos

The density within a fraction of the radius of the Cosmos is
mass /volume =
$fr^3*Mc/(4/3*pi*fr^3*c^3*age^3) =$
$3*Mc/(4*pi*c^3*age^3) = 1.6E\text{-}26\_kg/m^3$ **or** $1.6E\text{-}29\_g/cm^3$, the fr^3's canceled so this average density is the same throughout the Cosmos. The mass of a proton or hydrogen atom is **1.67E-27_kg** so the average density of the universe is about ten protons per cubic meter and is decreasing with the cube of the age of the Cosmos. This is in the range of reported values.

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http://blackholeformulas.com/files/GSJIntroduction.docx

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Chapter 2 - Black hole universe

Introduction

There are two ways of defining a black hole and two black hole formulas. The original black hole definition goes back centuries where ***gravitational energy equals kinetic energy***. It is based on escape velocity from a star *exceeding* the speed of light. There is more in the appendix. We have been using a second black hole definition in looking at the Cosmos. Here ***gravitational energy equals rest energy***. It is based on the idea that a black hole has enough mass for light and energy to orbit. This may be the first time it has been published. This is a simple and logical classical definition. We will continue using this new definition since it answers so many questions.

Energy in orbit black holes

$\mathbf{m*vt^2/r = G*m*M/r^2}$**,** The **centrifugal force** equals the **gravitational force**. **vt** is the tangent velocity. **M** and **m** are masses with the radius **r** between them. **G** is the gravitational constant.
$\mathbf{m*c^2/r = G*m*M/r^2}$**,** replaced the tangent velocity **vt** with **c**, now light can orbit.
$\mathbf{m*c^2 = G*m*M/r}$**,** multiplied by **r**
The orbiting energy equals the gravitational energy. If **G** and **r** both increase at the same rate then the orbiting and gravitational energy are constant as the black hole expands. Energy is conserved. The tangent velocity is **c**. Light orbits at the specific radius **r**. Can light follow an elliptical orbit which requires changes in velocity? Light might follow a circular orbital path, a spiral path or a bent path as in gravitational lensing. These paths could form a spherical shell or an empty shell since light has energy and consequently mass. Any mass inside the shell would contribute to the total mass, increasing the radius of the shell. An empty shell of a black hole does require some thought.
$\mathbf{c^2 *r = G*M}$**,** multiplied by r/m. This is our definition of a black hole or;
$\mathbf{c^2 *r /(G*M) = 1}$
$\mathbf{c^2 *c*age /(c^3*age) = 1}$**,** substituted the values we calculated in the section on Hubble for $\mathbf{r = c*age}$ and $\mathbf{G*M = c^3*age}$.
All the terms cancel, telling us that our Cosmos is a black hole.

Expanding black holes

$\mathbf{M/r = c^2/G = 1.35E27\_kg/m}$**,** the current value of the **mass per radius ratio** for a black hole which decreases with age. A black hole increases by **1.35E27_kg per meter** of radius currently but we will see there are lower limits for density and radius.
If $\mathbf{G = c^3*age/Mc}$ varies with age then $\mathbf{r = vr*age}$ must also vary with age, if the **mass** and **c** are constant. **vr** is the constant radial velocity of expansion at its perimeter.
$\mathbf{vr *age = M *G /c^2}$**,** substituted for $\mathbf{r = vr*age}$.

$vr * age = M * c^3 * age/Mc / c^2$, substituted $c^3 * age/Mc$ for **G**, **age** cancels
$vr = M * c/Mc$, collected terms, since the **age** cancels, the radial velocity of expansion is constant and proportional to mass. ***Black holes expand***.
vr = M *1.568E-45_m/(s*kg), or
vr/c = M/Mc

- For a **ten solar mass** black hole or **1.99E31_kg, vr = 3.12E-14_m/s**
- For a **billion solar mass** black hole or **1.99E39_kg, vr = 3.12E-6_m/s**. This expands at **98_m/year**.
- For a **9.61E22 solar mass** black hole or **1.91E53_kg, the mass of the Cosmos Mc, vr=299792458_m/s = c**

Black holes expand proportional to their mass. The radius of the Cosmos expands at the speed of light **c**, or **1_light year per yea**r, because it has enough mass for it to expand at **c**. This expansion is one year in the age of the Cosmos or **one part in 15 billion per year** currently. This is quite small.

Variable G

You may have noticed that **G** has a value of **one in 15 billion**. It is increasing in proportion to the age of the Cosmos.
1/(15 billion) - 1/(15 billion and one).
$G = c^3 * age / Mc$, so in a year, $deltaG = c^3 * (seconds\ in\ a\ year) / Mc = 4.44E\text{-}21\_m^3/(kg*s^2)$
The gravitational force was stronger in the past. ***How do we detect such a small ongoing increase in the gravitational constant?***
$c^2 * r = G*M$, after canceling the **m**'s from above
$c^2 * c * age = G*M$, substitute for **r = c*age**.
$c^3 * age = G*M$, collect the **c**'s.
We take **c** and **M** to be constants. If **r** is a variable and increases with age then **G** is a variable and must increase with age. This can be written **G = gk*age, G** increases with time.
$gk = G/age = G*Ho = 1.41E\text{-}28\_m^3/(kg*s^3)$, **gk** appears to be a universal constant in contrast to **Ho** which is Hubble's variable *constant* and **G** which is the variable gravitational *constant*.
$c^3 * age = G*M$, from above.
$c^3 * age = gk*age*M$, **G** increase with age so we can substitute **G = gk*age**
$c^3 = gk*M$, we can cancel the **age**.
$c^3/gk = Mc = 1.91E53\_kg$ = The **mass of the Cosmos.** Is **mass is due to gravity** since that would explain **rest energy equals gravitational energy**?

G increases with time while gravitational force decreases with time

$force = G*m*M/r^2$, gravitational force
$force = gk*age*m*M/(c*age)^2$, substituted for **G** and for **r** the size of the Cosmos.
$force = gk*m*Mc/(c^2*age)$, the force decreases with age. The gravitational force was much stronger earlier. Light from a distant earlier time has a greater gravitational red shift. *How does this affect distance calculations?* Star formation, accretion and fusion rates would have been affected by the stronger gravitation in the past. The standard candle, Type 1A supernovas would

have been affected. *What does this do to the accelerating universe dark energy theory?*
force = gk*m*c^3/(gk*c^2*age), substituted for **Mc = c^3/gk**.
force = m*c/(c*age) = m/age, force decreases with **age** or radius of the Cosmos for a energy equivalent of a mass at the radius of the universe.
Mc/r = c^2/G = 1.35E27_kg/m, The Cosmos has always been a black hole. This mass to radius ratio quantifies an energy in orbit black hole at the present time. If the mass is constant and the radius increases then this ratio must decrease with time.
Mc/(c*age) = c^2/(gk*age), expand **r** and **G**.
Mc = c^3/gk, multiplied by age and collected c's, the mass of the Cosmos does not vary with age but its radius does.

Black hole density

mass = c^2*r/G = c^2*c*age/(gk*age) = c^3/gk, for the **Cosmos**
r = mass*G/c^2 = mass*gk*age/c^2
density = mass /volume
c^2*r/G /(4*pi*r^3/3) =
3*c^2/(4*pi*G*r^2), the density decreases with **r^2**.
3*c^2/(4*pi*gk*age*c^2*age^2), substituted for **r = c*age**.
3/(4*pi*gk*age^3), the density decreases with **age^3** as you would expect.

3*c^2/(4*pi*G*r^2), from above, substitute for **r = mass*gk*age/c^2** and **G = gk*age**
3*c^6/(4*pi*gk^3*age^3*$mass^2$), the density decreases with **$mass^2$** or with **age^3**.
Four examples of black hole density using the mass formula;

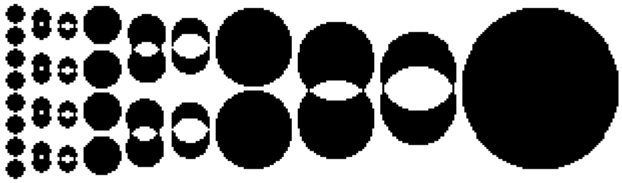
twenty solar mass = 3.68E17_kg/m^3
ten solar mass = 1.47E18_kg/m^3
five solar mass = 5.90E18_kg/m^3
1.4 solar mass = 6.6E25_kg/m^3

These are in the range of the density of a neutron star or nuclear density of **10E21_kg/m^3** inside the nucleus of an atom, as calculated by particle physicists. The density increases as the mass of the black hole decreases up to a limit and then the black hole is seen as a neutron star not a black hole. Less than five solar masses is observable as a neutron star not a black hole. Astronomers say neutron stars cluster around a mass of **1.4** solar masses or **2.8E30_kg**, and a radius of **9.6 - 11.0_km** which gives a density of between **6.9E25_kg/m^3** and **6.0E25_kg/m^3**. The highest density in energy in orbit black holes is therefore nuclear density. The density decreases as the square of the radius or mass so a larger radius or mass means a lower density. As the mass goes up the density goes down. ***We have black holes without infinities.***

Cosmic density

The lowest density black hole is our Cosmos.
Mc/ (4/3*pi*c^3*age^3) = 1.6E-26_kg/m^3 or 1.6E-29_g/cm^3
The mass of a proton or hydrogen atom is **1.67E-27_kg** so the average density of the universe is about ten protons per cubic meter and is decreasing with the cube of the age of the Cosmos. This is in the range of reported values

Merging black holes



Visualize two spheres that overlap, their contents merge, thereafter being enclosed by a single larger sphere, of their combined diameters. The light and energy in orbit around each black hole, will after merging, and after their travel through space, eventually orbit at this new larger radius. The light that previously orbited around each black hole will combine to orbit at the new combined black hole radius.

All these photons orbiting at the same radius have many photon-photon impacts which make the very thin layer of photons uniform. Not all of these photon-photon or gamma-gamma scattering's are elastic, many of these impacts emit light which reaches us as the cosmic microwave background the CMB.

While we would expect to see an approaching object to be seen as blue-shifted on the outside of our Cosmos, an approaching black hole emits no light, as all its perimeter light is in orbit. We would only see an approaching black hole when it merged with our own and suddenly appeared inside the perimeter of our Cosmos.

Little ones merge to make big ones. Two soap bubbles merge to make a larger soap bubble. In eggland, two eggs touch. Their shells merge much like soap bubbles merge. Their contents merge. Where there were two eggs, there is now one larger egg with two merged yokes. Over time, there is a very big egg with many yokes merged together. The yokels, being unaware of the mechanics of merging, make up odd stories of their creation and their importance to the creator.

There are groupings of mass in space so great, that gravity in the age of the Cosmos, would be inadequate for their formation from hydrogen gas. These are called large-scale structure. An example is the Sloan Great Wall. Their great mass should have been reflected in the observed inhomogeneities in the CMB, if the conventional theory is right. The merging of black holes, does however, explain these structures. The smaller black hole has a much higher density. The merged contents are enclosed in a much larger volume. From within, one sees only the merged contents. The smaller black hole leaves behind a higher residual mass density, in the stretched out, merged contents, which is the artifact or footprint of their merging.

M/r = mass/radius = c^2/G = 1.35E27_kg/m
radius = r = mass *G/c^2
surface area = $mass^2$ *4*pi* G^2/c^4
volume = $mass^3$ *4*pi*$G^3/(3*c^6)$
density = mass /volume = $3*c^6/(mass^2$ *4*pi*$G^3)$

Two times mass equals; two times radius, four times surface area, eight times volume, density divided by four, and two times vr.

Spherical caps of merging spheres: See the figure above.
A spherical cap is a part cut off a sphere. When two spheres merge they create a lense shaped merged region. The volume of the lens shaped merged region includes twice the volume of the spherical caps of each sphere. The volume of a spherical cap is,
$1/3*pi*r^3*(3-fr)*fr^2$, with fr, being the fraction of r, that is the height of the cap. The volume of a sphere equal to four spherical caps would be
$4/3*pi*r^3 = 4/3*pi*r^3*(3-fr)*fr^2$, or
$1 = (3-fr)*fr^2$, or **fr = .6527036**
When the spherical caps of merging black holes of the same size reach .6527 of their radius, the volume and the mass of the merged portions satisfies the mass/radius formula for a black hole.

The new velocity distribution in the merged black hole will cause all the orbits to relocate over time but these are small acceleration forces in a low density Cosmos like our own. Light and energy will eventually occupy a circular orbit at the new now larger radius of the black hole. The masses within will seek their own new orbits. The acceleration at the edge of the Cosmos is **c/age = 6.33E-10_m/s^2** and is fractionally smaller within the Cosmos. This is billions of times smaller than the acceleration of gravity at the Earth's surface of **9.8_m/s^2**. Far from being a dramatic event, the merging of low density black holes would be hardly detectable from an acceleration standpoint. A black hole approaching ours would be invisible until the merging. Its contents would then become visible in our Cosmos.

Panspermia

When black holes merge they also incorporate a lot of volume and matter which was outside the two original black holes. The material outside the merging volumes would be relatively undisturbed in large low density black holes. This seems a very natural way for black holes to grow and many stars and galaxies would survive as would the life they might harbor. This is another level being added to the ancient idea of panspermia or transfer of life between planets or stars as popularized by Fred Hoyle and others. The viral or bacterial spores in rock can survive for many thousands of years so a super nova, planetary impacts or planetary explosions could spread rock fragments and spores to other planets or star systems. Life could spread across a solar system, galaxy or merging Cosmos's.

There was a super nova relatively near our solar system around the time that the Earth formed. It left the Earth with its radioactive materials. It would not be surprising if it also left the Earth seeded with life in the form of rocks with embedded bacteria or spores from the nova stars solar system.

Appendix- review of traditional black holes

There are two ways of defining a black hole and two black hole formulas. In the traditional black hole **gravitational energy equals kinetic energy** while in the energy in orbit black hole **gravitational energy equals rest energy**. The original black hole definition goes back centuries and is based on escape velocity from a star *exceeding* the speed of light.

If the escape velocity only *equals* the speed of light then the light will escape. This is the case with the Schwarzschild black hole. The idea with escape velocity is that the escaping object is slowing continuously and reaches infinity with zero velocity and zero kinetic and gravitational energy.

$.5*m*vr^2 = G*m*M/r$, The kinetic energy equals the gravitational energy. Here **vr** is the radial velocity, the escape velocity and **c**. The idea here is that the light has no energy when it reaches infinity. Anyone closer than infinity might find light with energy remaining and a very visible black hole.

$.5*m*c^2 = G*m*M/r$, if **vr = c**

$m*c^2 = 2*G*m*M/r$, the rest energy equals twice the gravitational energy. This demonstrates another aspect of traditional black holes. The energy of the escaping light is twice the gravitational energy, so when the gravitational energy is zero at infinity, the light still has half its original energy.

$m*c^2/r = 2*G*m*M/r^2$, divided by **r**.

The centrifugal force equals twice the gravitational force, so light can not be restrained to an orbit.

Using escape velocity has problems with the fixed velocity of light,

$.5*m*vr^2 = G*m*M/r$, kinetic energy equals gravitational energy

$r = 2*G*M/vr^2$, isolated **r**, this is called the ***Schwarzschild radius*** in General Relativity.

If **r = infinity** in the equation above, then **$infinity = 2*G*M/vr^2$** which is ok, **vr** is a variable that goes to zero at infinity.

If **r = infinity** and **vr = c** then **$infinity = 2*G*M/c^2$** which is false, **c** can not go to zero at infinity.

Other characteristics of the traditional black hole are:

$M/r = c^2/(2*G) = 6.73E26$_kg/m

$c^2*r/(G*M) = 2$

density = mass /volume =

$3*c^2 /(8*pi*G*r^2)$, using the radius, here the density decrease as the square of the radius not according to **$mass/volume = mass*3/(4*pi*r^3$**) or

$3*c^6/(32*pi*G^3*mass^2)$, using the mass. This equation allows for no change over time. ***In an expanding universe the density must decrease over time***.

Two times mass equals two times radius, four times surface area, eight times volume and density divided by four.

Energy in orbit black holes

Energy in orbit black holes are *not* the photo-sphere, within the event horizon of the Schwarzschild black hole, where light may orbit because gravity is stronger due to warped space-time than gravity would be according to the mass of the black hole alone.
The mass/radius ratio of traditional black holes is half that of energy in orbit black holes. This difference may be detectable with the measurement of orbital periods of x-ray emitting clouds that orbit some black holes in binary systems of a black hole and star as reported, in this edited excerpt from May 12, 2001, Science News.
"The Rossi satellite detected X rays that flicker 300 times per second, from the region around GRO J1655-40. Astronomers would expect this from a blob of hot gas orbiting 64 km from the 6.3 solar mass black hole. Rossi also recorded an X-ray signal flickering 450 times per second. A radiating blob of gas orbiting a black hole is like a lighthouse beacon sweeping past Earth hundreds of times per second, suggests Strohmayer. The closer the blob gets to the black hole, the faster it orbits. The most rapid oscillation detected by Rossi can best be explained by blobs of gas that are orbiting 15 km nearer to the hole than indicated by the slower flickering, he says. The material could maintain itself at this closer distance only if the black hole spins, Strohmayer asserts."

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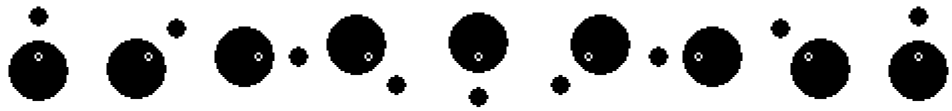
Chapter 3 - The rotating universe



Introduction

As the light and energy orbit the expanding Cosmos, it takes longer to reach a reference point against the background universe. Newton would call this reference point absolute space. Mach would call it the fixed stars. The Cosmos, galaxy and solar system all rotate, with respect to that which is outside our cosmic dynamic unit. If the background universe has features which are close enough, and these features are not black holes, then they may be visible through the intense orbiting energy and light around the Cosmos. Seeing through this orbital energy seems possible since stars are visible near the sun during an eclipse as starlight perpendicular to the huge energy flow from the sun. We might be seeing such features in the Hubble telescope deep field photographs. It would not be remarkable if the background universe looks the same as it does within our dynamic unit Cosmos.

Rotation or vorticity

The **angular velocity = tangent velocity/radius= vt/r = c/(c*age) = 1/age** in radians/second or Hubble's constant as a rotation rate or **fr*c/(fr*c*age) = 1/age**

The **rate of change** of the **angle of rotation** is the **angular velocity.**
The **rate of change** of the **angle of rotation** is **1/age.**
The **rate of change** of the **ln(age)** is **1/age.**
The **angle of rotation = ln(age)** = the natural logarithm of the age = **ln(4.73E17) = 40.7 radians**.
The base of the natural logarithms is **e**.
$\mathbf{e^{(\text{angle of rotation})} = e^{40.7} = 4.73E17 = age}$
ln(age*2) = ln(age) + ln(2). Each time the Cosmos doubles in age or size the angle of rotation of the Cosmos increases by the **ln(2) = .693 radians = 39.7 degrees**
We are currently at 40.7 radians so **40.7 /(2*pi) = 6.5 revolutions** might have been made by the orbiting light and energy in the age of the Cosmos. The last revolution started when the Cosmos was, $\mathbf{e^{(40.7 - 6.28)}}$ **= 8.88E14_s = 28.1 million years old.**
The previous revolution took **15 billion years**.
The next revolution will end in, $\mathbf{e^{(40.7 + 6.28)}}$ **= 2.53E20_s = 8.017E12_years = 8017 billion years.**
The next revolution will take **8000 billion years**. ***The slowly stirring Cosmos is slowing down***.

The rate of change of the angular velocity **1/age** is the angular acceleration.
angular acceleration = $\mathbf{-1/age^2 = -4.46E\text{-}36\_1/s^2}$**.** This is the second derivative of the angle of rotation. This very small rate that the Cosmos is decelerating in its rotation is necessary for the

equilibrium between rotation and expansion. We are rotating with the Cosmos. Everything has the same universal angular velocity **1/age** as a component of their local angular velocity, as we will see in our galaxy. The Cosmos rotated faster when it was younger. This differential rotation might be detected but the angular acceleration is profoundly slow at **1/age**.

Inertial accelerations

To calculate the path of expansion of a particle we need the vector sum of three accelerations; the centrifugal, tangent and Coriolis. These are components of the so called fictitious forces which are more properly called forces due to inertia. They are certainly not fictitious if you take the Machian view that inertia is the acceleration dependent gravitational force exerted by the rest of the Cosmos. See the article on Inertial Inductance.

Centrifugal acceleration

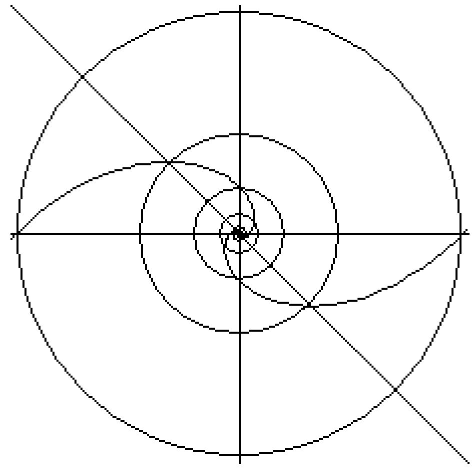
The centrifugal and gravitational forces are equal. **$m*c^2/r$** equals the centrifugal force and **c^2/r** is the acceleration felt by light or energy in orbit at the perimeter of the Cosmos.
$c^2/r = c^2/(c*age) = c/age = 6.33E\text{-}10\_m/s^2$ or **$c^2*fr^2 /(c*age*fr) = fr*c/age$** if fr is less than one

Tangent acceleration

We can calculate the tangent acceleration using the torque formula.
moment of inertia*angular acceleration = force*radius.
$m*r^2$*angular acceleration = m*a*r.
a = r *angular acceleration = tangent acceleration
$a = c*age *1/age^2 = c/age$, or
a = fr*c/age if fr is less than one
The direction of deceleration is opposite of rotation. The tangent acceleration can also be calculated from velocity dependent inertial induction with the same result.

Coriolis acceleration

Inertia will cause an outward directed mass, on a rotating platform, to lag behind in a direction opposite to the rotation. This is the reaction. The action which is the Coriolis acceleration is in the direction of the rotation. A person in an accelerating car is pushed back against the seat. This is a reaction to the acceleration. The acceleration is in the direction of the velocity. The reaction is in the direction opposite the velocity.
2 *angular velocity *vr = 2 *vt/r *vr = 2 *c/(c*age) *c = Coriolis acceleration
vr is the radial velocity which at the perimeter is **c**.
2*c/age = Coriolis acceleration or
fr*2*c/age if fr is less than one



Click to enlarge! Spirals:

Now that we have calculated the inertial accelerations, we can look at the way the Cosmos expands. We have the **centrifugal acceleration of c/age,** directed radially out. We have the **Coriolis acceleration of 2*c/age,** in the direction of rotation, and the **deceleration of c/age,** in the direction opposite of rotation. The resultant of these accelerations is 45 degrees between the direction of rotation and the outward directed radius. It has a value of **$2^{1/2}$ *c/age = 8.96E-10_m/s^2**, quite close to that of the Pioneer Anomaly. A particle moving in this way traces out a logarithmic spiral. We have seen that the

angle of rotation = ln(age). This can be written as

age = $e^{(\text{angle of rotation})}$. Now

r = c*age, can be written as

r = c*$e^{(\text{angle of rotation})}$. This is the equation of a logarithmic spiral. It is no coincidence that many galaxies have a spiral shape. Indeed, it is not that space expands, but that the distance between orbiting masses increases as they spiral out and apart from each other, as the Cosmos expands and slows in its rotation. The tangent velocity of the stars orbiting in galaxies stays the same as the galaxies expand and the orbital periods increase. Any velocity change would require force and energy which are absent.

Torque of a spinning black hole

moment of inertia *angular acceleration = torque

M *r^2*angular acceleration =

M *vr^2 *age^2*angular acceleration, but

vr/c = M/Mc, so **vr^2 = c^2*M^2/Mc^2,** therefore substituting for **vr^2**

M *{c^2*M^2/Mc^2} *age^2 *angular acceleration =

M^3 *c^2/Mc^2 *age^2 *angular acceleration = torque.

If the mass of the black hole is, **M = Mc**, the mass of the Cosmos, then

Mc *c^2 *age^2 *(1/age^2) = Mc *c^2

We see that the **age^2**, in the square of the radius, in the moment of inertia, increases at the same rate the angular acceleration **1/age^2** decreases so that the **age^2** in each cancels and the energy stays constant. We will see the same thing in the torque of a spinning galaxy.

The dynamics of the Cosmos

The radius of the Cosmos increases while the rotation of the Cosmos slows down, and with it all the black holes and galaxies, without a change in energy or use of power, always in dynamic equilibrium. Orbits spiral out as the gravitational force decreases with the age of the Cosmos.

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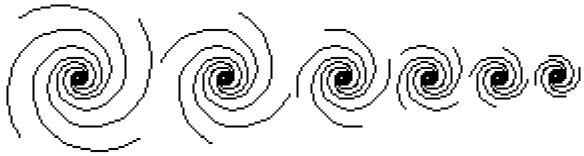
Chapter 4 - Dark matter



Introduction

Dark matter can be explained by matter present farther out from the galaxy than is seen in the optical spectrum. The orbiting atomic hydrogen clouds are also in this region. Each meter of radius in moving out from the center of a galaxy adds a fixed amount of mass to a bigger volume so the density decreases with radius. The galaxy extends to the radius at which the galaxy is the same density as the Cosmos.

Measured tangent velocity within our galaxy

We have a tangent velocity **vt** of 210,000 m/s at a radius within the galaxy of **30_kpc** or **98,000 light years = 9.26E20_m**. The mass contained within this orbit is
M = vt^2*radius/G = 6.12E41_kg or 308 billion solar masses.
The mass/radius ratio **m/r = 6.12E41_kg/9.26E20_m = 6.61E20_kg/m** or **vt^2/G.**
The mass added by the next meter of radius **6.61E20_kg** when divided by the volume added by the next meter of radius, is the density at this radius, or the mass/radius ratio, **m/r = vt^2/G**, divided by the surface area of a sphere at this radius.
(m/r)/(4*pi*r^2) or **(vt^2/G)/(4*pi*r^2) = density = 6.61E20_kg/m/(4*pi*$(9.26E20\_m)^2$) = 6.13E-23_kg/m^3.**
I suspect that this low density of matter or dark matter, would usually be hard to detect for example with 21_cm radiation, but it is obviously still probably matter not some mysterious stuff. Radio telescopes can detect the atomic hydrogen at **21_cm** if it is dense enough along their line of sight. Cold molecular hydrogen which is more stable, is probably much more common but is unfortunately invisible at radio wavelengths. It may be detected in the future as the unseen dark matter.

Flat rotation curves of galaxies

m*vt^2/r = G*m*M/r^2, centrifugal equals gravitational force.
In reference to galaxies, **vt^2 *r = G*M,** as **r** the radius within a galaxy increases, **vt^2** the tangent velocity of stars, at that radius within the galaxy should decrease with **G*M** taken as a constant. However, what is seen is that the tangent velocity **vt** is largely flat. Vera Rubin's made the discovery that the velocity stays the same with increasing radius once outside the galactic core. This is called a flat rotation curve, an unsolved problem of physics for which we provide an answer. A way this can be written is **vt^2/G = M/r**. The **vt** will stay constant with increasing radius and mass if the **mass/radius ratio M/r** is maintained in **vt^2/G = M/r**. This is similar to the mass/radius ratio seen as a defining condition for a black hole and the Cosmos with **c^2/G = M/r**, another clue we are on the right track.
If the galaxy increases with a constant **m/r** then the density **m/r*R/(4/3*pi*R^3)** decreases as

$1/R^2$. A good upper limit for the radius of the galaxy would be the radius at which the ***density of the galaxy equals the average density of the Cosmos***.
$m/r*R/(4/3*pi*R^3) = Mc/(4/3*pi*c^3*age^3)$, but **$m/r = vt^2/G$** so
$vt^2/G*R/(4/3*pi*R^3) = Mc/ (4/3*pi*c^3*age^3)$
$vt^2/R^2 = Mc*G/(c^3*age^3)$, substitute for **$Mc*G = c^3*age$**
$vt^2/R^2 = c^3*age/(c^3*age^3)$, collect terms
$vt^2*age^2 = R^2$
vt*age = R
The tangent velocity **vt**, which is seen in the flat rotation curves of galaxies, times the age of the Cosmos equals the radius of the galaxy. The outer extent of the galaxy which also orbit at **vt** is too low in density to be seen with telescopes except for occasional higher density gas clouds, which may produce stars and containing atomic hydrogen, which are seen with radio telescopes. The more stable low density and low temperature molecular hydrogen remains invisible.
210,000_m/s *4.73E17_ s = R = 9.94E22_m = 3.22_Mpc = 10.5 million light years to where the galaxy is as low in density as is the Cosmos. This is the perimeter of the galaxy.
m/r times the galactic radius gives a **total galactic mass = 6.61E20_kg/m * 9.94E22_m = 6.57E43_kg**
The total galactic mass when divided by the visible mass within the **30_kpc** radius of **6.12E41_kg** gives **107 to 1** as the ratio of dark to visible matter. This explains the anomaly between observed galactic dynamics and estimated masses of the galaxies.
For **vt^2** and **M/r** to remain constant, both **$G = c^3*age/Mc$** and **r = vt*age** vary with **age**.
$vt^2/G = Mg/r$
$vt^2*Mc/(c^3*age) = Mg/(vt*age)$
$vt^3/c^3*Mc = Mg$, the **mass of the galaxy**
vt*age = R, suggest that there is a ***Hubble expansion occurring within the galaxy***. Hubble's constant is about **65_km/(s*Mpc)** so we have **vr = 3.22_Mpc * 65_km/(s*Mpc) = 209,000_m/s** or **vr = vt.** The radial velocity equals the tangent velocity at the perimeter of the galaxy. When the tangent velocity of something equals its radial velocity, it spirals out at a constant angle of 45 degrees. ***This is the same spiral as the Cosmos***.

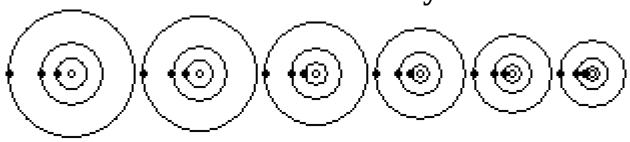
Torque of the spinning galaxy

Here mass is the mass of the galaxy. **r** is the radius of the galaxy. **vr** is the radial velocity of expansion at the perimeter of the galaxy or **vr = vt** the characteristic tangent velocity of the flat rotation curve of the galaxy.
moment of inertia *angular acceleration = torque =
$mass *r^2$ *angular acceleration =
$mass *vr^2 *age^2 *1/age^2 = mass *vr^2$
We see that the square of the radius in the moment of inertia for the galaxy **vr^2*age^2** increases at the same rate the angular acceleration of the galaxy **$1/age^2$** decreases so that the **age^2** in each cancels and the energy stays constant.

The dynamics of the galaxy

The radius of the galaxy increases while the rotation of the galaxy slows down without a change in energy or use of power. Orbits spiral out as the gravitational force decreases with the age of the Cosmos.

Hubble in the solar system



If the Hubble expansion extends to the solar system, then all the planets share the same very small precession rate, of their major axis within the planet's elliptic plane. An expanding ring slows in its rotation. We calculate a change in angular velocity, which is due to a radial Hubble velocity. This effect is quite small.

r is the radius from the sun to any planet. **vr = r/age**, the radial velocity, the Hubble expansion velocity in meters per second.

The length of the orbit when divided by **2*pi*radians** per revolution equals the meters per radian or **2*pi*r/(2*pi*radians)= r/radians**.

vr/(meters per radian) = r/age/(r/radians) = radians/age = precession

We see that the **r**'s cancel so that this rate of precession is universally true for the entire solar system and is not tied to any radius.

radians/age = radians/(4.73E17_s) = 2.11E-18 radians/second . This is Hubble as a rotation rate.

radians/(15 billion years) = 6.66E-11 radians/year =
1.375E-5_arcs/year = 1.375E-3_arcs/century. This is a very small angle to measure. The Gravity Probe B satellite was seeking to measure a Lense-Thirring frame dragging of **4,200E-5_arcs/year**.

31,556,925.9747_seconds/year/1,296,000_arcs/year = 24.3495_s/arcs for the earth to cover one arc second of circumference in its orbit.

24.3495_s/arcs *1.375E-5_arcs/year = 3.348E-5 _s/year which is the amount added yearly to the orbital period by the Hubble expansion. This is one leap second being added to our orbit every **2,986.8 years**. The entire solar system is slowing in its rotation while it expands, like a dynamic unit, like the galaxy and like the Cosmos. This rate of precession is universally true. It is a consequence of the slowing rotation of the Cosmos and is tied by dynamics to the expansion of the Cosmos. The precession is proportional to **1/age**. The **rate of change** of **1/age** is **$-1/age^2$**. It may be detected by large ring laser gyroscopes, a form of interferometer which detects absolute rotations by interference fringes between light beams traveling in opposite directions around a loop. The Michelson-Morley interferometer detects differences in the light velocity on perpendicular paths.

Inertial accelerations

To calculate the path of expansion of a planet we need the vector sum of three accelerations; the centrifugal, tangent and Coriolis accelerations.

Centrifugal acceleration

Centrifugal force uses the tangent velocity, but here, we are looking for the recessional component or factor, of the centrifugal force which is due to the Hubble expansion. The tangent and radial velocity **vt = vr** due to precession are equal.

$\mathbf{m*vr^2/r}$ equals the centrifugal force and $\mathbf{vr^2/r}$ is the acceleration.

vr = r/age.

For the earth, **vr = 149E9_m/4.73E17_s = 3.16E-7_m/s** or **9.97_m/year.**

For the moon, **vr = 379737123_m/4.73E17_s = 8.018E-10_m/s** or **25.3_mm/year.** The moon's slightly larger recession from us is usually attributed to tidal friction.

$\mathbf{vr^2/r = vr^2/(vr*age) = vr/age}$ **or**

$\mathbf{vr^2/r = r^2/(age^2*r) = r/age^2}$

This is the radius divided by the angular acceleration of the Cosmos. This is a clue that the ultimate source of the centrifugal force is the Cosmos.

Tangent acceleration

We can calculate the tangent acceleration using the torque formula.

moment of inertia*angular acceleration = force*radius.

$\mathbf{m*r^2}$***angular acceleration = m*a*r.**

a = r *angular acceleration =

$\mathbf{a = vr*age *1/age^2 = vr/age}$

The direction of deceleration is opposite of rotation.

Coriolis acceleration

2*angular velocity *vr = Coriolis acceleration

vr is the radial velocity.

2*vr/age = Coriolis acceleration

Spirals

Now that we have calculated the inertial accelerations we can look at the way the solar system expands. We have the centrifugal acceleration of **vr/age** directed radially out. We have the Coriolis acceleration of **2*vr/age** in the direction of rotation and the deceleration of **vr/age** in the direction opposite of rotation. The resultant of these accelerations is **45** degrees between the direction of rotation and the outward directed radius. It has a value of $\mathbf{2^{1/2}*vr/age}$. A planet moving in this way traces out a logarithmic spiral.

Torque in the solar system

Here **mass** is the mass of a planet. **r** is the distance from the sun. **vr = r/age** is the radial velocity.

moment of inertia*angular acceleration = torque.

$\mathbf{mass *r^2 *angular\ acceleration =}$

mass $*vr^2 *age^2 *1/age^2 = $ mass $*vr^2$
We see that the square of the radius in the moment of inertia for the planet, $\mathbf{vr^2*age^2}$ increases at the same rate the angular acceleration of the planet $\mathbf{1/age^2}$ decreases so that the $\mathbf{age^2}$ in each cancels and the energy stays constant.

The dynamics of the solar system

Expansion and rotation rates are linked. The radius from the sun, to the planets, increases while the orbital periods of the planets slow down, without a change in energy or use of power. Orbits spiral out as the gravitational force decreases with the age of the Cosmos.

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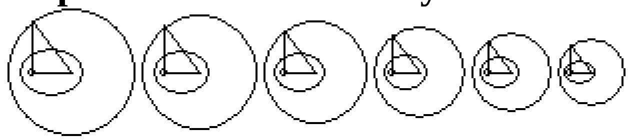
Chapter 5 - The uniformity of the CMB



Introduction

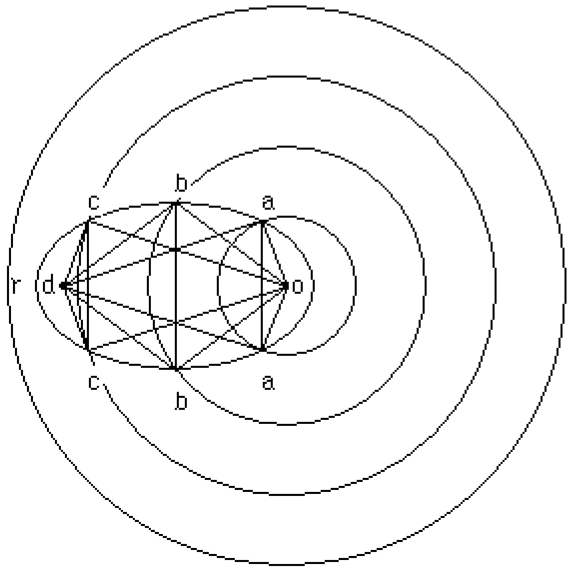
The cosmic microwave background **CMB** is seen as uniform ***not because*** the explosion of the Big Bang was everywhere and stretched to uniformity by Inflation. The CMB is uniform, another unanswered question of physics, because it was emitted from the expanding luminous spherical shell of the Cosmos by photon scattering from the thin shell where light orbits in our black hole Cosmos. No light escapes from a black hole because it is constrained to orbit at the speed of light. However, light could reach us from outside the Cosmos. We could see out if there is something close enough to see. The galaxies near the perimeter of the Cosmos are severly red shifted because they are receding so fast. Something outside our Cosmos would have a different velocity. We might see something from outside our Cosmos if it wasn't a black hole. We do see the light from the luminous spherical shell of the Cosmos. This allows some of the radiation to reach us at the same time at the same temperature because we are riding the Hubble expansion too. See the geometry of the expanding luminous shell and the ellipse below.

Ellipsoids

The ellipse is the path of point that moves, so that the ***sum of its distances from the two foci is constant***. A whisper at one focus of an elliptical room, is heard at the other focus in the room, because the distance and travel time from focus to focus, is the same for any path of sound reflecting off the walls.

Light acts the same, with the same geometry, with ellipsoidal mirrors. The two foci can be called the origin and the destination. Light leaves the origin as an expanding sphere and reflects at the ellipsoidal surface as a ring. It is a ring because it is the intersection of a sphere and ellipsoid. This reflection focuses the light on to the destination. The overall travel time from the origin, to reflection, to destination, is always the same for all angles of light departing from the origin.

If we retain the origin and destination and change to a luminous expanding sphere we can eliminate the mirror and reflection while keeping the geometry of the intersection of an expanding sphere and ellipsoid. The ***luminous sphere is the shell of the Cosmos which emits the CMB***. Now the ellipsoid is an abstraction that exists in concept but not in reality. The ellipsoid defines the path of things that are perceptible at our location at a certain time.



Click to enlarge figure 3!

r = c*age/2*(1-fr^2)/(1+cos(angle)*fr), this is the ellipse drawn from the center focus, which is the origin, **o** on the figure. The eccentricity of the ellipse is **fr**. The radius of the expanding sphere, which intersects the ellipse is **r** in the equation. As the angle is varied, the points form an ellipse stretched in the radial direction with **fr*c*age** as the distance between the **foci** or **od** on **figure 3**. The sum of the distances from the two foci, to a point, is always equal to **c*age**. The angle and radius when rotated around the centerline trace a ring that is the intersection of the sphere and the ellipsoid, **aa** or **bb** or **cc** on figure 3. All the CMB we see apparently comes from within the surface of the ellipsoid. This nested series of rings may partially polarize the CMB, along the axis of the origin. Other polarizations seem likely. There is evidence that light traveling through space is polarized in a non-random direction. There is also evidence from the WMAP satellite that space could be rotating. We are located at someplace like **d**, at an unknown **fr**, on figure 3, on a concentric **radius = fr*c*age** and are moving radially and tangentially with a **velocity = fr*c**. All that our telescopes can see is within the sphere centered around **d,** with the radius **or,** which is 15 billion light years.

Uniformity of the CMB

The question of the uniformity of the CMB is usually answered; that we appear to be at the center of the Big Bang, because the Big Bang explosion happened everywhere. A more quantitative, and less miraculous solution, looks again at figure 3.

A ray of **CMB** reaches us after **two distinct intervals**.

The **first interval** starts at the center focus, at the origin, at point **o**, on figure 3. It is with the expanding and cooling spherical shell, before the ray of CMB, which we will be observing, is emitted. Examples on figure 3; are the lines **oa**, **ob** and **oc**. The **temperature** and **watts/meter^2**, of the expanding sphere is proportional to the inverse square of the radius.

The **second interval** is the travel of the ray of CMB through space, after it leaves the expanding spherical shell. Examples on figure 3; are the lines **ad**, **bd** and **cd**. It ends with the reception of the CMB, at the observer at point **d**. The temperature and watts/meters^2, of the CMB during the second interval is also proportional to the inverse square of the radius.

The two intervals always add up to, **c*age** meters in **age** seconds, in any direction the observer looks. For CMB emitted early in the Cosmos, there is a shorter interval with the expanding sphere, and a much longer path through space interval to reach the observer. For CMB emitted later, there is a longer spherical expansion interval, before the CMB is emitted, but a shorter path through space interval to the observer. The expanding spherical shell, the CMB which it emits, and the CMB during its travel through space, all have a temperature proportional to, the inverse square of the distance traveled from the origin, **o**.

When the radius of the Cosmos was **oa** it emitted CMB from the entire spherical surface. Only that from the ring, on the sphere at **aa** will reach **d** at the same time, as the other rings on the same ellipsoid. A similar argument can be seen in the rings **bb** and **cc**. All the CMB from the various rings, which intersect the ellipse arrives at point **d** at the same time and temperature.
oa + ad = ob + bd = oc + cd = or = c*age.

The formulas in the next section show the relationship between radius and temperature in the CMB.
The temperature at point **a** when the Cosmos was **1/4** its age and size was **5.4_K**.
The CMB arrived at point **d at 2.7_K** after expanding for **3/4** the age of the Cosmos.
The temperature at point **b** when the Cosmos was **1/2** its age and size was **3.8_K**.
The CMB arrived at point **d at 2.7_K** after expanding for **1/2** the age of the Cosmos.
The temperature at point **c** when the Cosmos was **3/4** its age and size was **3.2_K**.
The CMB arrived at point **d at 2.7_K** after expanding for **1/4** the age of the Cosmos.

Blackbody watts from the CMB radiation

A flux of radiation has a Kelvin temperature. We see the temperature of the CMB as **2.735 Kelvin**. We can convert this to **watts/meter^2** for blackbody radiation with the Stephan and Boltzmann law. **K^4*5.5698E-8_W/(m^2*K^4) = _W/m^2**
2.735 Kelvin = 3.11E-6_W/m^2
When one sees something, it is in terms of **W/m^2** and the inverse square law.

The ***W/m^2* times the area of the Cosmos = wattage of the CMB**, because as we saw in figure 3, the temperature at point **d**, where the observer is located, is the same as a point **r**, the radius of the Cosmos.
$(2.735\_K)^4$*5.5698E-8_W/(m^2*K^4)*4*pi*ru^2 = 7.9E47_W = watts = power = energy /second
The CMB has the luminosity of a **7.9E47 watt** light bulb seen from a distance of 15 billion light years.

This is the same as **7.9E47 watts** stretched over the area of a sphere with a radius of 15 billion light years.

The CMB is emitted from the expanding radiant shell which is where light orbits at the perimeter of the Cosmos. The scattering of photons along this thin spherical shell is the source of the CMB. The light was accumulated as the Cosmos gained mass and light through the merging of Black holes. The energy emitted in 15 billion years by the CMB, if the energy output is constant, is **7.9E47_Watts*age = 3.7E65_J**. For comparison, the energy of the Cosmos, **Mc*c^2=1.7E70_J is 46,000 times bigger**. If the CMB is the remnant energy from the Big Bang, why is it so feeble? However, if the CMB is emitted instead through the scattering of photons at the perimeter of the Cosmos then this small value of energy makes sense.

The gravitational and centrifugal accelerations on the photon in orbit are **c/age**. As the Cosmos expands, the photons orbit at a larger radius and the orbital accelerations decrease. The rate of change of the acceleration is **1/age^2**. The **W/m^2** of the CMB is **7.9E47_W/(4*pi*ru^2)=7.9E47_W/(4*pi*c^2*age^2)**. The photon density decreases at **1/age^2** as the spherical shell of the Cosmos increases in area.

We can map the power of the CMB onto the smaller spheres and higher temperature when the Cosmos was younger, as long as we keep well clear of infinities.
$(7.9E47/(5.5698E-8*4*pi))^{1/2}$ /(temperature_K^2) = radius in meters
1.0615E27_m/(temperature_K^2) = radius in meters
The radius, of the expanding sphere of the shell, is proportional to the inverse square of the temperature.
The following examples map temperature and radius.
1.0615E27_m /$(2.735\_K)^2$ = 1.42E26_m = ru = the radius of the Cosmos currently.
1.0615E27_m /$(273.5\_K)^2$ = 1.42E22_m = ru/10000 = 1.5 million light years, at an age of **1.5 million years**, at the freezing point of water of **273_K**
At a temperature of **3000_K** plasma becomes transparent to light. The radius becomes **1.18E20_m = 12466 light years at an age of 12466 years**.

What is reasonable?

This last example would fit in the core of a galaxy. This is only the CMB, but this much power would require an absurdly large star. An inside out or hollow star since its radiation comes to us from every direction. We have allowed the ease of doing calculations to project something absurd. We can see that these formulas and others like them might be used to trace back to a creation event at a point of infinite temperature and density. This has become dogma, trussed up with patches, which helps obscure the absurdity of physical infinities.

Another way of looking at it is; *at its present mass*, our Cosmos could never have been that small or young. Since little ones make big ones, the Cosmos came about by the merging of black holes. Low density black holes are big, old and expanding fast so they incorporate a lot of space over time. Big ones present a bigger target for merging. Old ones present a target for merging that has been around for a long time. Our space seems well populated with black holes. It is a small step, for our dynamic unit, our Cosmos, to be just another ordinary low density black hole in a universe full of the same.

Conclusions

A ledger might have beliefs on the left side, and evidence for those beliefs on right side. The dynamics described here are mathematically consistent beliefs, which don't require physical infinities. The evidence is the values presented by the mass, radius and density of the Cosmos, uniformity of the CMB, the flat rotation curves of galaxies and prevalence of dark matter. All the parts slip together seamlessly, and the dynamics locks all the parts together. There are no free parameters which might be adjusted to reflect a point of view.

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