The structure of the Pivot Universe

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Abstract

Our Universe is a finite island, possibly one of many other Universes spread, in the infinite space. The Pivot theory describes our Universe structure. It postulates that the Universe has a fixed center in space, but it spins around an axis through its center. The Universe is composed of two parts: a massive spinning nucleus, designated the Pivot, and a ring-shaped visible Universe orbiting it. From the QM point of view, the Pivot is a solid sphere composed of an enormous number of nucleons packed to the maximum density possible in the Universe. From the GR point of view, the Pivot is a Kerr black hole. This combined structure, namely a Kerr black hole and an orbiting ring, is a known phenomenon in cosmology.

The Pivot theory postulates that our Universe started as a spinning primeval nucleus. This primeval nucleus accumulated mass (or energy) from the vacuum space. The growth of this nucleus stopped when the velocity on its equator surface reached the speed of light and then exploded. The nucleus exploded into two distinct parts: The Pivot and a ring of the visible Universe. To find the size of the Universe, I postulate two things: The first is that there is an upper limit to the density of matter and the second that there is a maximum acceleration in the Universe. Using these postulates and relying on: known physical constants, cosmological observations, and conservation laws, the size of our Universe is calculated.

Finally, the theory verification is done against known cosmological observations, such as the flat rotation curve in Spiral Galaxies, the Spiral shape of Galaxies, the high redshift of Galaxies, Michelson-Morley experiment, Sagnac effect, and other observations.

Keywords: Universe structure, frame-dragging, Black hole, Neutron star, QM, GR, gravitational constant, gravitational z shift.

Contents

1. The Pivot theory - Overview

The Pivot theory postulates that our Universe is composed of a massive and slowly spinning neutron star, the Pivot, located at its center. Orbiting the Pivot is a ring-shaped visible Universe. The Pivot can describe by two theories: on the one hand, quantum physics, where it is described as a nucleus that is composed of an enormous number of nucleons that are packed in this nucleus to the maximum density possible. On the other hand, the Pivot can be described by GR as a huge, slowly spinning Kerr black hole that drags the space around it.

The Pivot theory answers three questions:

The first question is: How did it all begin?

This part of the theory is speculative and is not adequately addressed; however, it is not out of the blue. The theory is based on quantum physics. The origin of the matter Universe is the energy fluctuations of the vacuum space. Space, or vacuum, permeates infinitely in all directions. Quantum theory describes all elementary particles as vibrational modes in fundamental fields that exist at all points of space and time. Quantum physics also teaches that any given point in space can have any energy. The lower energy value being the most common. In the case of lower energy fluctuations, virtual particles are always popping in and out of existence. These virtual particles are coming in pairs, e.g., a quark and antiquark, exist for a short time, and then mutually annihilate. Rarely, it happens that the energy fluctuations are large enough so that the virtual particles are pushed apart to avoid annihilation and become real particles such as a hadron. If the event of significant energy fluctuation repeats itself at the same place, more hadrons are created. These hadrons attract each other to create an ever-increasing nucleus that is designated here as a primeval nucleus.

Speculative note: According to the description above, additional primeval nucleus can be created at any other point in space. This gives rise to the possibility that there are additional Universes in the infinite space.

The model includes several additional assumptions:

1) From the beginning, the primeval nucleus started to spin, and new nucleons that accumulated around it continued to spin in the same direction.

2) According to GR, the spinning of the primeval nucleus that eventually became a very massive body dragged space around it.

3) The nucleons were added to the primeval nucleus in such a way that they were packed to the maximum density possible in the Universe. I postulate that there is a maximum density possible in the Universe. It is approximately the density of a neutron, the nucleus of an Atom, or a neutron star. At maximum density, the nucleons are so close to each other that they start to repel each other. QCD teaches that bringing the nucleons too close requires infinite force.

4) An additional assumption relates to the origin of gravity. During the epoch of the primeval Universe, only the primeval nucleus existed. The only sources for holding the nucleus together were the nucleons themselves. Quantum physics teaches that there is a powerful, attractive force between nucleons that are located at a sub-atomic distance. This strong force was the one that kept the nucleons together in the primeval nucleus. **My claim is that this strong force between nucleons is the origin of gravity between celestial bodies**. At cosmological distances, the strong force (= gravity) decreases to extremely small values, however, as the number of nucleons

in celestial bodies is enormous, there is still considerable gravity force between celestial bodies. Appendix A elaborates on this topic.

<u>The second question is</u>: Why did the primeval nucleus stop growing?
I postulate that in addition to the maximum velocity in the Universe, there is also a maximal acceleration possible in the Universe (See Fotzel [6]). The radius of the primeval nucleus grew until the gravity on its surface reached the maximum acceleration possible in the Universe. At this stage, additional nucleons that were accumulated to the primeval nucleus did not increase its radius, but rather its spin rate. The tangential velocity on the equatorial surface of the primeval nucleus grew until it reached the speed of light, and then it exploded. Based on the Big Bang theory, this explosion occurred 13.7 billion years ago. The open question is, how long did it take for the primeval nucleus to reach its maximum size? Another open question is, what was the temperature of the nucleus after the explosion?

<u>The third question is</u>: How has the Universe evolved into the Pivot structure?
The explosion shattered the outer layers of the primeval nucleus, specifically those regions that were near the equatorial plane. It caused the nucleons of these layers to flung off tangentially in the equatorial plane of the primeval nucleus and the same direction of the primeval nucleus spin. The final result was as follows: The more significant part of the primeval nucleus became the Pivot. The other nucleons that flung off tangentially from the primeval nucleus arranged around the Pivot in a ring-shaped visible Universe. This combined structure, namely a black hole and an orbiting ring, is an established phenomenon in general relativity. One characteristic of the combined black hole-ring structure is that there is a stable region around the black hole where the orbital velocity of the ring equals the angular velocity of the dragged space. An observer located in the stable region will orbit the black hole but will be stationary in reference to the dragged space.
The center point of the Pivot is fixed in space. In other words, the Universe has an absolute reference frame. From the GR point of view, the Pivot is a Kerr Black hole. The Kerr black hole has a singularity ring inside which mass can exist. The Pivot nucleus is located inside the singularity ring. (Note: this description differs from Schwarzschild black hole – where, theoretically, all the mass of the black hole is concentrated in a singularity point). As for the ring-shaped visible Universe- its inner radius must be bigger than the Schwarzschild radius of the Pivot. An observer located in the visible Universe will not be able to observe the Pivot. Simultaneously, as is known from the Kerr solution, the space around the Pivot is dragged by the Pivot in the same direction of Pivot's spin. An essential assumption in the calculations is that the angular speed of space dragged by the Pivot at the radius of the Milky Way is equal to the angular velocity of the visible Universe measured by Birch [1]. This fact explains the Michelson-Morley experiment. An observer located in the ring will not be able to measure his speed relative to the space that surrounds him because there is no relative motion between him and space. One can sum up that Newton was correct by arguing that there is a fixed center of the Universe, but to explain additional observations, such as frame-dragging, Einstein's GR must be taken into consideration.
After the explosion of the primeval nucleus, the visible Universe contained only very hot nucleons that were orbiting the Pivot. It took the visible Universe 380,000 years to cool down. When this happened, ordinary atoms were formed. The local density of the visible Universe was the cause of the variety of celestial bodies. If the density of atoms at a particular region in the

visible Universe was too low to enable attraction between them, they remained as a cloud of gas that orbits the Pivot. If the density of atoms was sufficient for interaction between them, stars were created. The variety of celestial bodies was dependent on the mass of the born star. Some stars that had enough mass to collapse by gravity into neutron stars, more massive stars collapsed into black holes. The black hole was powerful enough to attract new stars that started to orbit it. Thus, stars performed two simultaneously trajectories. One around the Pivot and the other around the black hole of a Galaxy- this was the way that Galaxies were created.

So far, the description of the Pivot Universe was qualitative. The next paragraphs are quantitative. In these paragraphs, I calculate the size of the primeval nucleus and the sizes of the Pivot and the visible Universe ring.
In order to test the theory, the Pivot structure is verified against known cosmological observations: Origin of spinning and rotation of all celestial objects, flattened rotation curve in Spiral Galaxies, Spiral shape of Galaxies, Redshift of Galaxies, Blue shift of Galaxies, Cosmic Microwave Background, Handedness of Galaxies, Olbers' paradox, Hubble's observations.
Finally, there are spin-offs of the Pivot theory. I relate to them in the Appendixes:

Appendix A- The origin of gravity.
It is shown how quantum physics, Newton's gravitational law, and GR can be unified.
Appendix B- Is a black hole a neutron star?
I claim that there is one difference between the Pivot and the black holes in the visible Universe. The primeval nucleus and the Pivot were created from the accumulation of nucleons. In contrast, a black hole in the visible Universe ring is the result of the gravitational collapse of a massive star. However, the final result is the same. A nucleus in which nucleons are packed to the maximum allowed density in the Universe.

2. **Known constants and accepted parameters**

Definitions:

$Gly = 9.46 \cdot 10^{24}$ m …is the distance of billion light years.

$Mly = 9.46 \cdot 10^{21}$ m …is the distance of million light years.

$Kly = 9.46 \cdot 10^{18}$ m …is the distance of thousand light years.

Accepted parameters:

$G = 6.67 \cdot 10^{-11} m^3 / kg / \sec^2$ …is the Gravitational constant.

$C = 2.9979 \cdot 10^8 m / \sec$ …is light velocity.

$\rho_{ring} = 10^{-26} kg / m^3$ …is the density of matter in the visible Universe

$\hbar = 1.0545716 \cdot 10^{-34} J \cdot \sec$ …is the reduced Planck's constant.

$m_{neutron} = 1.674927471 \cdot 10^{-27} kg$ …is the mass of neutron.

$R_{neutron} = 0.8 \cdot 10^{-13} cm$ … is the radius of the neutron

2.1 Evaluated and estimated parameters:

Each of the following parameters is the best estimations I have found in the literature.

What is the maximum density in the Universe?

One of the central claims of the Pivot theory is that there is a maximum density of matter in the Universe. This density occurs when nucleons of matter are packed so densely that they cannot be squeezed anymore. It is known that neutron stars, atom nucleus, and neutrons have approximately the same maximum density.

$$\rho_{\max} \cong \rho_{neutron} = \frac{m_{neutron}}{\frac{4}{3} \cdot \pi \cdot R_{neutron}{}^3} = 7.81 \cdot 10^{17} \cdot kg / \mathrm{m}^3$$

Birtch's observation of the spinning Universe.

Birch [1] calculated from the study of position angles and polarization of high luminosity classical double radio sources an angular velocity of the Universe. Although his work has not been convincingly refuted, it was criticized for using improper statistics. He found an approximate value of:

$$\omega_{Birtch} =\sim 10^{-13} rad / yr$$

In this paper, I choose $\omega_{Birtch} = 0.3 \cdot 10^{-13} rad / yr$. This is the angular velocity of the Milky Way around the Pivot.

Having an accurate measurement of this parameter will enable exact calculations of the orbiting radius of the Milky Way.

Maximum acceleration in the Universe.

There is a theory that there is a maximum acceleration possible in the Universe. Recent experiments were conducted to find this acceleration. Potzel [6] did such an experiment. He calculated that the maximal acceleration possible in the universe is $> 1.5 \cdot 10^{21} \cdot m / \sec^2$. In his paper, he mentions another experiment done by Friedman, who found an acceleration of $1 \cdot 10^{19} \cdot m / \sec^2$. The experiments are quite sensitive and they both agree that more refined experiments are needed.

In this paper, I estimate: $a_{\max} = 1.58 \cdot 10^{20} \cdot \dfrac{m}{\sec^2}$

Having an accurate measurement of the maximum acceleration in the Universe will enable calculating the exact primeval nucleus mass and radius.

3. **The Primeval Universe**

The calculation of the mass $M_{nucleus}$ and the radius $R_{nucleus}$ of the primeval nucleus at the moment it exploded can be derived by using the following equations:

1) Newton's theory of gravity:

$$a_{\max} = \frac{G \cdot M_{nucleus}}{R_{nucleus}{}^2}$$

Where: (3.1)

$M_{nucleus}$ ...Mass of primeval nucleus

$R_{nucleus}$ ...Radius of primval nucleus

The logic of using this equation is that maximum acceleration $a_{\max}$ was reached on the equator surface of the primeval nucleus.

2) The following formula is based on the model used for calculating the radius of atom's nucleus.

$$R_{nucleus} = R_{neutron} \cdot \left(\frac{M_{nucleus}}{m_{neutron}}\right)^{\frac{1}{3}} \qquad (3.2)$$

The reasoning of using this equation is that the structure of primeval nucleus is similar to the structure of the atom nucleus. The atom's radius is calculated by $R = r_0 \cdot A^{1/3}$ where R – radius of atom nucleus and A number of nucleons. In the case of the atom nucleus r_0 varies depending on the atom and is 1.25+/-0.2fm. For the primeval nucleus I assume $r_0 = R_{neutron} = 0.8\, fm$.

3) Mass of primeval nucleus sphere:

$$M_{nucleus} = \frac{4}{3} \cdot \pi \cdot R_{nucleus}{}^3 \cdot \rho_{\max} \quad .... \quad (3.3)$$

From the above equations the primeval nucleus mass and its radius can be calculated:

$$M_{nucleus} = m_{neutron} \cdot \left(\frac{a_{\max}}{4 \cdot \pi / 3 \cdot G \cdot \rho_{\max} \cdot R_{neutron}}\right)^3 = 1.24 \cdot 10^{54} \cdot kg \qquad (3.4)$$

The radius of the primeval nucleus is calculated by:

$$R_{nucleus} = \sqrt{\frac{M_{nucleus} \cdot G}{a_{\max}}} = 7.24 \cdot 10^{8} \cdot km \qquad (3.5)$$

The Pivot theory uses also the primeval hadron theory described by Muradian [4] and others. He uses the generalized Regge's law general formula which connects the maximal spin J and the mass m of a celestial object: $J = \hbar \cdot \left[\frac{m}{m_{proton}}\right]^{1+1/n}$ where for Galaxies, clusters of Galaxies and globular Galaxies the two-dimensional disk-like hadron n=2. For stars, planets and asteroids n=3. He showed that the calculated values of J and m of all celestial bodies, namely superclusters, Galaxies, stars, and planets, are in good agreement with cosmological observations. I am using this equation for calculating the angular momentum of the primeval Universe. Note: I am replacing the mass of the proton (m_{proton}) in Muradian's equation by the mass of a neutron $(m_{neutron})$, because the primeval Universe was composed mainly from neutrons.

$$J = \hbar \cdot \left(\frac{m}{m_{neutron}}\right)^{\frac{3}{2}}$$

I postulate that the primeval nucleus grew until $a_{\max}$ was reached. When additional neutrons were accumulated the spin of the nucleus grew until, at the moment of explosion, the maximum velocity on the primeval nucleus surface at the equator was reached. Other inner regions of the primeval nucleus were moving at velocities near the speed of light, therefore relativistic effect is taken into consideration. The analysis by Bass [13] is used here. He gives estimations for the relativistic mass as well as other characteristics of rapidly spinning spherical body.

In the following paragraphs, the ratio of the primeval Universe angular momentum to the angular momentum of the nucleus sphere is calculated. The primeval Universe total angular momentum is the sum of the angular momentum of the primeval solid sphere of neutrons, plus the angular momentum of space that is dragged by this primeval sphere of neutrons. Dragging of space by a spinning celestial body is a result of GR. It will be shown that the angular momentum of the neutrons sphere is negligible compared to the angular momentum of the dragged space. This is done in the following steps:

1. Finding the total relativistic mass of the primeval nucleus M_{rel_nucleus}. The relativistic mass of the nucleus is calculated per Bass [13]:

$$M_{rel\_\text{nucleus}} = \sqrt{\frac{5}{3}} \cdot M_{nucleus} = 1.6 \cdot 10^{54} kg \qquad (3.6)$$

2. The total angular momentum of the primeval Universe at the moment of explosion is calculated per Muradian [4]:

$$J_{prime} = \hbar \cdot \left(\frac{M_{nucleus}}{m_{neutron}} \right)^{\frac{3}{2}} = 2.13 \cdot 10^{87} \, J \cdot s \quad (3.7)$$

3. The explosion of the primeval nucleus occurred when the tangential velocity at the equator of the neutron star was equal to the speed of light C. The angular velocity of the nucleus was at that moment:

$$\Omega_{nucleus} = \frac{C}{R_{nucleus}} = 1.31 \cdot 10^{4} \cdot rad / yr \quad (3.8)$$

4. The primeval nucleus was a solid sphere of neutrons. The angular momentum of this sphere, while taking into considerations relativistic effect, is:

$$J_{rel\_nucleus} = \frac{2}{5} \cdot M_{rel\_\text{nucleus}} \cdot R_{nucleus}{}^{2} \cdot \Omega_{nucleus} = 1.39 \cdot 10^{74} \, J \cdot s \quad (3.9)$$

5. The ratio of $\frac{J_{rel\_nucleus}}{J_{prime}} = 6.5 \cdot 10^{-14}$ (3.10) shows that almost the entire angular momentum of the primeval Universe J_{prime} was used for dragging of space around the primeval nucleus.

<u>Note:</u> Relating to the fact that almost all the primeval nucleus angular momentum is used for dragging space means that the viscous forces were >> than the inertial forces of the primeval sphere. The above description of a spinning sphere in an unbound space resembles a known problem from the field of fluid dynamics. In Stokes flow, that describes a case when the inertial forces are negligible compared to the viscous forces, i.e., Reynolds number is very small, the solution yields a steady state spin of the sphere together with the fluid around it. Therefore, it is possible that Stokes flow can also describe motion of celestial bodies in space.

Solving Stokes flow on the surface of the spinning primeval nucleus gives the torque τ :

$\tau = 8 \cdot \pi \cdot \mu_{space} \cdot R_{nucleus}{}^{3} \cdot \Omega_{nucleus}$ ....where μ_{space} is the viscosity of the space (3.11).

On the other hand, $\tau = J_{prime} \cdot \Omega_{nucleus}$ where the dragged space on the neutron star surface is spinning at $\Omega_{nucleus}$. Therefore, the viscosity of space μ_{space} on the surface of the primeval nucleus can be calculated by:

$$\mu_{space} = \frac{J_{prime}}{8 \cdot \pi \cdot R_{nucleus}{}^{3}} = 2.23 \cdot 10^{50} \cdot Pa \cdot s \quad (3.12)$$

The high viscosity of space on the surface of the primeval nucleus means that space clings strongly to this surface. I speculate that the viscosity of space is dependent on gravity. It is maximal near a celestial body and drops substantially far away from this celestial body.

4. The Pivot Universe

In this paragraph, the sizes of the Pivot and the ring-shaped Universe are calculated. Calculating the dimensions of the Pivot Universe is based on conservation laws of angular momentum and mass. The angular momentum of the Pivot Universe must be equal to the angular momentum of the primeval Universe J_{prime} (3.7). The angular momentum of the Pivot Universe is the sum of the angular momentum of the Pivot + the dragged space + the visible Universe. In addition, the mass of the Pivot + the mass of the visible Universe must be equal to the mass of the primeval nucleus. I assume that the angular momentum of the primeval Universe is divided equally between the (Pivot + space) and the ring-shaped Universe.

The calculation of the dimensions of the Pivot Universe is done in the following steps:

4.1 The angular momentum of the Pivot and the space it drags J_{pivot} is:

$$J_{pivot} = J_{ring} = \frac{J_{prime}}{2} = 1.06 \cdot 10^{87} J \cdot s \qquad (4.1)$$

Note: This angular momentum of the Pivot is equal to the angular momentum of the ring J_{ring}.

4.2 Based on (3.7) the mass of the Pivot is found:

$$M_{pivot} = (\frac{J_{pivot}}{\hbar})^{\frac{2}{3}} \cdot m_{neutron} = 7.82 \cdot 10^{53} kg \quad (4.2)$$

4.3 The mass of the ring is found based on mass conservation ($M_{nucleus}$ from (3.4):

$$M_{ring} = M_{nucleus} - M_{pivot} = 4.6 \cdot 10^{53} kg$$

4.4 The Schwarzschild radius of the Pivot is:

$$R_H = \frac{2 \cdot G \cdot M_{pivot}}{C} = 122.76 Gly \qquad (4.4)$$

4.5 The Pivot Universe structure is similar to the known GR structure of the composed black-hole-ring system. In GR there is a term called Innermost stable circular orbit (ISCO) which marks the inner radius of a particle orbiting the black hole. According to GR, a particle can stably stay in orbit around a massive object if its orbiting radius is greater than ISCO. The ISCO of a ring orbiting the black hole differs from the ISCO of a particle. I assume a relation between the inner radius of the visible Universe ring and the Schwarzschild radius of the Pivot. Clearly, the inner radius must be greater than the Schwarzschild radius.

$$R_{in} = 1.01 \cdot R_H = 123.99 \cdot Gly \qquad (4.5)$$

4.6 The dimensions of the ring where adjusted so that the radius of the Milky Way R_{mw} is in agreement with the cosmological observations of the z shift of galaxies in the Universe (see paragraph 5)

In order to find the outer radius of the visible universe ring R_{out} an additional phenomenon predicted by GR must be used. This is the frame dragging of space by the Pivot. The angular speed of space in the plane of the equator is dependent on the radius r according to: See Wikipedia [5].

$$\Omega(r) = \frac{R_H \cdot \alpha \cdot C}{r^3 + \alpha^2 \cdot r + R_H \cdot \alpha^2} \qquad (4.5)$$

Where: $$\alpha = \frac{J_{pivot}}{M_{pivot} \cdot C} = 4.54 \cdot 10^{21} \cdot km = 0.48 Gly$$

The outer radius of the ring R_{out} is found by equating the angular momentum of a disk about its central axis to J_{ring} from Eq. (4.1).

$$\frac{1}{2} \cdot M_{ring} \cdot (R_{in}{}^2 + R_{out}{}^2) \cdot \frac{\Omega(R_{in}) + \Omega(R_{out})}{2} = J_{ring} ..... \Rightarrow R_{out} = 287.21 Gly \qquad (4.6)$$

The width of the visible Universe W is found by:

$$M_{ring} = W \cdot \rho_{ring} \cdot \pi \cdot (R_{out}^2 - R_{in}^2) .... \Rightarrow W = 257.4 Mly \qquad (4.7)$$

Radius of the Pivot:

$$R_{pivot} = R_{neutron} \cdot \left(\frac{M_{pivot}}{m_{neutron}}\right)^{\frac{1}{3}} = 6.235 \cdot 10^8 km \qquad (4.8)$$

The tangential velocity on the surface of the Pivot is:

$$V_{pivot} = \Omega(R_{pivot}) \cdot R_{pivot} = 0.04 \cdot mm / \sec \qquad (4.9)$$

<u>Conclusion</u>: In GR terms the Pivot is a very slow spinning Kerr black hole.

4.7 The orbiting radius of the Milky Way.

Finding the Milky Way (R_{mw}) will enable calculating the orbiting radiuses of other galaxies by relying on their Z shift. (See paragraph 5)

The orbiting radius of the Milky Way R_{mw} can be found by equating the measured ω_{Birch} to the angular velocity $\Omega(r)$ of Eq (4.4).

$$\omega_{Birch} = \frac{R_H \cdot \alpha \cdot C}{R_{mw}{}^3 + \alpha^2 \cdot R_{mw} + R_H \cdot \alpha^2} ..... \Rightarrow R_{mw} = 125.22Gly \qquad (4.10)$$

<u>Additional Notes:</u>

1. Newton's calculation Vs. Birch's observation

Having found the dimensions of the Pivot Universe, one can compare the velocity of the Milky Way orbiting the Pivot at a radius of R_{mw} according to Newton's gravitational law in comparison the velocity derived from Birch's observation:

$$V_{mw\_Newton} = \left(\frac{G \cdot M_{pivot}}{R_{mw}} \right)^{0.5} \cong 0.7C \qquad (4.11)$$

The velocity of a celestial body orbiting the Pivot at a radius of R_{wm} can be also calculated by:

$$V_{\mathrm{mw\_Birch}} = \omega_{Birch} \cdot R_{mw} = 0.00376C = 1130km/s \qquad (4.12)$$

There is a significant discrepancy between the two calculations. The ratio is:

$$R_{atio} = \frac{V_{mw\_Newton}}{V_{mw\_Birch}} = 186.4 \qquad (4.13)$$

GR can explain this discrepancy. GR teaches that space is wrapped around a celestial body. Newton was not aware that all celestial bodies spin and while spinning drag the space around them. I postulate that the distance between two bodies that according to Newton's gravitational law is a straight line between their centers, should be replaced by the length of the geodesic formed by the dragged space between the two bodies.

2. The graph of the frame dragging $\Omega(r)$ according to (4.5) is shown in Fig. 4.1

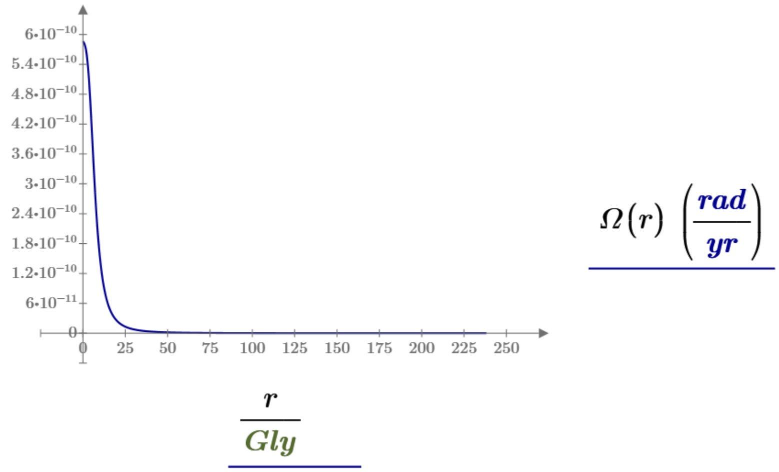


Fig. 4.1 – Frame dragging caused by the Pivot on equator plane

3. Space velocity around the Pivot

Another interesting issue arises from Fig. 4.2. This graph shows the velocity of the dragged space $\mathrm{V}(r) = \Omega(r) \cdot r$. In the range of $r = 0.48Gly \leftrightarrow 7.39Gly$ the velocity of the dragged space is higher than speed of light, reaching a peak of 3.2C. This range can be considered as a singularity ring. Material that crosses the event horizon of the Pivot and plunges towards the Pivot will not reach the Pivot but rather will turn into energy in this singularity ring. This energy is ejected via two jets along the axis of rotation. Note: According to Kerr solution the singularity ring has no width.

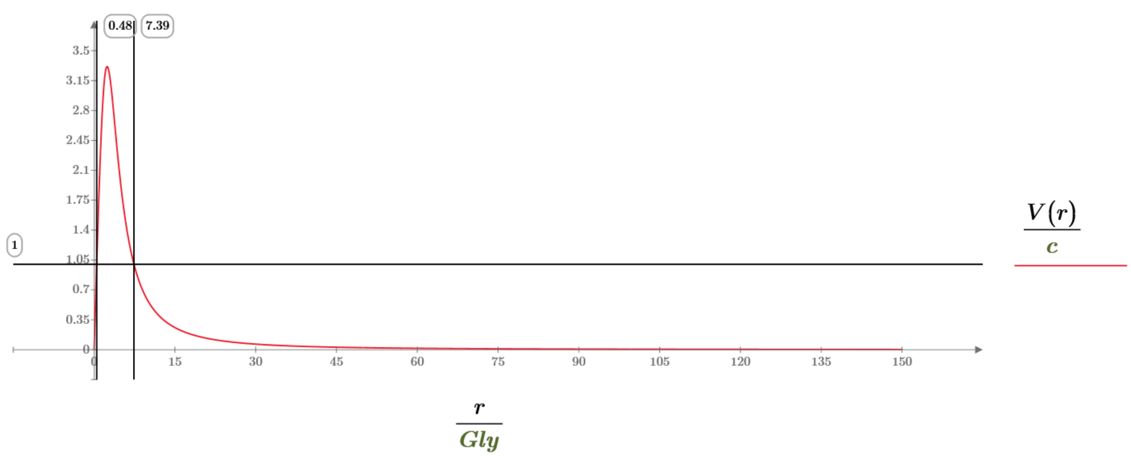


Fig. 4.2 – Velocity of dragged space around the Pivot

4. The calculated radius of the Pivot is $6.2 \cdot 10^8 km$. For comparison only, the distance of Jupiter from the Sun is $7.8 \cdot 10^8 km$. The size of the Pivot is impressive, but it is dwarfed when compared to the radius of the visible Universe ring. This ratio is:
   $Ratio = \frac{R_{pivot}}{R_{out}} = 2.28 \cdot 10^{-16}$.
5. While calculating the angular momentum of the visible Universe ring, the spinning angular momentum of all celestial bodies, i.e., Galaxies, stars, planets, interstellar planets should have been included. However, it is shown now, that the sum of the spinning angular momentum of all these celestial bodies is negligible in comparison to the orbital angular momentum of the ring-shaped visible Universe. Based on Muradian [4], an estimated total angular momentum of all celestial objects is:
   $J_{objects} = J_{gal} \cdot N_{gal} + J_{star} \cdot N_{star} + J_{planet} \cdot N_{planet} = 2 \cdot 10^{85} erg \cdot \sec$

   Where:
   The average angular momentum of a Galaxy: $J_{gal} = 10^{74} erg \cdot \sec$, Number of Galaxies: $N_{gal} = 2 \cdot 10^{11}$, Angular momentum of an average star: $J_{star} = 10^{49} erg \cdot \sec$, Number solar systems: $N_{star} = 10^{22}$, Angular momentum of an average planet: $J_{star} = 10^{40} erg \cdot \sec$, Number planets: $N_{planet} = 10^{24}$. $J_{objects} = 2 \cdot 10^{85} erg \cdot \sec << J_{ring} = 1.06 \cdot 10^{94} erg \cdot \sec$ and therefore, can be neglected.

6. It is interesting to compare the mass calculated in this paper with results calculated by others.

$M_{visible\_Universe} = 1.45 \cdot 10^{53} kg$ …is the mass of visible Universe according to Big Bang theory, Wikipedia [2].

$R = \frac{26.8\%}{4.9\%} = 5.47$ … is the ratio of “dark matter” mass to visible Universe mass, according to Big Bang theory. Wikipedia [3].

$M_{dark\_matter} = R \cdot M_{ring} = 7.93 \cdot 10^{53} kg$ …is the calculated mass of the dark matter according to Big Bang theory.

$M_{total} = M_{dark\_matter} + M_{ring} = 9.38 \cdot 10^{53} kg$ …is the calculated total mass of the Universe according to Big Bang theory.

Comparing the masses calculated by the Big Bang theory to this paper:

$$\frac{M_{ring}}{M_{visible\_Universe}} = 3.17 \quad ; \quad \frac{M_{nucleus}}{M_{total}} = 1.32 \quad ; \quad \frac{M_{pivot}}{M_{dark\_matter}} = 0.99$$

<u>Note:</u> I concur with the theories that claim that adding "dark matter" to the Universe, solves the issue of curve flattening of Galaxies. However, I claim that this "dark matter" resides in the Pivot rather than being spread in and around Galaxies. This is the reason why the "dark matter" has not been observed.

Based on the description and the calculations above, Figure 4.3 depicts schematically the structure of Pivot Universe. The Pivot is a neutron nucleus whose center is fixed in space but it spins around an axis through this fixed point. The visible Universe ring is located outside the event horizon and rotates in the same direction of the Pivot. The Pivot cannot be observed by an observer located at the visible Universe ring. In the figure it is also shown schematically - the dragging of space around the Pivot. It is divided into the dragging on the equator and the dragging about the axis. I claim that the ring-shaped Universe is located in space at such a distance from the Pivot that the velocity of the dragged space is equal to the velocity of the visible Universe. Thus, there is no relative motion between space and the visible Universe. The figure shows schematically the trajectory of a body rotating the Pivot. (Note: the size of the body is exaggerated. In the scale of the figure, even the largest galaxy in the universe is no more than a faint point). The center of this body orbits the Pivot at a velocity V, exactly as the speed of the dragged space. However, there is a difference in the velocities of regions on the body. The region that is closer to the Pivot moves at V+ΔV. The region that is further from the Pivot moves at V-ΔV. As a result, the body must spin around its center in the direction opposite the spin of the Pivot. This configuration explains both Michelson-Morley experiment (M-M) and the Sagnac effect.

M-M experiment: If "V" is exactly in the direction of the trajectory than there the result from M-M is null. However, the situation is more complicated because a celestial body may also rotate around its star and the star rotates around the center of its galaxy. Take, e.g., Earth. Its tangential velocity at the equator due to its spin is ~0.46km/s. Earth also rotates the Sun at 30km/s, and the Sun rotates the Milky way center at 230km/s. Simultaneously, Earth and the entire Milky Way velocity around the Pivot is approximately 1130km/s (this velocity is calculated from eq. (4.12)). Thus, the resultant velocity of Earth around the Pivot does not have exactly the magnitude and direction of "V." Indeed, the results from various tests of M-M show that the velocity of Earth relative to space is not precisely null but rather between 1km/s to 10km/s. The results change because of the different relative position of the Sun around the center of the Milky Way and Earth position around the Sun.

The Sagnac effect is explained by the fact that all bodies, no matter their size, spin naturally in a direction opposite to the Pivot's spin. The magnitude of this natural spin is constant along the trajectory. Now, if the spin of the body is changed artificially, as for example in Sagnac gyro, then there is a difference between the natural spin and the artificial spin that can be measured by the Sagnac effect.

To sum up, the Pivot and the Universe ring are in a dynamic equilibrium. On the other hand, celestial bodies located in visible Universe ring can change. Stars will consume their energy; galaxies may collide and so on.

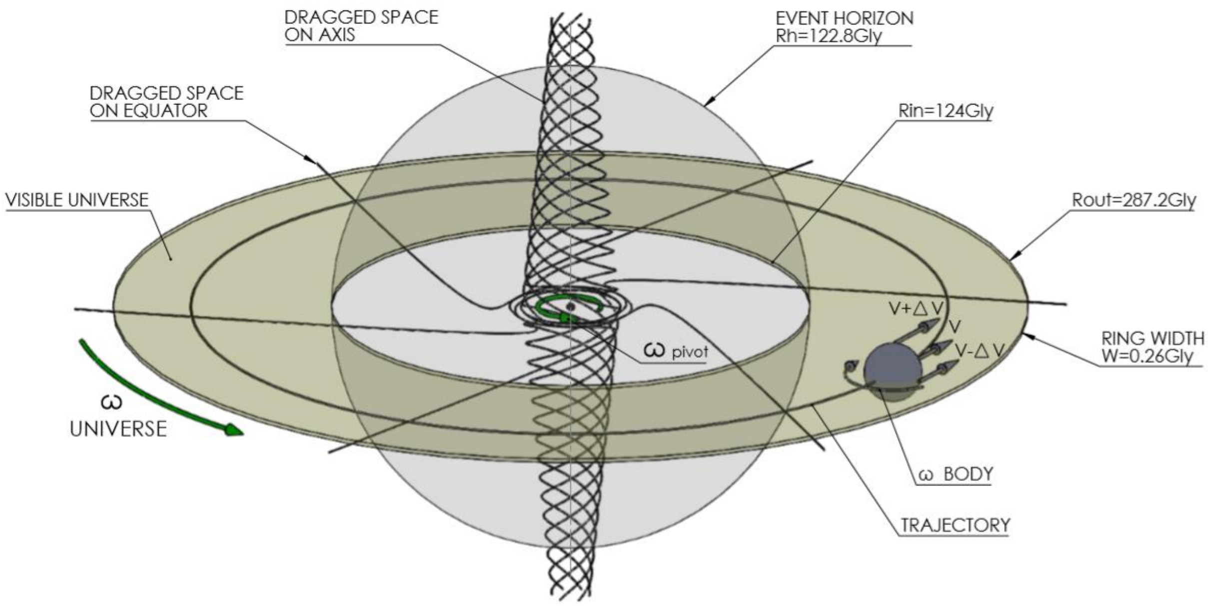


Fig. 4.3- Structure and dimensions of the Pivot Universe

5. Gravitational z shift

The Pivot theory postulates that the gravitational field of the Pivot causes the z shift of Galaxies. GR states that electromagnetic radiation originating from a Galaxy orbiting the Pivot is reduced in frequency, or redshifted when observed from a Galaxy that is closer to the Pivot. But, since the Pivot theory claims that Galaxies are orbiting the Pivot at different velocities, the Doppler shift cannot be excluded. However, it will be shown later (see paragraph 8) that the Doppler redshift contribution to the measured z shift is small.

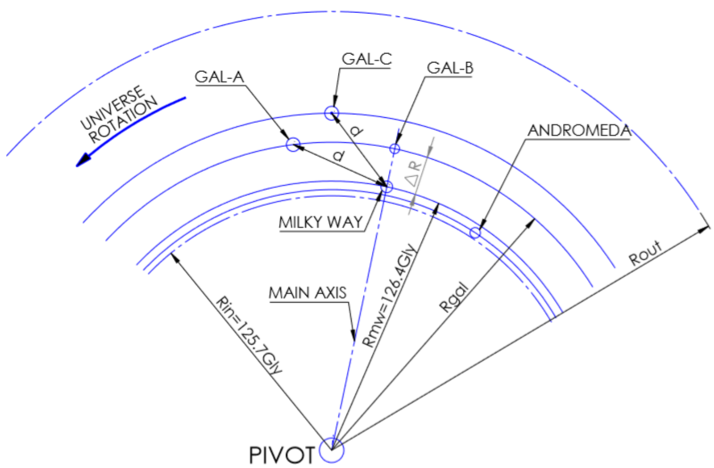


Fig. 5.1 – The Pivot Universe structure shows Galaxies orbiting the Pivot

Fig. 5.1 shows that Galaxies observed from the Milky Way can be either red shifted or blue shifted. For Galaxies that are closer to the Pivot than the Milky Way, e.g., Andromeda galaxy, $Z_{gal} < 0$. Galaxies that are orbiting the Pivot at a radius larger than the Milky Way radius are red shifted $Z_{gal} > 0$. Referring to Fig. 5.1, GAL-A and GAL-B are shown to have different distances from the Milky Way. Nevertheless, they have the same z shift, because both Galaxies are located on the same orbit. Had the Milky Way been located on the outer radius of the Universe ring, all Galaxies would have been blue shifted. It was shown in Eq. (4.10) that the Milky Way orbiting radius R_{mw} is closer to R_{in} than most of the Galaxies, therefore from the Milky Way most of the Galaxies will be redshifted.

The gravitational z shift of a Galaxy Z_{gal} orbiting the Pivot at a radius R_{gal}, is calculated by GR Eq. (5.1) and is shown in Fig. 5.2:

$$Z_{gal}(R_{gal}) = \frac{1}{\left(1 - \frac{2 \cdot G \cdot M_{pivot}}{R_{gal} \cdot C^2}\right)^{0.5}} - 1 \qquad (5.1)$$

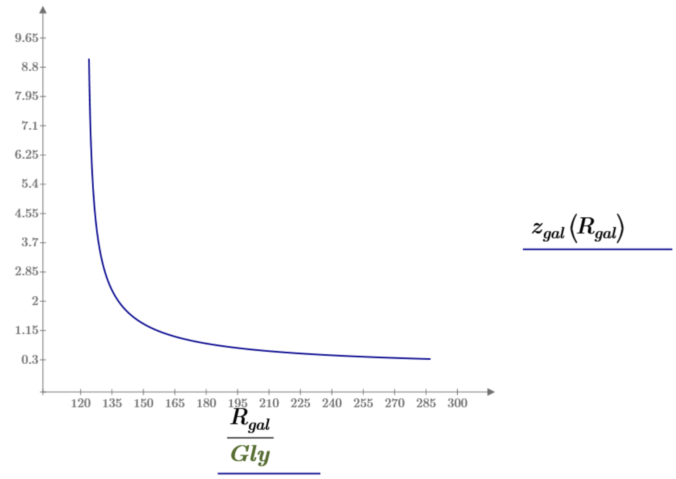


Fig 5.2 – Gravitational z shift caused by the Pivot

The z shift of the Milky Way is calculated by:

$$z_{mw} = \frac{1}{\left(1 - \frac{2 \cdot G \cdot M_{pivot}}{R_{mw} \cdot C^2}\right)^{0.5}} - 1 = 6.14 \quad (5.2)$$

Now, the orbiting radius R_{gal} of any Galaxy can be found by the measurement of z shift as seen the Milky Way z_{gal}.

$$R_{gal} = \frac{2 \cdot G \cdot M_{pivot}}{\left(1 - \frac{1}{(z_{mw} - z_{gal} + 1)^2}\right) C^2} \quad (5.3)$$

Two examples of finding the orbiting radius of Galaxies using Eq. (5.3):

1) Andromeda Galaxy measured blue shift: -0.001001 gives that radius of Andromeda around the Pivot is: $R_{andromeda} = 125.2167 \cdot Gly$. The Milky Way radius is $R_{mw} = 125.2714 \cdot Gly$. This means that Andromeda's orbit is smaller by $703.18 \cdot Kly$ than the orbit of the Milky Way. As $703.18 \cdot Kly$ is bigger the sum of the radiuses of both galaxies, there will be collision between the galaxies.
2) Galaxy GN-z11 is the Galaxy with the height redshift ever measured: 11.09. The radius of GN-z11 is 131.15Gly i.e., 5.94Gly further from the Pivot than the Milky Way.

6. The Origin of spinning and rotation of celestial bodies

After the explosion of the primeval nucleus, the visible Universe contained only very hot nucleons that were orbiting the Pivot. It took the visible Universe 380,000 years to cool down. When this happened, ordinary atoms were formed. All the atoms orbited the Pivot because they were dragged by the viscous space and simultaneously spin around their axis in the opposite direction to the Pivot spin. The explanation of this combined movement is not intuitive. The reader is referred to an experiment of Stokes flow that is shown in NSF [7] https://www.youtube.com/watch?v=QcBpDVzBPMk , start time: 3:38 min.

The celestial bodies created as a result of atoms attracting each other by gravity retained the spin direction of the atoms. The local density of the visible Universe was the cause of the variety of celestial bodies. If the density of atoms at a particular region in the visible Universe ring was too low to enable significant attraction between them, they remained as a cloud of gas that orbits the Pivot. If the density of atoms was sufficient for interaction between them, stars were created. The variety of celestial bodies was dependent on the mass of the born star. Some stars that had enough mass to collapse by gravity into neutron stars. Galaxies were formed in the following way: if the mass of the star was big enough, it collapsed by gravitation to form a black hole. Once a black hole was created, it started to accumulate matter and stars from the surrounding space. The black hole swallowed some of the matter/stars, but other matter/stars began to orbit around it. Fig 6.1 shows trajectories of stars around the Galaxy's black hole. Stars that are orbiting the Pivot at a bigger radius than the Galaxy's black hole move slower than the Galaxy's black hole. Stars that are orbiting the Pivot at a smaller radius than the Galaxy's black hole move faster than the Galaxy's black hole. This created torque on the Galaxy, consequently causing it to simultaneously spin around its black hole and orbiting the Pivot in a counter direction of the Pivot's spin. The black hole in the Galaxy's center played a crucial role in the first stages of the Galaxy evolvement. Even though the mass of the black hole in the center of the Galaxy is relatively huge, it can influence only stars that are orbiting near it. For example, the radius of the Milky Way is 100,000 light-years Vs. The Schwarzschild radius of its black hole that is $1.3 \cdot 10^{-6}$ light-years. But at this stage, new stars were attracted by the distributed mass of the new Galaxy, rather than the gravity caused by the supermassive black hole.

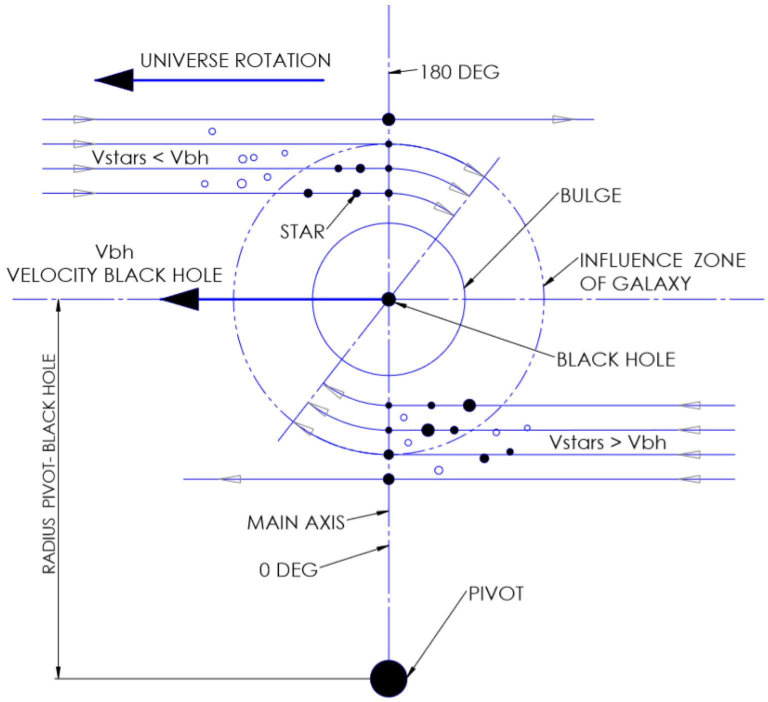


Fig. 6.1 – Trajectories of stars around a Galaxy black hole

7. Rotation curve and spiral shape of a Galaxy

The rotation curve of a Galaxy is a plot of the orbital speeds of stars or gas in that Galaxy versus their radial distance from that Galaxy's center. (See Fig. 7.2). The rotation curves of Galaxies where measured accurately by Vera Rubin and her team. They verified that the rotation curve was flattened, or in other words, that the velocities of stars orbit at roughly the same speed not depending on their distance from the Galaxy's center. This observation is contrary to Newton mechanics that claims that stars that are located further from the Galaxy center will move slower. The Pivot structure can explain the flattening of the rotation curves.

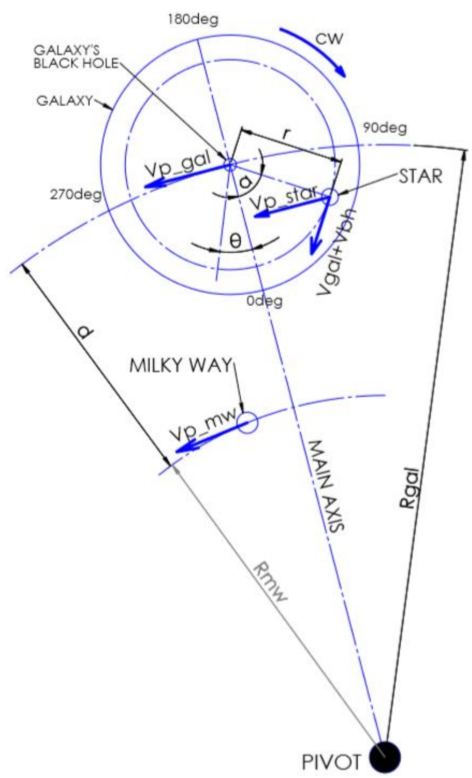


Fig. 7.1 – Velocities of a star in a Galaxy

The gravitational forces exerted on a star in a Galaxy are caused by:

a) Distributed mass of the Galaxy.

b) The Black hole in the center of a Galaxy.

c) The Pivot.

Data:

$M_{gal} = 10^{39} kg$ … is an average mass of a Galaxy.

$M_{bh} = 10^{36} kg$ … is the average mass of a black hole in the center of a Galaxy.

$d = 50 Mly$ … distance between the Milky Way to a center of a Galaxy

$R_{gal} = R_{mw} + d$ … is the distance between a Galaxy and the Pivot.

$r = 0...140\,\text{Kly}$ …is the distance from the star to the black hole of the Galaxy

$r_0 = 30\,\text{Kly}$ ... is an estimated characteristic radius of distributed mass of the Galaxy. (see (7.1)

$V_{sun\_bh} = 213 \cdot km/s$ …is the velocity of the Sun around Milky Way black hole

$V_{\text{earth\_sun}} = 30 \cdot km/s$ …is the velocity of Earth around the Sun

$\alpha = 0 \cdot Deg..360 \cdot Deg$ …Angle, see Fig. 7.1

a) Velocity of a star due to distributed mass of the Galaxy according to Newtonian dynamics: (Note: this is an approximation because Newton related to a sphere and a galaxy has a thin-disk shape)

$$V_{gal}(r) := \text{if } 0 \cdot Kly < r \le r_0 \;\; \left\| \left(\frac{G \cdot M_{gal}}{r_0}\right)^{0.5} \cdot \frac{r}{r_0} \right. \;\; \text{else} \;\; \left\| \left(\frac{G \cdot M_{gal}}{r}\right)^{0.5} \right. \qquad (7.1)$$

b) The velocity of a star around the Galaxy's Black hole:

$$V_{bh} = \left(\frac{G \cdot M_{bh}}{r}\right)^{0.5} \qquad (7.2)$$

c) The velocity of a star in a Galaxy orbiting the Pivot:

$$V_{p\_star} = \Omega\ (R_{gal}) \cdot (R_{gal} - r \cdot \cos(\alpha)) \qquad (7.3)$$

Summation of the three velocities on the star gives:

$$V_{sum} = V_{p\_star} + (V_{gal} + V_{bh}) \cdot \cos(\alpha) \qquad (7.4)$$

Orbital velocity of Milky Way around the Pivot:

$$V_{p\_mw} = \omega_{Birch} \cdot R_{mw} = 0.013C \qquad (7.5)$$

The velocity of a star in a Galaxy as seen by an Earth observer is given by:

$$V_{star} = V_{p\_mw} - V_{sum} + (V_{sun\_bh} + V_{earth\_sun}) \qquad (7.6)$$

Figure 7.2 shows the velocities of stars in an arbitrary Galaxy as seen from Earth. The red curve is a star velocity in a Galaxy and it is flattened out as r becomes bigger. Some of the curve velocities of stars will be flattened, similar to the red curve. In any case, all the curves are confined between the two extreme curves of the graph (the black and the blue). The exact shape of the graph is dependent on α, d, r, and the mass of the Galaxy's black hole.

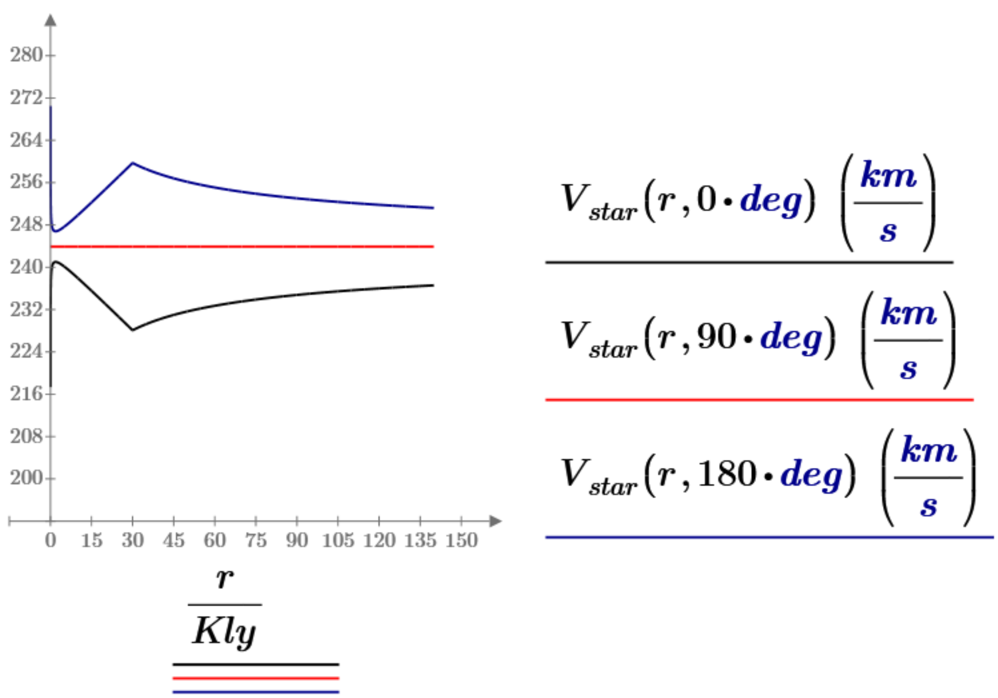


Fig. 7.2 – Rotation curve for a Galaxy at as seen by Earth observer

The shape of a spiral Galaxy

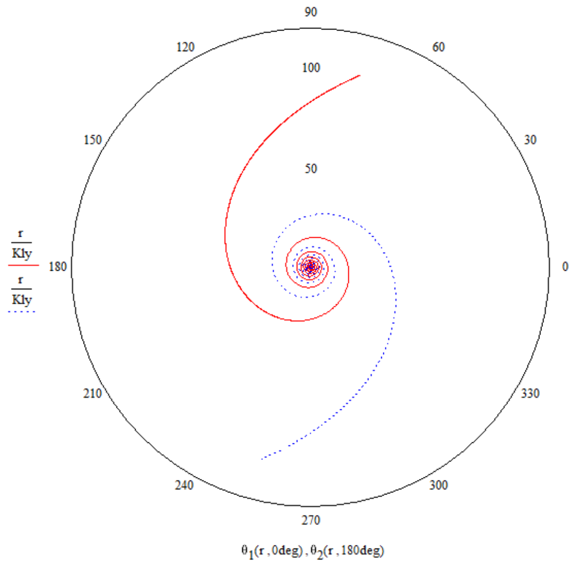
Most spiral Galaxies contain a central bulge surrounded by a flat rotating disk of stars. The bulge in the Galaxy center includes a supermassive black hole. The supermassive black hole is created from the cloud of dust and stars that are orbiting the Pivot. This black hole was the kernel of the Galaxy. The size of this black hole varies, and it is also possible that there are Galaxies without black holes at their center. The bulge has an ellipsoidal shape because stars that were attracted by the central black hole in the Galaxy originated not only from stars that were located on the equatorial plane of the Galaxy but also from planes that are "above" or "below" the equatorial plane. A rotating disk that separates itself into arms circle the Galaxy center. The spiral arms are the result of the superposition of the motion of a star around the Pivot and its motion around the supermassive black hole at the center of the Galaxy. Spiral Galaxies may have more than two arms. A Galaxy may have more than two arms if the Galaxy encountered several dense regions at various times. Each time the Galaxy crosses a dense region a new arm is added to the Galaxy. The width of the arm depends on the size of the dense region.

The angular displacement, during elapsed time t, of a star orbiting the Galaxy's black hole is designated (θ) (See Fig. 7.1). $\theta(r,\alpha)=\int_0^t \frac{V_{star}(r,\alpha)}{r}\,dt$, where $V_{star}(r,\alpha)$ is given in (7.6). This integration is done only for stars that are located on the main axis (i.e., the axis that connects the Pivot and the Galaxy's black hole, i.e., angles of 0deg and 180deg – (See Fig. 6.1 and Fig. 7.1). Only at these angles, stars begin to orbit around the Galaxy's center. Fig. 7.3 shows the shape of a spiral shape Galaxy 10 billion years after its creation. Note: The modulo operator "mod" before the integral enables the spiral shape of only the last rotation to be shown. The "mod" operator - returns the remainder on dividing x by y (x modulo y). In the current case y=360deg. The reason for using this operator is that stars in Galaxies have completed many full rotations around the Galaxy's black hole during its life. For example, the Milky Way makes a full rotation around the black hole located at its center every ~250 million years. Thus, the Milky Way has completed during its life ~54 full rotation.

It is interesting to show the prediction of the Pivot theory as to what will be the shape of the spiral Galaxy 50 Billion years after its creation. From Fig. 7.4 it can be concluded that the spiral shape of a spiral Galaxy is changing at a slow pace over billions of years.

$$\theta_1(r,\alpha) := \mathrm{mod}\left[\left[\int_{0yr}^{t} \frac{V_{star}[r,(\alpha)\cdot deg]}{r}\,dt\right]\cdot deg, 360deg\right]$$

$$\theta_2(r,\alpha) := \mathrm{mod}\left[\left[\int_{0yr}^{t} \frac{V_{star}[r,(\alpha)\cdot deg]}{r}\,dt\right]\cdot deg, 360deg\right] + 180deg$$



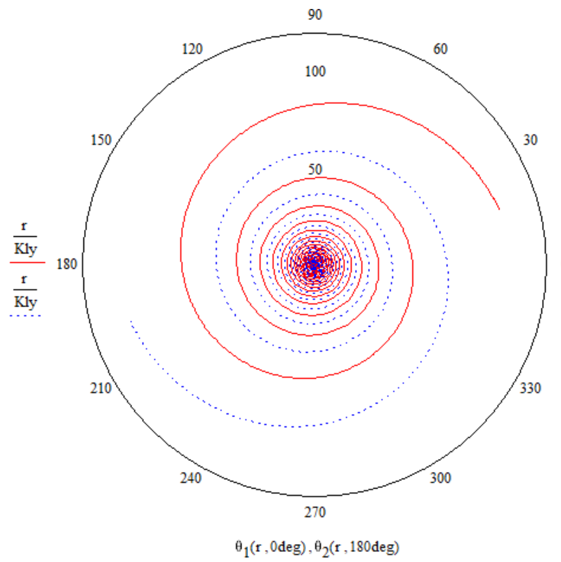


Fig. 7.3 – Shape of a spiral Galaxy at t =10 Billion years after its creation.

Fig. 7.4 – Shape of a spiral Galaxy at t =50 Billion years after its creation.

8. Hubble's observations

The aim of this paragraph is to show that Hubble's law is wrong. I am elaborating on this issue because Hubble's law is in clear contrast to the Pivot theory that claims the Universe has a rotation axis. I am not disputing the correctness of the observations made by Hubble and others. But, I argue that the laws he derived from these observations are wrong.

Hubble's law is a cornerstone in the Big Bang (BB) theory. Hubble's law consists actually of two laws. The first states that Galaxies are receding from each other at a velocity that is linear to their relative distances $V = H_0 \cdot d$. An important conclusion that can be derived from the BB theory is that the Universe "on large-scale" is isotropic and homogenous. The second law claimed by Hubble is $V = z \cdot C$, meaning that there is a linear relationship between the receding velocity and the redshift of a Galaxy. Hubble's laws seemed to be correct at his time when measurements were done on Galaxies near the Milky Way. However, when Hubble's law was used for observations of distant Galaxies with high redshifted the graph curved up. This finding was a basis of an additional paradigm: The Universe is expanding forever in all directions, at an ever-accelerating speed. According to Hubble's laws, there are observed Galaxies with z>1.5 that are receding from the Milky Way at speeds greater than the speed of light, Davis & Lineweaver [8]. The accelerated expanding Universe gives rise to yet another theory claiming that to accelerate the Universe expansion at the observed rates, there must be an additional force. This force is dubbed "dark energy". The mass of this dark energy was calculated to be ~70% of all the mass in the Universe. The confusion, among the scientific community, is great. Kirshner [9] relates to Hubble's diagram (Fig. 7.1): "Staring at his original Hubble diagram, you can see that there is a handful of nearby Galaxies with blue shifts, and a large scatter of velocities at any given distance. Hubble shrewdly used plausible methods to average the data for Galaxies that are at the same distance to make his result stand out more clearly from the noise. He was fortunate to have data that behaved so well."

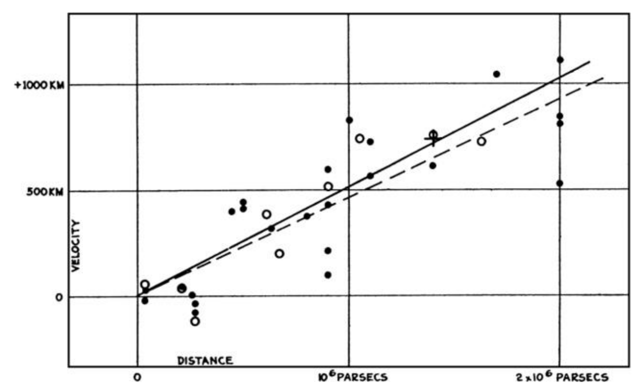


Fig. 7.1 – Hubble's original graph (1929)

Hubble's diagram shows that there is a significant scatter of the measurements. Some Galaxies are located at the same distance from the Milky Way but have different velocities. The Pivot theory can explain Hubble's observations. Fig. 6.1 shows two Galaxies GAL-A and GAL-C having the same distance (d) from the Milky Way, but are located on different radiuses. According to the Pivot theory, they have different z shifts. But according to Hubble, they should have the same redshift and the same velocities. Hubble's law is valid only in a particular case, when the observed Galaxies are located on the main axis (the axis that connects the Milky May and the Pivot), as is shown, e.g., for GAL-B. In this case, ΔR=d and the relation velocity-distant is linear. To sum up: the linear relation in Hubble's law is velocity-distance of the Galaxies, whereas in the Pivot theory the linear relation is between the velocity and the orbiting radiuses of the Galaxies.

Doppler shift Vs. gravitational shift

Hubble claims that the redshift of Galaxies is due only to the Doppler effect. The Pivot theory claim that there is a Doppler effect, but it is small in comparison to the gravitational shift that is calculated in paragraph 5. For finding the Doppler shift of an observed Galaxy, first, the orbiting velocities around the Pivot of the Milky Way (8.1) and the observed Galaxy (8.2) should be found. Then, the velocity difference between the two Galaxies is calculated (8.3). Subsequently, the Doppler shift is calculated (8.4). Finally, the ratio of the Doppler shift to the total z shift is calculated (8.5) and shown in Fig. 8.2. From this graph, the maximal Doppler effect contribution to the total z shift can reach 1% at R_{out} .

$$V_{mw} = \omega_{Birch} \cdot R_{mw} = 0.0038C \quad (8.1) \qquad\qquad V_{gal} = \Omega(R_{gal}) \cdot R_{gal} \quad (8.2)$$

$$\Delta V = V_{mw} - V_{gal} \quad (8.3)$$

$$Z_{doppler} = \frac{\Delta V}{C} \quad (8.4) \qquad\qquad R_{percent} = \frac{Z_{doppler}}{Z_{gal} + Z_{doppler}} \cdot 100 \quad (8.5)$$

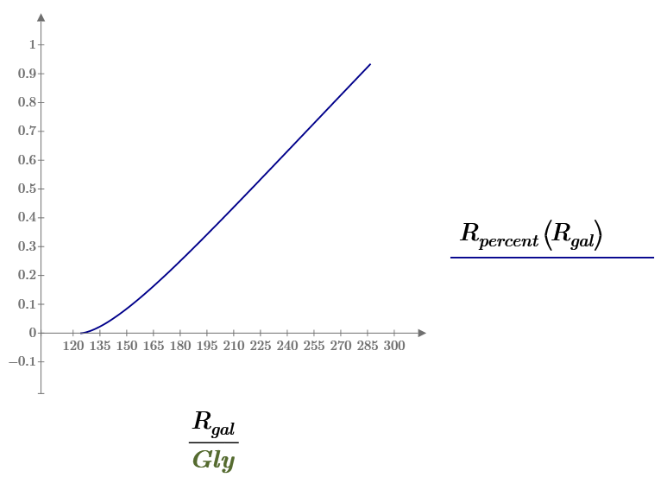


Fig. 8.2 - The ratio (%) of Doppler shift to the total z shift

9. Cosmic Microwave Background (CMB)

A known paradigm in modern cosmology is the cosmological principle. It states that at a “large-scale,” the spatial distribution of matter in the Universe is isotropic and homogeneous. The most robust observational evidence for the cosmological principle is the CMB. Therefore, people may claim that the Pivot Universe that has a preferred axis is improbable. I argue that even though the Pivot Universe has a preferred axis, it still agrees with the CMB observation. It was demonstrated in this article, that the Milky Way is located inside a sizeable observable Universe ring. A Milky Way observer sees a considerable number of Galaxies in whatever direction he looks. He may conclude that the entire Universe is isotropic and homogeneous. But for an observer in a Galaxy located on the outer surfaces of the ring, the Universe is not isotropic and homogenous. In one direction, he will be facing the vacuum, which is dark and has a temperature of absolute zero. Likewise, an observer that is located on the inner surface of the ring, i.e., facing the Pivot, sees total darkness and measures the temperature of the vacuum. Only an observer that will travel outside the ring of the visible Universe will be able to see that the Universe has an axis of rotation.

10. Olbers' paradox

Olber’s paradox is that an infinitely old Universe with an infinite number of stars distributed in an infinitely large space would be bright rather than dark. The BB theory explains this paradox by claiming that space is expanding. Therefore, the emitted light from distance Galaxies is reduced via redshift so that the most distant Galaxies are not seen from the Milky Way. The Pivot Universe, on the other hand, is a finite Universe with a limited number of stars and Galaxies. Outside the ring of the visible Universe, there is the darkness of space. An observer located inside the visible Universe ring sees a considerable number of Galaxies in whatever direction he looks, but eventually, in the background, he sees the total darkness.

11. Handedness of Galaxies

The Pivot theory explains yet an additional observation related to the handedness of the Universe. Longo and others [10] found an abundance of left-handed, or counterclockwise (CCW) Galaxies. The excess is small, about 7 percent, but the chance that it could happen in an isotropic and homogeneous Universe is slim. Fig. 11.1 shows a sector of the observable Universe ring. The figure shows the equatorial plane of the visible Universe ring and three Galaxies, the Milky Way, and two arbitrary Galaxies: Galaxy A and Galaxy B. The Milky Way is located "above" Galaxy B and "below" Galaxy A. It was explained earlier, that the Pivot theory postulates that all Galaxies rotate in the same direction, opposite to the Universe ring rotation. The location of the Galaxies, relatively to the Milky Way, will determine the direction of their rotation, as seen from the Milky Way. Thus, Galaxy A will be seen as rotating clockwise (CCW), while Galaxy B will be seen as rotating counterclockwise (CW) when observed from the Milky Way. Had the Milky Way been located on the equatorial plane, then the number of CCW and CW Galaxies would have been the same. However, if the Milky Way is offset by 7% from the equatorial plane, then the number of CCW Galaxies and CW Galaxies will differ by 7%.

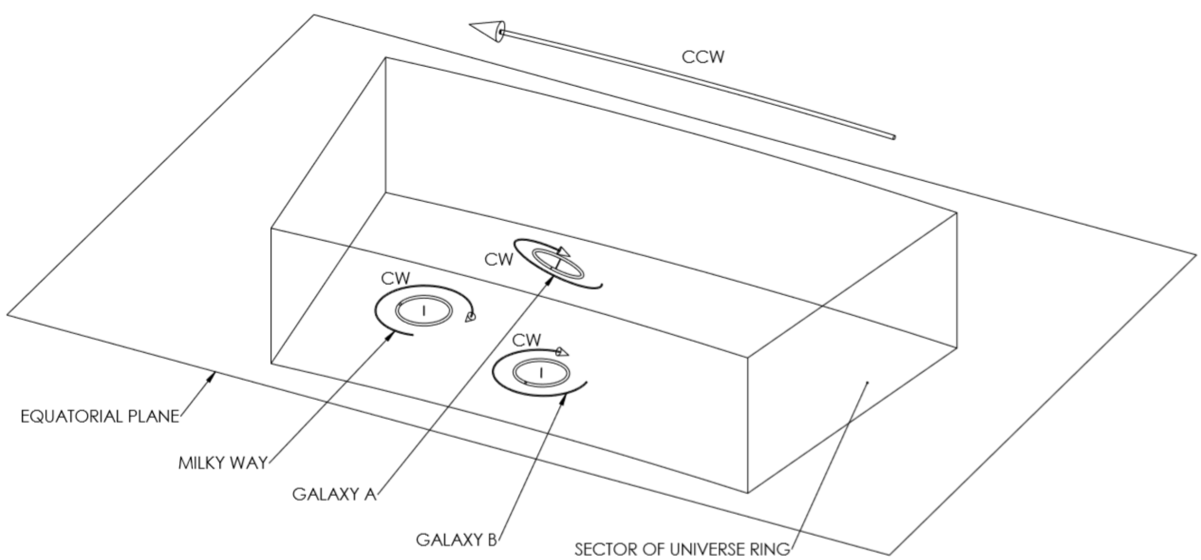


Fig. 11.1- Handedness of Galaxies

12. Historical notes

There is an ongoing debate in the scientific community about what is space and how it relates to matter — discussions concerning the nature of space date back 2500 years ago to the Greek philosophers Timaeus and Socrates. The ancient Greek perception of the Universe was characterized by the belief in the existence of a superior element -aether- which permeates the cosmic space. This topic was reformulated in the 17th century, particularly during the early development of classical mechanics. There are two opposing views regarding space and matter. One was argued by Leibniz, who claimed that space is merely the spatial relation between real things in the Universe. He meant that space would not exist undependably from the things. In other words, remove the real things from the Universe and space would not exist. This view is called relativism. Clarke argued the opposing view. He claimed that space is a sort of a substance that exists everywhere. Space contains all the things in the Universe: stars, planets, Galaxies, etc. The entire Universe is moving through space that is absolute. This view is called absolutism.

Newton took part in this debate. He argued that that absolutism was the correct view, and more than that, the Universe should have a center. He postulated that at this center, the group density of the stars is maximal. As we proceed outwards of this center, the group density of the stars decreases until finally at great distances, it is succeeded by an infinite region of emptiness. In other words, the Universe is a finite island in an infinite ocean of space. Newton, in 1718, suggested that the unlimited space was filled with an aether that serves as a fixed frame in the Universe. People argued against this concept because it leads to the result that light emitted by the stars and also individual stars are perpetually passing into the infinite space, never to return. Such a finite material Universe should be destined to become impoverished. Modern cosmologists abandoned Newton's theory. Specifically, because of an experiment that was done in 1887 by Michelson-Morley. They showed that light was traveling at the same velocity no matter in what direction it was moving. This fact proved that there is no reference frame in the Universe, so Newton was wrong.

Einstein related to this debate. In 1905 he published his Special Relativity that did not need the existence of the aether. At that time, Einstein supported Mach's principle that claimed that there is no absolute reference frame in the Universe, and everything is relativistic. In 1913, he wrote to Mach: "For me, it is an absurdity to ascribe physical properties to 'space.'"

However, this debate has not been solved because of another experiment done by Sagnac in 1913. Sagnac showed contrary to the M-M experiment that there is an aether. Einstein changed his mind. In an address he gave at Leiden University in May 1920, he concluded, "Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable;"

As for Einstein's Universe, when he published GR, in 1917, he supposed the Universe to be static and unchanging, but in 1930 he changed his mind after the discovery of Hubble that the Universe was expanding in all direction. Based on the theory of GR and observations, the current prevailing theory in cosmology is the Big Bang theory. According to the BB, the Universe started as a point of infinite density, 13.8 Billion years ago, and since then, it is expanding at an ever-increasing acceleration in all directions. Before the BB, there was nothing, no matter, no space, and no time. The current Universe, according to the BB, is homogeneous and isotropic, which means that the Universe has no preferred frame of reference, or in other words, there is no aether. Now, it is essential to mention a recent experiment published in 2011, named Gravity Probe B. In this experiment space dragging around Earth that was derived in 1918 in the framework of GR by Lense and Thirring was proven to be correct. The experiment shows that aether/space is a real substance that has physical properties. After all, if aether/space was nothing, then what is dragged?

The Big Bang theory can explain various cosmological observations, but on the other hand, in addition to the aether/space problem, it has raised more fundamental issues. For example, how did the Universe start? What are the physical laws at the exact moment of creation? What is the reason that all celestial bodies spin? Why is the velocity curve of Galaxies flat? Etc., To solve them, cosmologists suggest new hypotheses such as dark matter and dark energy. Currently, these theories have no theoretical explanations nor observational evidence.

The Pivot theory describes in general, a Universe that resembles Newton's Universe, i.e., it is an isolated island in an infinite space and has a fixed center in space. The group density of the stars, as described by Newton, is replaced in the Pivot theory by the Pivot. Also, to explain cosmological observations, it combines Newton's Universe and Einstein's GR. Newton could not imagine such a structure because his gravitational law did not take into consideration the fact that all bodies in the Universe spin and drag space around them.

13. Summary

Our Universe is a finite island, possibly one of many other Universes spread in the infinite space.

The Pivot theory describes a Universe that began as a primeval nucleus. It originated from the vacuum, as can be explained by QFT. This primeval nucleon was a neutron star that exploded when the velocity on its surface reached the speed of light. Following the explosion, the current Universe was created. The current Universe is composed of a neutron star the Pivot that can also be described as a Kerr black hole and a ring of visible Universe orbiting it in the direction of the Pivot's spin. This structure defines a Universe that is in a state of dynamic equilibrium. Although the Pivot is very massive, it occupies a tiny volume of the Universe. In this sense, the Universe resembles the structure of the atom. The entire Universe may last forever. On the other hand, the visible Universe may change, stars will consume their energy; Galaxies orbiting in too close orbits will eventually collide, etc.

The Pivot Universe explains fundamental questions in physics:

Does the Universe have a reference frame? What is the origin of gravity? What is the structure of a black hole? How are QM and GR connected? Was there time before the Universe was created? What is dark matter?

However, there are opened issues, e.g., How long did it take to the primeval nucleus to reach its final size before it exploded? How long did it take the Pivot Universe to rearrange after the primeval nucleus exploded? Will our Universe last forever?

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Appendix A - The origin of gravity

The gravitational constant G is of profound importance in physics as it is involved in the calculations of gravitational effects in Newton's gravitational law and Einstein's general relativity theory. However, no theory explains its origin. G is an empirical physical constant first measured by Cavendish in 1789 and since then was verified several times.

I claim that the strong force and gravity are the same force. The strongest attractor in the Universe is the Pivot, but it contains only nucleons. Nucleons attract each other by the strong force. The magnitude of this force changes considerably as a function of the distances between nucleons. In the quantum world, the strong force reigns, but in the Universe, the weak gravity force takes over.

The theory of the origin of gravity is based on the work done by Ma and Wang [11]. They developed formulas based on field theory. The formulas developed relate to the strong force interaction between quarks, nucleons, and atoms. They developed a modified Yukawa potential equation. Yukawa, around 1930, developed a formula for the strong force that indicates that the strong nucleon force between two nucleons is always attractive. However, experimentally, it is now known that the force is attractive and repulsive depending on the distance between nucleons.

The strong force between two nucleons F_n is described by formula 6..12 in [11].

$$F_n = g^2 \cdot (\frac{1}{4 \cdot e^2} \cdot \frac{1}{r^2} - \frac{2 \cdot r}{r_1^3} \cdot e^{-\frac{r}{r_1}}) \qquad \text{(A.1)}$$

Where:

$g^2 = 10 \cdot \hbar \cdot C$ …Nucleon interaction constant.

<u>Note</u>: Ma and Wang are using the above value of g^2, however this value depends on the energy of the interaction or the distance between particles (TBD).

r …is the distance between nucleons centers.

$r_1 = 10^{-13} cm$ …is Yukawa radius

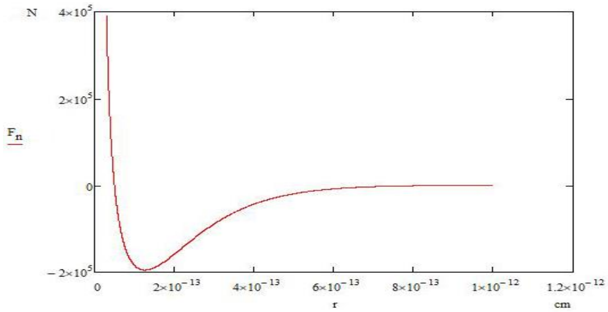


Fig. A.1 – Force between two nucleons as a function of the distance between them.

Figure A.1 is in good agreement with measurements. From the graph, it is also clear that the strong force is reduced substantially as the distance between nucleons grows. For example, at a distance of one hundred centimeters between nucleons, the attractive force is $4.8 \cdot 10^{-26} N$, dropping down from the maximum force of $2 \cdot 10^5 N$ at a distance of $1.3 \cdot 10^{-13} cm$. Here, I postulate that although the force between nucleons in the Universe is extremely small, there is nevertheless, a significant attraction force between celestial bodies in the Universe because each of them contains an enormous number of nucleons. This applies specifically to the Pivot that its attraction is felt on any celestial body even if the distance between the celestial body and the Pivot is over hundreds of billions light years. In the following paragraph, I will show that the gravitational constant G can be calculated by using other fundamental physical constants.

Examining equation (A.1) shows that $\frac{1}{4 \cdot e^{0.5} \cdot r^2} \gg \frac{2 \cdot r}{r_1^3} \cdot e^{-\frac{r}{r_1}}$ when the distance between nucleons increases. The meaning of this is that at cosmic distances the second part of the equation (A.1) can be discarded and the attraction force can be written as:

$$F_n = g^2 \cdot \frac{1}{4 \cdot e^2} \cdot \frac{1}{r^2}$$

Now, consider the force between two celestial bodies one with mass M_1 and the second M_2.

The number of the protons in the first body is: $N_1 = \frac{M_1}{m_{proton}}$. The number of protons in the second body is $N_2 = \frac{M_2}{m_{proton}}$

The force between the two bodies each of them containing many nucleons, according to Ma and Wang, is:

$$F_n = 3 \cdot g^2 \cdot N_1 \cdot N_2 \cdot (\frac{\rho_0}{\rho_n})^6 \cdot \frac{1}{4 \cdot e^2} \cdot \frac{1}{r^2} = 3 \cdot g^2 \frac{1}{m_{proton}{}^2} \cdot (\frac{\rho_0}{\rho_n})^6 \cdot \frac{1}{4 \cdot e^2} \cdot \frac{M_1 \cdot M_2}{r^2} \qquad \text{(A.2)}$$

On the other hand, in Newton's gravitational theory, the force between two bodies is given by:

$$F_G = G \cdot \frac{M_1 \cdot M_2}{r^2} \qquad \text{(A.3)}$$

where G - the universal gravitational constant.

By equating F_n (A.2) and F_G (A.3) the value of G can be calculated:

$$G = 3 \cdot g^2 \cdot \frac{1}{m_{proton}{}^2} \cdot \left(\frac{\rho_0}{\rho_n}\right)^6 \cdot \frac{1}{4 \cdot e^2} \qquad \text{(A.4)}$$

Where: $\rho_n = 0.85 \cdot 10^{-13} cm$ - the radius of the proton.

Note: In equation (A.4) the effective radius of the quark ρ_0 is not accurately known, therefore, its value is calculated. The result is: $\rho_0 = 0.2809 \cdot 10^{-19} cm$. From experiments it is known that its radius is smaller than about $\rho_0 = 20 \cdot 10^{-19} cm$.

Equation (A.4) unifies quantum physics, Newton's gravitational law, and GR.

Appendix B - Is a black hole a neutron star?

The Pivot is described in this article as a neutron star from QM point of view, and as a Kerr black hole from GR point of view.

Black holes existence in the visible Universe were predicted by solving GR equations. There is one profound difference between the Pivot and the Black holes in the visible Universe. The accumulation of nucleons built the Pivot whereas a Black hole in the visible Universe ring is the result of the gravitational collapse of a massive star. However, the final result is the same. A nucleus in which nucleons are packed to the maximum allowed density in the Universe.

Karl Schwarzschild in 1915 found an exact solution to Einstein's field equations. This solution predicted that Black holes exist in the Universe. In this solution there is an essential singularity at r = 0, meaning that the density at the center of the Black hole is infinite. This singularity implies that the known laws of physics break down. Einstein rejected this singularity. In a paper from 1939, Einstein concluded that there was no way a Schwarzschild singularity could ever be possible and therefore the Schwarzschild singularity does not exist in physical reality.

This issue can be resolved by postulating that in the physical world all parameters have bounds. There is no mathematical reason why there is a maximum speed in the Universe; however, physics does not allow any speed to exceed the speed of light. The same implies to density. I postulate that the maximum density of matter in the Universe is the density of a proton (or a neutron), i.e., ~6.5*10^17 kg/m^3. This maximum density is found in the nucleus of an atom and a neutron star. The density of a neutron star is 3.7x10^17 to 5.9x10^17 kg/m^3, which is comparable to the approximate density of an atomic nucleus of 3x10^17 kg/m^3. Wikipedia https://en.wikipedia.org/wiki/neutron_star

Note: There are additional theories regarding the maximal density in the Universe. The standard model of particle physics claims that there is a definite upper limit to the density of celestial bodies. The maximal theoretical density is Planck's density of 10^96 kg/m^3. However, intermediate between the neutron star density and the Planck's density there are hypothetical celestial bodies: The first is a quark star that has a density of 10^19kg/m^3. The second is a Preon star that has a density of 10^26kg/m^3. No evidence for quark and Preon stars was found. https://arxiv.org/pdf/astro-ph/0410407.pdf

I postulate that also a Black hole, precisely as a neutron star and a nucleus of an atom, have the same structure. Namely, the nucleons are densely packed to the maximum density possible in the Universe. Specifically, the maximum possible density in the Universe is the density observed in the Universe ~ 6.5*10^17 kg/m^3.

While GR allows the density theoretically to become infinite, quantum theory and quantum experiments show that it is not possible. One of the theoretical reasons is Pauli's exclusion principle which forbids from two identical fermion particles to occupy the same place at the same time. In a neutron star, the neutrons are packed so densely that they touch each other. To turn into other elementary particles, first the neutrons must be squeezed together so that they overlap, but this is not possible according to Pauli's exclusion principle.

There are QCD experiments that show why squeezing nucleons in a nucleus more than the density of a proton is not possible.

1) Experiments that measure the force between two nucleons as a function of the distance between them show that the force between them can be described by the graph shown in https://en.wikipedia.org/wiki/Nuclear_force . This graph is based on Reid's potential formula. It shows that for a distance smaller than 0.8fm, the force becomes a sizeable repulsive force. Further analyzing Reid's equation shows that at r=0 the potential as well the force between nucleons becomes infinite.
2) Physicists at Jefferson Lab did another experiment https://www.jlab.org/news/releases/quarks-feel-pressure-proton . They measured the distribution of pressure inside the proton. The findings show that the proton's building blocks, the quarks, are subjected to a pressure of 100 decillions Pascal (10^35) near the center of a proton, which is about ten times greater than the pressure in the heart of a neutron star. The meaning is that the outward-directed pressure from the center of the proton is higher than the inward-directed pressure near the proton's periphery and therefore a neutron star cannot collapse.

Given the description above, the question now is how come that Black holes are not directly observed in the Universe, while neutron stars are seen. My answer is: **The visibility depends on the relation between the physical radius of the nucleus and its Schwarzschild radius**. A celestial body will be observed if its physical radius is bigger than its Schwarzschild radius. On the other hand, if a celestial body has a physical radius that is smaller than its Schwarzschild radius, it will be hidden.

The limiting mass and radius between a neutron star and a Black hole can be found in the following manner:

1. Given a celestial body with mass M.

2. The radius of a densely packed spherical celestial body is:

$$R_n = R_{neutron} \cdot (\frac{M}{m_{neutron}})^{1/3} \qquad (1)$$

where:

Mass of Neutron: $m_{neutron} = 1.6749275 \cdot 10^{-27} kg$

Radius of Neutron: $\mathrm{R}_{neutron} = 0.8 \cdot 10^{-13} cm$

3. The Schwarzschild radius of a celestial body is:

$$R_H = \frac{2 \cdot G \cdot M}{C^2} \qquad (2)$$

where:

Gravitational constant: $G = 6.67 \cdot 10^{-11} \frac{m^3}{kg \cdot \sec^2}$

Light velocity: $C = 2.99 \cdot 10^8 \frac{m}{\sec}$

4. Equating Schwarzschild radius of the celestial body to its physical radius; $(\mathrm{R}_H = R_n)$:

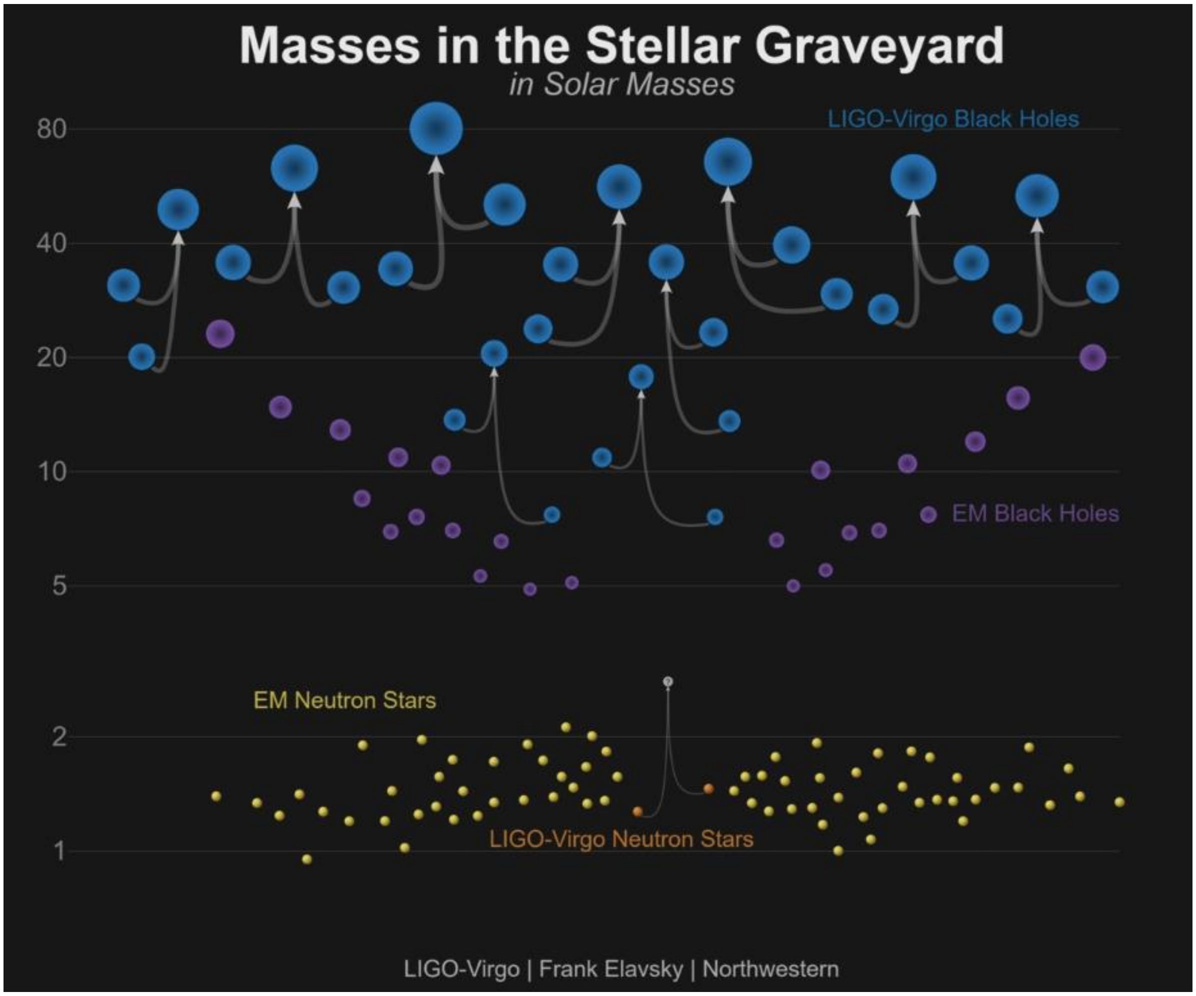
Gives: $M_{\lim it} = (\frac{R_{neutron} \cdot C^2}{2 \cdot G \cdot m_{neutron}^{1/3}})^{3/2} = 9.67 \cdot 10^{30} kg \sim 4.86 Sun - masses.$ (3)

and $R_{\lim it} = 14.35 km$

From the above calculations, it is shown that the limit between a neutron star and a Black hole is 4.86 Sun-masses and a radius of 14.35km. A celestial body with a mass higher than 4.86 Sun-masses will become a Black hole because its physical radius is smaller than its Schwarzschild radius.

Observations: This result of the minimal mass of a black hole in the Universe is in good agreement with observations. A recent summary of observations of black holes and neutron stars is shown in the following graph: https://www.ligo.caltech.edu/image/ligo20181203a

The graph shows ten black-hole mergers (blue) and one neutron-star merger (orange). Also shown are black holes (purple) and neutron stars (yellow) observed using electromagnetic (EM) radiation. There is a mass gap between the heaviest neutron stars and the lightest black holes. The smallest black hole observed is slightly less than 5 Solar-masses. This is in good agreement with theory described here. On the other hand, the biggest neutron star found is ~2 Solar-masses. Note: The mass gap between neutron stars and black holes is odd because stellar mass distribution is ranging smoothly from 0.1 to 100 Sun-masses. At this stage it is not clear why neutron stars with mass between ~2 to ~5 Solar-masses were not found. (Courtesy: LIGO-Virgo/Frank Elavsky/Northwestern)



So far, the development of the above equations is based only on classical mechanics. The Schwarzschild radius that was found from the solution of GR equations can be derived directly from the classical equation of the escape velocity from a celestial body. (The first who suggested this was John Michell in 1783). In Newton's equations, the spinning of celestial bodies is not taken into considerations. It is known now that all bodies in the Universe spin. A Black hole or a neutron star that is formed by gravitational collapse of a massive star must retain the angular momentum of this progenitor star. In SBH (Schwarzschild black hole), it is assumed that the mass collapses to an infinitely small point. However, as a point cannot have angular momentum the conclusion is that SBH is a theoretical solution of GR. But there is an additional solution to

GR equations. This solution takes into consideration the spinning of bodies. It was suggested in 1963 by Roy Kerr and is called KBH (Kerr black hole). Analyzing the Kerr solution shows:

1) KBH has a singularity ring at its center rather than the point singularity of SBH.
2) There is no singularity inside this ring, i.e., matter can exist inside the ring.
3) The KBH has two event horizons the outer event horizon, and an inner event horizon.
4) There is a frame dragging of the space around the black hole nucleus.

I postulate that:

a) The nucleus of the Black hole resides inside the ring singularity. In other words: R_n of the solid nucleus sphere $\leq$ the radius of the singularity ring that is equal to the spin parameter α defined by the Kerr solution.
b) The density of the nucleus inside the ring singularity is the maximum density possible in the Universe.
c) The angular momentum of the black hole, or a Neutron star, is comprised from the angular momentum of the spinning sphere + the angular momentum of the dragged space.

$R_n \leq \alpha$ ....is an assumption

where:

$\alpha = \dfrac{J}{M \cdot C}$ ...is the spin parameter defined by Kerr

J Angular momentum of the Black hole

M Mass of Black hole

$$R_{outer} = R_H + \sqrt{R_H{}^2 - R_n{}^2} \qquad (4)$$ ...is the outer event horizon

Frame dragging in the equatorial plane around the nucleus is calculated by:

$$\Omega(r) = \frac{R_{outer} \cdot R_n \cdot C}{r^3 + R_n{}^2 \cdot r + R_{outer} \cdot R_n{}^2} \qquad (5)$$

Velocity at r:

$$V(r) = \Omega(r) \cdot r \qquad (6)$$

In the following examples the tangential velocity on the surface of the nucleus $V(\mathrm{R}_n)$ of the biggest known and the smallest black holes are calculated:

1) The biggest supermassive black hole observed : $M = 2.1\cdot 10^{10}\cdot Sunmasses = 4.2\cdot 10^{40}\,kg$

$R_n = 2.34\cdot 10^{4}\,km$ from (1)

$R_H = 6.23\cdot 10^{10}\,km$ from (2)

$R_{outer} = 6.2\cdot 10^{11}\,km$ from (4)

$\Omega(\mathrm{R}_n) = 12.8Hz$ from (5)

$V(R_n) = 1\cdot C$ from (6)

2) The smallest black hole (according to the current article): $M = 4.86\cdot Sunmasses = 9.67\cdot 10^{30}\,kg$

$R_n = 14.35km$ from (1)

$R_H = 14.35km$ from (2)

$R_{outer} = 14.35km$ from (4)

$\Omega(\mathrm{R}_n) = 6.96\cdot 10^{3}\,Hz$ from (5)

$V(R_n) = 0.333\cdot C$ from (6)

<u>Note:</u>

At the beggining of this appendix the value of $\mathrm{M}_{\mathrm{lim}\,it}$ was calculated for a SBH eq. (3). It seems that this must be changed for KBH because now, $R_n = R_{outer}$ rather than $R_n = R_s$.

However solving $R_n = R_s + \sqrt{R_s^{\,2} - R_n^{\,2}}$ shows that $R_n = R_s$.

Thus the value of $\mathrm{M}_{\mathrm{lim}\,it}$ applies for SBH as well as for KBH.