The structure of the Pivot Universe

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Abstract

The Pivot theory presents a new theory regarding the structure of the Universe. It postulates that the Universe is composed of a massive spinning body, the Pivot, and a ring of a finite visible Universe that is orbiting it. The Pivot can be described by two theories, that currently are not unified. From the GR point of view, the Pivot is a Kerr black hole. From the quantum physics point of view, the Pivot is a super dense hadron. It is shown that by combining the two theories, QM and GR, the gravitational constant G can be calculated based on other fundamental physical constants.

The Pivot theory, described in this article, consists of two parts. The first relates to the questions of how did it all begin and how did the Universe has evolved into the Pivot structure. This part is not fully addressed. The Pivot theory is based on the theory of the primeval hadron. Using the primeval hadron's theory, the structure of the Universe is explained and its size is calculated. It is shown that the primeval hadron theory can answer questions relating to time, namely, what happened at the exact moment of the Universe creation i.e., t=0 and, more importantly, what happened before t=0.

The second part relates to the current structure of the Universe. The structure of the Pivot Universe is in accord with many known cosmological observations, to name some: The flattened rotation curve in Spiral Galaxies, the Spiral shape of Galaxies, Redshift of Galaxies etc.

Key words: Universe structure, black hole, hadron, QM, GR, gravitational constant, gravitational z shift

Contents

1. The Pivot theory- Overview

The Pivot theory consists of two parts. The first part relates to the questions, how it all began and how has the Universe evolved into the Pivot structure. This part is not fully addressed. However, it has not out of the thin air. It is based on the theory that the Universe began as a primeval hadron. Muradian [1], showed that there is a universal relationship between mass and intrinsic angular momentum of cosmic objects. He showed, by comparing calculations and observations, that this relation is valid for superclusters, Galaxies, stars, and planets. However, when he tried to calculate the mass of the entire Universe, he got a large discrepancy. In order to calculate the mass of the Universe, he assumed that the primeval hadron can be modeled as a Kerr black hole. By doing so he limited the mass that was accumulated by the primeval hadron to gravitational mass. I suggest re-modeling the primeval hadron as a Kerr-Newman black hole (KNBH), thus enabling inclusion of the electromagnetic mass. This model answers questions relating to time: what happened at the exact moment of the Universe creation i.e., t=0 and, more importantly, what happened before t=0. These questions cannot be answered by the Big Bang (BB) theory because there is a singularity problem at t=0, indicating that the laws of physics collapse and cannot be applied at the moment of creation.

The second part describes the current structure of the Universe; a massive spinning black hole, the Pivot, with a ring of a finite visible Universe orbiting it in the opposite direction. The Pivot theory solves the dark matter issue by postulating that the dark matter is concentrated in the Pivot rather than being spread throughout the Universe, as claimed by the BB. Being located in this huge black hole is the reason why the dark matter cannot be observed, even though it influences any celestial body, starting from dust and ending in the largest structures in the Universe. The Pivot structure, answers, quite strikingly, observed and unsolved issues in cosmology: 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, Universe rotation observed by Birch, Handedness of Galaxies, Olbers' paradox, Hubble's observations (but not Hubble's law!), Mach's principle. The Pivot theory answers two most mind-boggling theories in modern cosmology: the dark matter and the dark energy. The solution for the first is described here and the second is simply not needed in the Pivot theory.

2. Known constants and accepted parameters used in this article

$Gly = 9.454 \cdot 10^{24}\,\mathrm{m}$ …Billion light years.

$Mly = 9.454 \cdot 10^{21}\,\mathrm{m}$ …Million light years.

$Kly = 9.454 \cdot 10^{18}\,\mathrm{m}$ …Thousand light years.

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

$C = 2.99 \cdot 10^{8} m / \sec$ …Light velocity.

$\rho = 10^{-26} kg / m^3$ …Density of ordinary matter in Universe.

$\hbar = 1.054571 \cdot 10^{-34} J \cdot \sec$ …Reduced Planck's constant.

$m_{proton} = 1.6726219 \cdot 10^{-27}\ kg$ …Mass of proton.

$\omega = 10^{-13} rad / yr$ …Angular velocity of the Universe- Birch [6].

Birch [6] calculated from the study of position angles and polarization of high luminosity classical double radio sources a rotational velocity for the Universe of the order of $\omega = 10^{-13} rad / yr$. Although his work has not been convincingly refuted, it was criticized for using improper statistics, see e.g., Nodland & Ralston [13]. It is interesting to note that Sistero [9] tried to calculate the angular momentum and mass of a rotating Universe based on Birch's finding and Muradian estimations. However, he assumed that the Universe is a homogeneous spherical body with Hubble's radius. The results he got are in great discrepancy from accepted values. He himself acknowledges that the uncertainty in the values he got is very large. Birch's number of $\omega = 10^{-13} rad / yr$ plays an important role in the calculations of the Pivot theory, but in view of the criticism, it should be taken into account that it is possible that this number is not accurate.

$M_{vu} = 1.5 \cdot 10^{53} kg$ …Mass of visible Universe, Wikipedia [7].

$R = \dfrac{26.8\%}{4.9\%} = 5.47$ … Ratio of dark matter mass to visible Universe mass, Wikipedia [8].

$M_p = R \cdot M_{vu} = 8.2 \cdot 10^{53} kg$ …Calculated mass of Pivot.

$M_{total} = M_p + M_{vu} = 9.7 \cdot 10^{53} kg$ …Calculated total mass of the Universe.

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

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

$\rho_n = 0.85 \cdot 10^{-13} cm$ … Radius of the nucleon

3. The Pivot

3.1 **The primeval hadron and the Pivot from the GR point of view**

The Pivot theory uses the primeval hadron theory described by Muradian [1] and others suggesting that the Universe began as a super dense primeval hadron. 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 observations. Muradian [1] is aware that magnetic fields play an important role in astrophysics and that these fields can be a remnant of the magnetic field of the primeval hadron. However, the magnetic fields are not included in his calculations, as he claims that the charge cannot be calculated theoretically. For calculating the mass of the Universe Muradian [2] assumes that the primeval hadron can be modeled as a Kerr black hole. He equates the maximal angular momentum of the Universe $J = \frac{G \cdot m^2}{C}$ to the angular momentum of the primeval hadron $J = \hbar \cdot \left(\frac{m}{m_{proton}} \right)^{\frac{3}{2}}$. By doing so he gets that the Universe mass m is:

$$m = \frac{\hbar^2 \cdot C^2}{G^2 \cdot {m_{proton}}^3} = 4.77 \cdot 10^{49} kg \qquad (3.1.1)$$

The calculated mass from (3.1.1) is significantly smaller than the accepted mass of the of the Universe that is $m = 1.5 \cdot 10^{53} kg$. My claim is that the electromagnetic mass must be added to the primeval hadron mass. I suggest that this discrepancy can be resolved by modeling the hadron as a Kerr-Newman black hole (KNBH). The mass of the KNBH is composed of gravitational mass and electromagnetic mass. The mass of the Universe calculated in equation (3.1.1) is merely the gravitational mass of the hadron and therefore it is designated hereafter as M_g.The electromagnetic mass Q is a part of M_{total} (the total mass of the Universe that was calculated before).

Let assume $Q = \gamma \cdot M_{total}$, γ than can be calculated in two ways:

1) Calculating the total mass of the hadron:

$$M_{total} = M_g + Q = M_g + \gamma \cdot M_{total} \Rightarrow \gamma = 1 - \frac{M_g}{M_{total}} = 0.9999\mathbf{51}$$

2) Using the KNBH solution that claims that in order not to destroy the horizon, KNBH must also satisfy equation (3.1.2)

$$Q^2 + a^2 \le M_{total}{}^2 \qquad (3.1.2)$$

The spin parameter a is defined as $a = \dfrac{J_{proton} \cdot C}{G \cdot M_{total}}$ (3.1.3) and $J_{proton} = \hbar \cdot \left[\dfrac{M_{total}}{m_{proton}}\right]^{3/2}$ (3.1.4)

Substituting (3.1.4) in (3.1.3) $\Rightarrow a^2 = \dfrac{\hbar^2 \cdot C^2}{G^2 \cdot m_{proton}{}^3} \cdot M_{total} = M_g \cdot M_{total}$

Further substituting Q and a^2 in equation (3.1.2) gives:

$$\gamma^2 \cdot M_{total} + M_g \le M_{total} \quad \text{and finally,} \quad \gamma \le \left(1 - \frac{M_g}{M_{total}}\right)^{0.5} = 0.9999\mathbf{75}$$

The calculated value of γ shows that practically the entire mass of the primeval hadron was contributed by the electromagnetic charge. It should be noted that γ was found here based on the accepted estimation of the total mass of the Universe. From the two calculated values of γ, it is shown the primeval KNBH exploded before the M_{total} reached its maximum allowed value. An open question remains: Why did the primeval hadron explode at this specific γ?.

According to quantum physics, it is possible that the primeval hadron or KNBH accumulated energy from the vacuum. As a result of accumulating the vacuum energy, the mass of the KNBH, its angular momentum, and its charge grew. Thus, the total mass of the primeval hadron originated from two sources; the gravitational mass and the electromagnetic charge mass. The KNBH growth continued until it reached an instability state and exploded. KNBHs are not observed in the Universe. Thus, according to the Pivot theory, the existence of KNBH was a unique event in the evolvement of the Universe. Two questions are not addressed here: First, how much time did it take for the primeval hadron to accumulate the energy from the vacuum. Second, why did the KNBH's explosion occur at the specific total mass of the current Universe. The explosion of KNBH is an ongoing research. Hod [4], e.g., describes the super radiant instabilities in the composed Kerr-Newman-black-hole-charged massive-scalar-field bomb. The mechanism in which the explosion of KNBH has evolved into the structure of the Pivot Universe may be explained as follows: The explosion produced, according to Newton's 3rd law, an equal inward force. This resulted in particles moving towards the center. Such a mechanism is known as implosion and is practically used in nuclear bombs. When the mass of the inward rushing particles was big enough, a new black hole, the Pivot, was created. A dynamic process occurred involving particles that spread out and particles that were swallowed by the Pivot. Consequently, the Pivot grew bigger until it reached its current size. The Pivot theory postulates that due to the fact that the disk-like primeval hadron had a spin, subatomic particles, during the explosion, flung off tangentially from it. This tangential motion of the particles accounts for the ring shape of the current visible Universe. It should also be noted that particles that were swallowed by the Pivot impinged it tangentially, causing it to rotate in the opposite direction of the particles that flew away from it. Eventually, a state of dynamic equilibrium was reached. The particles that escaped the Pivot's event horizon began to orbit it, creating the visible Universe.

Elementary particles can be presented as black holes, see e.g., Oldershaw [3]. Oldershaw notes that if a hadron, or proton, is modeled as a Kerr black hole, one can retrodict its mass and its radius. However, more accurate mass and radius values for the proton are retrodicted using the full KNBH solution. The conclusion is, that black holes can present the elementary particles as well as the largest cosmic structure in the Universe, including the entire Universe.

3.2 **The primeval hadron and the Pivot from the quantum physics point of view**

In paragraph 3.1 the primeval hadron was described as a KNBH that is one of the known solutions of GR. In this paragraph, the primeval hadron is described from the quantum physics and elementary particles point of view.

The Big Bang theory postulates that the Universe at its beginning was a singularity that included all matter of the current universe, at very dense and very hot state and included as well space itself. Prior the Big Bang nothing existed, not even time. Therefore, according to some scientists, the question of what was before the Big Bang is meaningless. Moreover, a bigger issue to the BB is that it cannot give an answer as to what happened at exactly the time of creation because at singularity the known laws of physics are not valid.

I claim that quantum physics can solve this issue. Before the Big Bang, nothing existed, as postulated by the BB theory, but this was the QFT "nothingness". QFT describes all elementary particles as vibrational modes in fundamental fields that exist at all points of space and time. In this "nothingness" virtual particles are constantly popping in and out of existence. These virtual particles are coming in pairs, e.g., a quark and antiquark. These pairs exist for an extremely short time, and then mutually annihilate. Quantum physics teaches that it is possible to boost the pair apart using external energy so that they avoid annihilation and become actual (long-lived) particles.

Following that, three quarks and gluons that were boosted by energy from the vacuum attracted each other to form a primeval hadron. Speculation: Was this a unique event, or more primeval hadrons could have been formed in the infinite space? If the second speculation is correct than our Universe is one of many others.

From QCD it is known that if additional external energy (from the vacuum) was supplied to this primeval hadron, the hadron did not dissolve to its constituents but rather caused the number of gluons and quarks inside the hadron grew considerably. As the number of gluons and quarks inside the hadron became so numerous the matter state became, to what is known as, a quark-gluon plasma. The pressure and temperature of this plasma are extremely high. The temperature of the plasma reached trillions of degrees Kelvin.

Eventually, 13.7 billion years ago, the primeval hadron exploded to create the Pivot and the visible Universe. The exact reason for this explosion is not known. Two opened questions: The first is how long did it take the primeval hadron to build up until it exploded? And the second is why did the primeval hadron explode at the specific total mass of the current Universe?

3.3 **Unification between quantum physics and GR**

In the two previous paragraphs (3.1 and 3.2), it was explained how the Pivot can be modeled as a black hole from GR perspective and as a super dense hadron from the quantum physics point of view. This paragraph describes a model that unifies quantum physics and GR.

The model is based on the work done by Ma and Wang [15]. They developed layered formulas based on field theory. The formulas developed relate to the strong force interaction between quarks, nucleons, and atoms. A modified Yukawa potential equation is developed. 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 [15].

$$F_n = g^2 \cdot \left(\frac{1}{4 \cdot e^2} \cdot \frac{1}{r^2} - \frac{2 \cdot r}{r_1^3} \cdot e^{-\frac{r}{r_1}}\right) \qquad (3.3.1)$$

Where: $g^2 = 10 \cdot \hbar \cdot C$ - Nucleon interaction constant,

r_1 is Yukawa radius = $10^{-13} cm$ and r distance between nucleons centers.

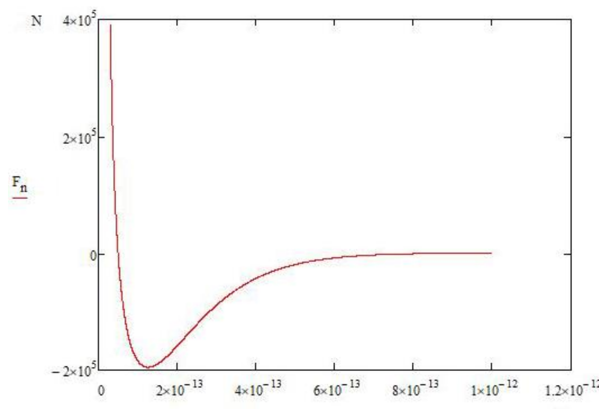

Fig. 3.3.1 – Force between two nucleons as a function of the distance between them.

Figure 3.3.1 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 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 all the 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 hundred billion of 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 (3.3.1) 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. For example, at a distance of $10^{-11}cm$: $\frac{1}{4\cdot e^{0.5}\cdot r^2} = 1.5\cdot 10^{25}\frac{1}{m^2}$ and $\frac{2\cdot r}{r_1^3}\cdot e^{-\frac{r}{r_1}} = 7.4\cdot 10^{-12}\frac{1}{m^2}$. The meaning of this is that at cosmic distances the second part of the equation (3.3.1) 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 is:

$$F_n = 3\cdot g^2\cdot N_1\cdot N_2\cdot(\frac{\rho_0}{\rho_n})^6\cdot\frac{1}{4\cdot e^2}\cdot\frac{1}{r^2} = 3\cdot g^2\frac{1}{m_{proton}{}^2}\cdot(\frac{\rho_0}{\rho_n})^6\cdot\frac{1}{4\cdot e^2}\cdot\frac{M_1\cdot M_2}{r^2} \quad (3.3.2)$$

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

$$F_G = G\cdot\frac{M_1\cdot M_2}{r^2} \quad (3.3.3)$$

where G - the universal gravitational constant.

By equating F_n (3.3.2) and F_G (3.3.3) the value of G can be calculated:

$$G = 3\cdot g^2\cdot\frac{1}{m_{proton}{}^2}\cdot(\frac{\rho_0}{\rho_n})^6\cdot\frac{1}{4\cdot e^2} \qquad (3.3.4)$$

Note: In equation (3.3.4) the effective radius of the quark is calculated to be: $\rho_0 = 0.2809\cdot 10^{-19}cm$. Currently, the radius of the quark ρ_0 is not accurately known. (Updated data relates to the upper limit of the effective quark radius: $0.43 \cdot 10^{-16}\,cm$). Its value is chosen to satisfy equation (3.3.4)

$\rho_n = 0.85 \cdot 10^{-13} cm$ - the radius of the nucleon

The gravitational constant G is of a profound importance in physics as it is involved in the calculations of gravitational effects in Newton's gravitational law and in Einstein's general relativity theory. However, there is no theory that explains its origin. G is an empirical physical constant first measured by Cavendish in 1789 and since then was verified several times. Equation (3.3.4) shows that G is expressed by other fundamental physical constants.

The above discussion shows that the strong force and gravity are actually the same 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.

This equation unifies quantum physics, Newton's gravitational law, and GR.

From the discussion above it is clear that there is an attractive force between nucleons even if they are separated at cosmological distances. From this, it could have been concluded that we should see that all celestial bodies are rushing one towards the other. However, observations show that most of the galaxies are moving apart. The Pivot theory explains it by arguing that the Pivot at the center of the universe is so powerful that it forces the entire universe to rotate around it, similar to the way planets in the solar system are forced to rotate around the sun. It should be noted that the trajectories of celestial bodies are not dominated only by the Pivot. In paragraph 19 the attraction forces between celestial bodies are calculated. It is shown that Galaxies are mainly influenced by the Pivot, but in the solar system, the attraction force between Earth and the Sun is much bigger than the attraction force between the Pivot and Earth.

The structure of the Pivot Universe resembles the structure of the atom. In the center of the atom, there is a nucleon that occupies a very small volume in comparison the atom volume, but the mass of the atom comprises mainly from the mass of the nucleon. Electrons are surrounding the nucleon.

I am speculating that similarly to the atom, the Pivot occupies only a small part of the Universe although its mass is greater than the mass of the Visible Universe. I speculate that the Pivot is a super dense hadron. The issue of the internal structure of hadron is under on-going research. The hadron confinement mechanism is known from experiments in hadron colliders but has not been solved theoretically.

In order to find the radius of the Pivot, I'll evaluate two cases. The first one is that all quarks in the Pivot are densely packed in one bag and the second is that all the nucleons of the Pivot are densely packed.

The number of protons in the Pivot is: $N_p = \dfrac{M_p}{m_{proton}} = 4.9 \cdot 10^{80}$

Earlier it was noted that the quark radius is: $\rho_0 = 0.281 \cdot 10^{-19} cm$ and the radius of the nucleon is: $\rho_n = 0.85 \cdot 10^{-13} cm$.

Based on a known formula, the radius of the Pivot in the first case is: $R_p = \rho_0 \cdot (3 \cdot N_p)^{\frac{1}{3}} = 320 km$ (3- is the number of quarks in the proton).

The radius of the Pivot in the second case: $R_p = \rho_n \cdot (N_p)^{\frac{1}{3}} = 6.7 \cdot 10^8 km$

In both cases, the radius of the Pivot is very small in comparison to the radius of the Universe (~ 130Gly, as is calculated in paragraph 4)

4. Dimensions of the Universe

In this paragraph the size of the Universe is calculated based on both the equity of total angular momentum and the mass of the primeval hadron to that of the current Universe.

The inner radius of Universe ring must satisfy $R_{in} \geq R_s$ (Schwarzschild radius), for simplicity it is assumed that $R_{in} = R_s$:

$$R_{in} = R_s = \frac{2 \cdot G \cdot M_p}{C^2} = 129.48 \cdot Gly \qquad (4.1)$$

The Pivot theory relies on two conservation laws: the mass conservation law and the total angular momentum conservation law. Based on the mass conservation law it is postulated that the total mass M_{total} of the current Universe is equal to the mass of the primeval hadron. The conservation law of the total angular momentum states that the sum of the orbital angular momentum plus the intrinsic spin of a system is constant. The Universe began as a hadron that had an intrinsic angular spin. Given that at the time of creation, the spinning primeval hadron was the only existing body, the Universe orbital angular momentum was zero. Following the hadron explosion, two distinct bodies were created: the Pivot, having only a spin angular momentum and the visible Universe that has orbital angular momentum. (Note: there is also the spin of celestial bodies, Galaxies, stars and planets. But it will be shown that the sum of spin angular momentum of the celestial bodies is negligible in comparison to the orbital angular momentum of the visible Universe ring). Since the orbital angular momentum at the time of the hadron explosion was zero, the sum of the total angular momentum in the current Universe must be also zero. Thus, the Pivot spin and the orbital angular momentum of the visible Universe must be equal, albeit, with opposite signs.

The spinning angular momentum of a disk-like hadron (proton) is given by Muradian [1]:

$$J_{proton} = \hbar \cdot \left[\frac{M_{total}}{m_{proton}} \right]^{3/2} = 1.474 \cdot 10^{94} erg \cdot \sec \qquad (4.2)$$

The outer radius of the visible Universe, R_{out}, can be calculated from (4.3). The left side of equation (4.3) is the angular momentum of the ring shaped visible Universe J_{vu}. It is equal to half of the angular momentum of the proton:

$$\frac{M_{vu}}{2} \cdot (R_{in}^2 + R_{out}^2) \cdot \omega = J_{vu} = \frac{J_{proton}}{2} \Rightarrow R_{out} = 133.87 Gly \qquad (4.3)$$

All celestial bodies i.e., Galaxies, stars, planets, interstellar planets, also have a spinning angular momentum. However, it is shown now, that the sum of the spin angular momentum of all these celestial bodies is negligible in comparison to the orbital angular momentum of the visible Universe disk. Based on Muradian [1], an estimated total angular momentum of all celestial objects is:

$$J_{obj} = J_{gal} \cdot N_{gal} + J_{star} \cdot N_{star} + J_{planet} \cdot N_{planet} = 2 \cdot 10^{85} erg \cdot \sec \qquad (4.4)$$

Where:
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 $N_{planet} = 10^{24}$.
From (4.4) $J_{obj} = 2 \cdot 10^{85} erg \cdot \sec << J_{vu} = 7 \cdot 10^{93} erg \cdot \sec$ and therefore J_{obj} can be neglected in (4.3).

The width of the visible Universe ring, W, can be calculated from equation (4.5):

$$M_{vu} = W \cdot \rho \cdot \pi \cdot (R_{out}^2 - R_{in}^2) \Rightarrow W = 4.9 Gly \qquad (4.5)$$

The Pivot's spin ω_p can be calculated from equation (4.6). The left side of (4.6) is the angular momentum of the Pivot J_p and is equal to half the angular momentum of the proton. It is assumed in (4.6), that the Pivot is a sphere with an equally distributed density. (Note: In paragraph 3.3, I speculate that the Pivot may have a small radius in comparison to the visible Universe. However, as it is a speculation, I use equation (4.6)). The minus sign indicates that the Pivot spins in opposite direction to the visible Universe.

$$-\frac{2}{5}\cdot M_p \cdot R_s^2 \cdot \omega_p = J_p = \frac{J_{proton}}{2} \Rightarrow \omega_p = -4.73\cdot 10^{-14}\, rad/yr \qquad (4.6)$$

Fig. 4.1 shows the dimensions of the Pivot Universe according to the above calculations.

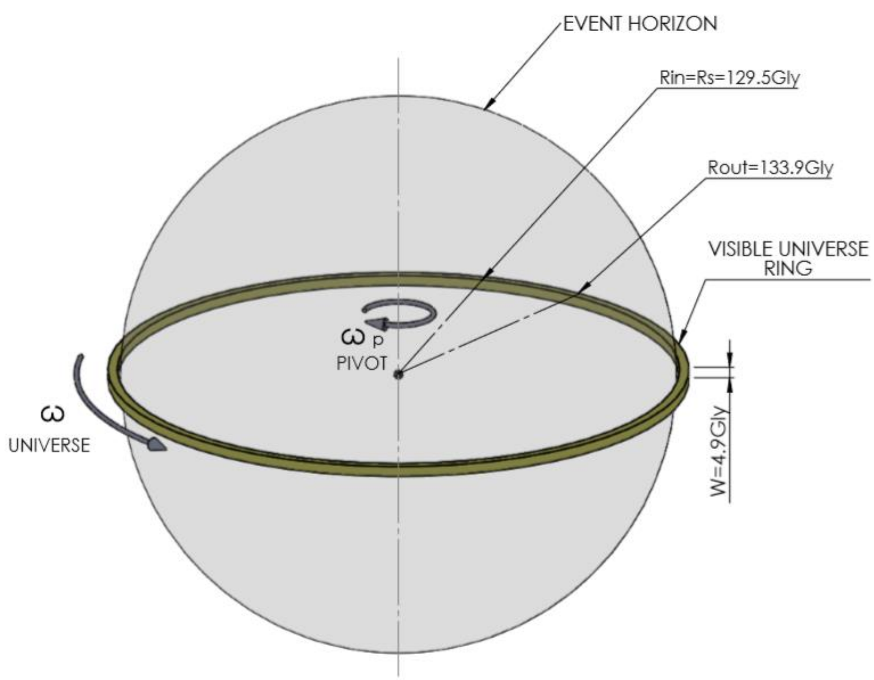

Fig. 4.1 – Structure and dimensions of the Pivot Universe

5. The visible Universe is an inertial frame

The reason for including this paragraph is to gives rise for using Newton's law of universal gravitation and the laws of SR. This assumption is used later for other calculation e.g., the flattened rotation curve in spiral Galaxies and the spiral shape of Galaxies.

The celestial bodies in the visible Universe, although located around such a huge black hole, can be considered as inertial frames. An inertial frame must fulfill two requirements:
1) The Galaxies are not accelerated (or the net force acting on them is zero).
2) The Galaxies move at a constant velocity in a straight line.

The first requirement is fulfilled by calculating the gravity of the Pivot acting in the visible Universe. The gravity is calculated at R_{in} (5.1) and at R_{out} (5.2):

$$g_{p\_in} = \frac{G \cdot M_p}{R_{in}^{\ 2}} = 3.65 \cdot 10^{-11} \frac{m}{\sec^2} \quad (5.1)$$

$$g_{p\_out} = \frac{G \cdot M_p}{R_{out}^{\ 2}} = 3.41 \cdot 10^{-11} \frac{m}{\sec^2} \quad (5.2)$$

This gravity of the Pivot is miniscule and is almost the same everywhere in the visible Universe.

The second requirement is fulfilled by the fact that the visible Universe radius is so enormous that the observable Galaxies can be considered as moving in straight lines. In addition, each Galaxy is orbiting the Pivot at a constant velocity.

6. Frame dragging of the space around the Pivot

The aim of this paragraph is to explain the discrepancy between (6.1) and (6.2).

The average velocity V_{avg} of the visible Universe at $R_{avg} = \frac{(R_{in} + R_{out})}{2}$ can be calculated in two ways:

1) Using Newton's law of universal gravitation (6.1):

$$V_{avg} = \left(\frac{G \cdot M_p}{R_{avg}} \right)^{0.5} \cong 0.7C \qquad (6.1)$$

2) Using angular velocity formula (6.2):

$$V_{avg} = \omega \cdot R_{avg} \ \cong 0.0132C \qquad (6.2)$$

There is a big discrepancy between the results of (6.1) and (6.2). This discrepancy is resolved by taking into account the frame dragging effect the Pivot has on the visible Universe. The twist of the space is such that the visible Universe that rotates in the opposite direction to the Pivot's spin will move slower in reference to the Pivot axis.

The frame dragging angular speed Ω is calculated by (6.3):

$$\Omega = \frac{R_{in} \cdot \alpha \cdot C}{R_{in}{}^{3} + \alpha^2 \cdot R_{avg} + R_{in} \cdot \alpha^2} = 1.798 \cdot 10^{-14} \frac{rad}{yr} \qquad (6.3)$$

Where $\alpha = \frac{J_P}{M_P \cdot C} = 3 \cdot 10^{24} m$ and the angular momentum of the Pivot: $J_P = \frac{J_{proton}}{2}$

The velocity of the Universe around the Pivot axis is

$$V_{avg} = (\omega - \Omega) \cdot R_{avg} = 0.0108C \qquad (6.4)$$

The result of (6.4) is in reasonable agreement with (6.2), when taking into account that some of the parameters used in this calculation are estimated

7. The Origin of spinning and rotation of celestial bodies

Following the explosion of the primeval hadron, it took the visible Universe some time (how long?) to arrange itself in an orbit around the Pivot. The temperature of the visible Universe, after the explosion, was extremely high and contained only a soup of sub atomic particles. Later on, as the Universe cooled down, ordinary atoms were created and this was the time that gravity forces between atoms appeared. The local density of the visible Universe was the cause of the variety of celestial bodies, which enabled several scenarios. If the density of atoms at a certain 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, then a nucleus of a star was created. The nucleus of the star encountered atoms from various orbits having different velocities. Stars that are farther from the Pivot than the Galaxy's center, move faster than the Galaxy's center. Stars located closer to the Pivot move slower. This created a torque on the star nucleus, consequently causing the star to spin while orbiting the Pivot, simultaneously. Fig 7.1 shows trajectories of stars (or any other celestial bodies) around the center of the Galaxy. If the mass of the star became big enough, it collapsed and created a black hole. The black hole attracted other stars that began orbiting it. The stars already orbiting the Galaxy's black hole attracted additional stars and thus giving birth to a full-sized Galaxy.

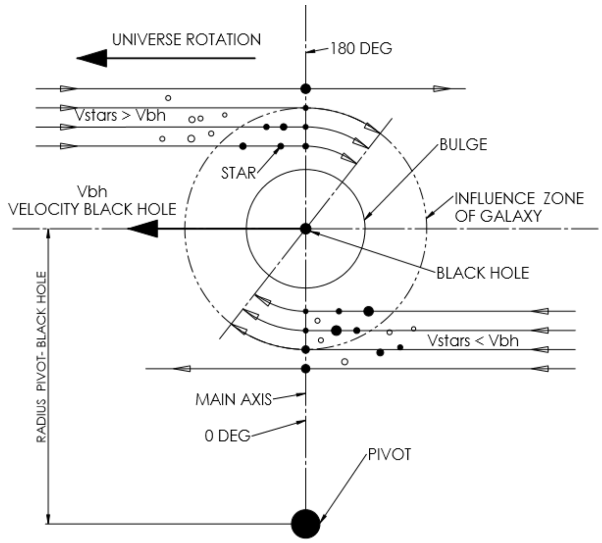

Fig. 7.1 – Trajectories of stars around a Galaxy black hole

8. Rotation curve of a Galaxy

The unexplained rotation curve of the galaxies was one of the main reasons for suggesting the dark matter theory. The rotation curve of a Galaxy is a plot of the orbital speeds of visible stars or gas in that Galaxy versus their radial distance from that Galaxy's center. (See Fig. 8.2). 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 rotation curves can be explained by hypothesizing the existence of a substantial amount of matter influencing the Galaxy. Cosmologists have calculated the amount of this matter to be 5.5 times the amount of the mass of the visible matter. The material responsible for the extra mass was dubbed, "dark matter” because it has not been found by observations and its nature is not known.

The Pivot theory accepts the hypothesis that the curve flattening is caused by the dark matter, but claims that the dark matter resided in the Pivot rather than being spread in and around Galaxies as postulated by current cosmology. The fact that the dark matter is located in the Pivot black hole is the reason why it cannot be detected. The Pivot theory explains in this paragraph the flattened curve of Galaxies by calculating the velocities of stars in Galaxies. The mass of the Pivot used in the calculations is assumed to be equal to the amount of the dark matter calculated by cosmologists to explain the curve flattening.

In the previous paragraph, the origin of spinning and rotation of celestial bodies was explained. It has been also calculated in paragraph 6 that any celestial body orbits the Pivot at an average speed of ~0.7C. A celestial body that is part of a Galaxy performs simultaneously two motions.

The first is orbiting the Pivot at a speed of ~0.7C. The second is orbiting the center of the Galaxy at a much lower speed of ~ tens to hundreds km/sec. The superposition of the two velocities results in the flattened curve of stars in a Galaxy. The following calculation is done on an arbitrary Galaxy located 150Mly from the Milky Way. The distance of 150Mly between the Galaxies is assumed in order to assure that there is no gravitational pull between Galaxies. (See paragraph 19, where the gravitational pull is calculated for Galaxies that are much closer to each other). It is shown that the exact shape of the curve is dependent on several parameters. This is the reason why, when curves of many Galaxies are depicted on the same graph, the motion of stars seems somewhat chaotic (See Fig. 8.2).

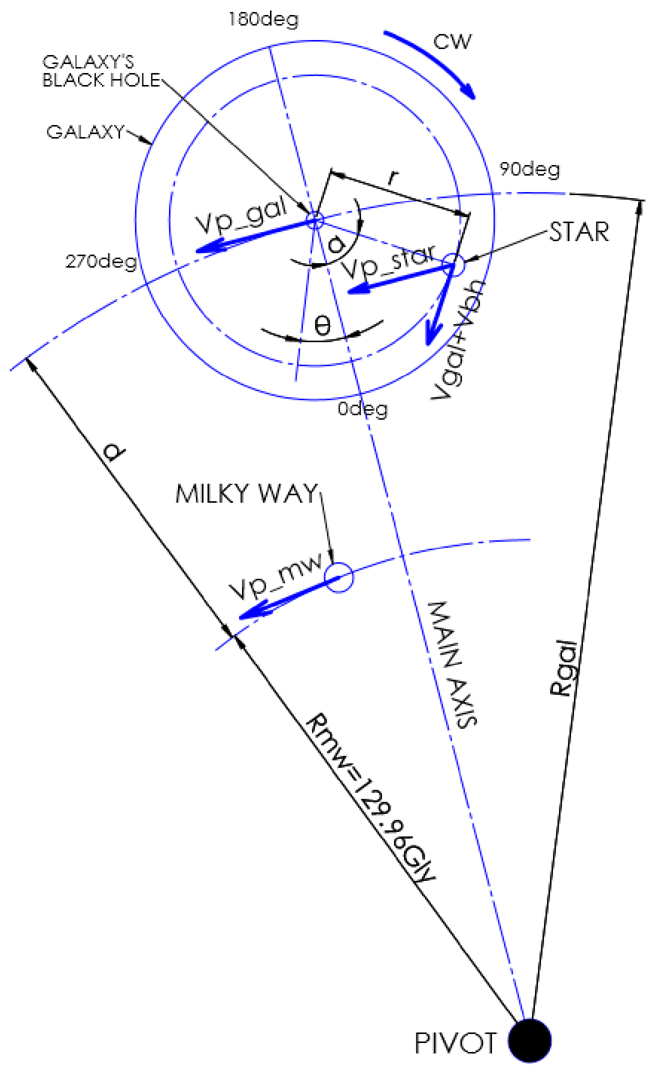

Fig. 8.1– Velocities of a star

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.

Note: The calculations are done with MathCad.

a) Velocity of a star due to distributed mass of the Galaxy

$r := 0.0001Kly, 0.01\cdot Kly .. 100\cdot Kly$ Distance range of star to its Galaxy center

$r_0 := 30\,Kly$ Assumed characteristic radius.

$$V_{gal}(r) := \begin{Vmatrix} \left(\frac{G\cdot M_{gal}}{r_0}\right)^{0.5} \cdot \frac{r}{r_0} \text{ if } 0\cdot Kly \le r < r_0 \\ \left(\frac{G\cdot M_{gal}}{r}\right)^{0.5} \text{ if } r \ge r_0 \end{Vmatrix}$$

Rotation velocity due to distributed mass of a Galaxy

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

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

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

$d := 150\cdot Mly$ Arbitrary assumed distance

$R_{gal} := R_{mw} + d$

$$V_{p\_star}(r,\alpha) := \left(\frac{G\cdot M_p}{R_{gal} - r\cdot\cos(\alpha)}\right)^{0.5}$$

Summation of the three velocities on the star:

$$V_{sum}(r,\alpha) := V_{p\_star}(r,\alpha) + \left(V_{gal}(r) + V_{bh}(r)\right)\cdot\cos(\alpha)$$

Only as a reference, the magnitudes of the three velocities are calculated for a star located 10Kly from the Galaxy's black hole. It is clear that the velocity of a star around the Pivot is dominant.

$$V_{p\_star}(10Kly, 0deg) = 210864\frac{km}{s} \qquad V_{gal}(10Kly) = 5.1\cdot\frac{km}{s} \qquad V_{bh}(10Kly) = 0.8\cdot\frac{km}{s}$$

Orbital velocity of Milky Way around the Pivot:

$$V_{p\_mw} := \left(\frac{G\cdot M_P}{R_{mw}}\right)^{0.5}$$

The velocities of Galaxies in the Universe, as shown earlier in this paper, are ~0.7C. The relativistic velocity of a star in a Galaxy as seen by a Milky Way observer is given by (8.1):

$$V_{star}(r,\alpha) := \frac{V_{p\_mw} - V_{sum}(r,\alpha)}{1 - \frac{V_{p\_mw}\cdot V_{sum}(r,\alpha)}{C^2}} \tag{8.1}$$

The rotation curve as observed for Galaxies is somewhat chaotic and is shown is shown in Fig. 8.2. The common characteristic for all observations is that as the distance of a star to the center of its Galaxy increases the curve flattens out.

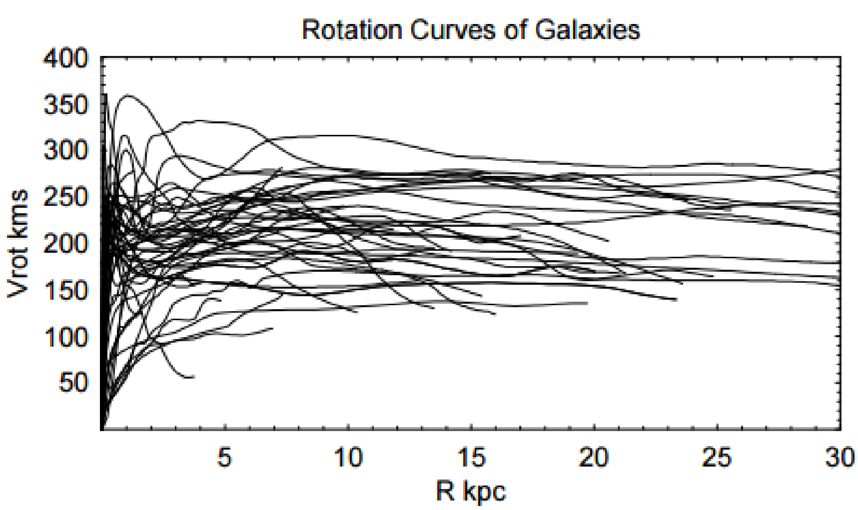

Fig. 8.2 -Rotation curves of Galaxies (from: Sofue [10])

The calculated velocity of a star in a Galaxy is given by (8.1) and is shown Fig. 8.3. It is seen that the observed velocities of stars in a Galaxy will be confined between the two extreme curves of the graph (solid red and dashed blue). The exact shape of the graph is dependent mainly on α, d and the mass of Galaxy. It is seen that Fig. 8.3 resembles Fig. 8.2.

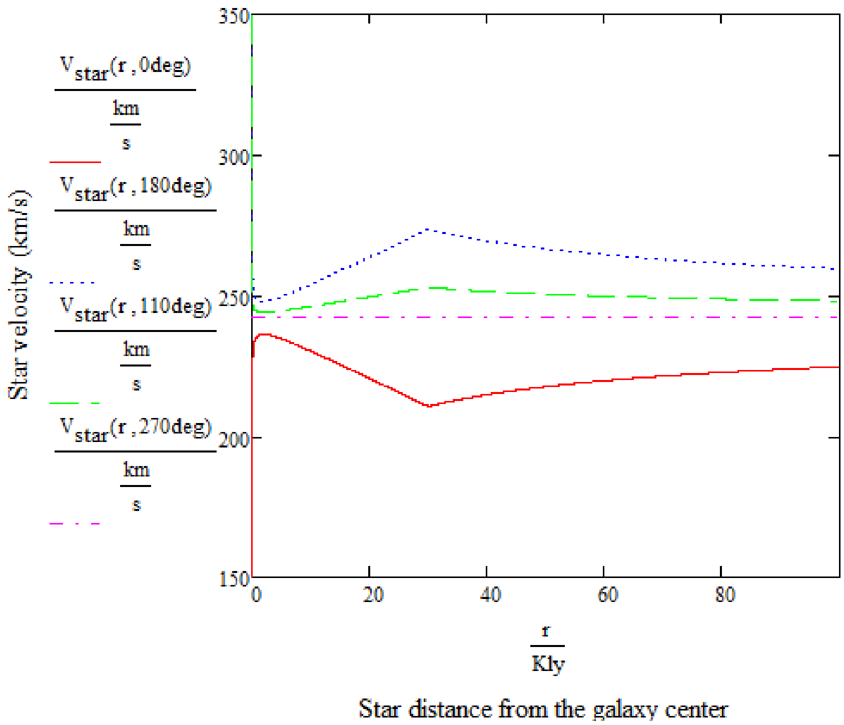

Fig. 8.3 – Rotation curve for a Galaxy at a distance of 150Mly from Milky Way

9. The shape of a spiral Galaxy

The spiral shape of Galaxies is based on the equations used in paragraph 7 and 8. Most spiral Galaxies contain a central bulge surrounded by a flat rotating disk of stars. The bulge in the Galaxy center contains a massive black hole. 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. Orbiting the bulge, the rotating disk separates itself into arms that that circle the Galaxy center. The spiral arms are the result of the superposition of the velocity of ~0.7C of a star around the Pivot and its velocity around the center of the Galaxy (several to hundreds km/sec). An additional observation explained by the Pivot theory is why spiral Galaxies may have more than two arms. A Galaxy has more than two arms if during its rotation around the Pivot the Galaxy encountered several dense regions at various times. Each time the Galaxy crosses a dense region new arms are added to the Galaxy. The width of the arm depends on the size of the dense region. Some Galaxies may encounter so many dense regions, that its arms may appear as an elliptical Galaxy.

The angular displacement of a star orbiting the Galaxy's black hole (θ) (See Fig. 8.1) is the integral $\int \frac{Vstar}{r}dt$, where $Vstar$ is given in (8.1) 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. 7.1 and Fig. 8.1). Only at these angles, stars begin to orbit around the Galaxy's center. Fig. 9.1 shows the shape of a spiral shape Galaxy 13.3 Billion years after the Galaxy creation. It can be shown that the spiral shape is changing at a very slow pace over Billions of years.

Note: In the following equations, the "mod" operator of MathCad- returns the remainder on dividing x by y (x modulo y). In the current case y=360deg. The reason for using this function is that stars in Galaxies have completed many full rotations around the Galaxy's black hole during 13.3 Billion years.

$$\theta_1(r,\alpha) := \mathrm{mod}\left[\left[\int_{0yr}^{13.3\cdot 10^9 yr} \frac{V_{star}[r,(\alpha)\cdot deg]}{r}\, dt\right]\cdot deg, 360deg\right]$$

$$\theta_2(r,\alpha) := \mathrm{mod}\left[\left[\int_{0yr}^{13.3\cdot 10^9 yr} \frac{V_{star}[r,(\alpha)\cdot deg]}{r}\, dt\right]\cdot deg, 360deg\right] + 180deg$$

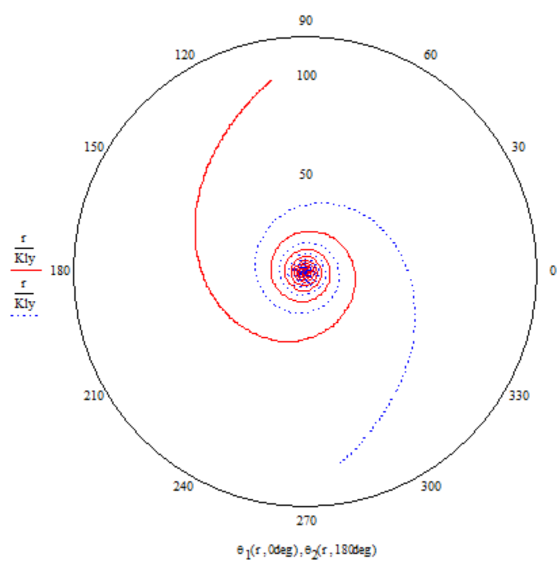

Fig. 9.1 – Shape of spiral Galaxy 13.3 Billion years after its creation.

10. Gravitational z shift

The Pivot theory postulates that the z shift of Galaxies is caused by the gravitational field of the Pivot. It 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. This is contrary to Hubble's assumption that the z shift of Galaxies is caused by the Doppler effect. The Doppler shift is caused by the difference in the velocities of the observed object and the Milky Way. However, since the Pivot theory claims that Galaxies are orbiting the Pivot at different velocities, the Doppler shift cannot be excluded. It will be shown later that its contribution to the measured z shift is small.

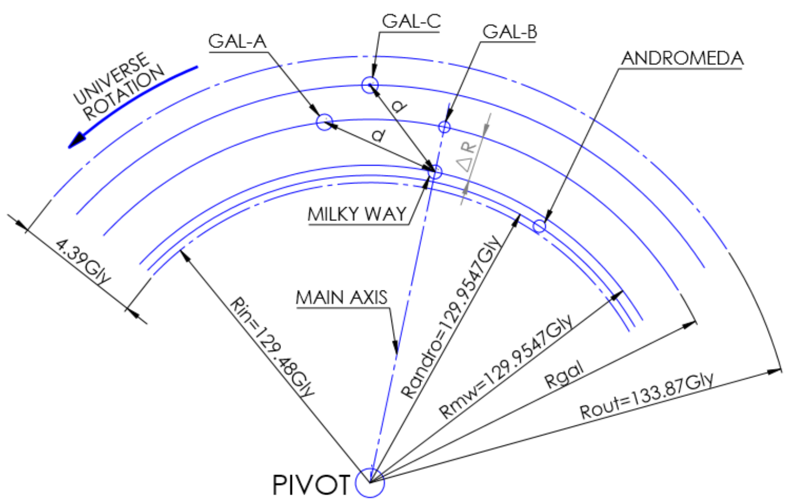

Fig. 10.1 – The Pivot Universe structure shows Galaxies orbiting the Pivot

Fig. 10.1 is a schematic structure of the Pivot Universe. It includes the Pivot, containing the entire dark matter in the Universe, with a ring of the visible Universe orbiting it. Clearly, the inner radius of the ring must be greater than the event horizon of the Pivot. Calculations of the gravitational z shift of a Galaxy Z_{gal_pivot} orbiting the Pivot at a radius R_{gal}, in the gravitational field of the Pivot, is given in equation (10.1) and shown in Fig. 10.2:

$$Z_{gal\_pivot} = \frac{1}{\left(1 - \frac{2 \cdot G \cdot M_p}{R_{gal} \cdot C^2}\right)^{0.5}} - 1 \qquad (10.1)$$

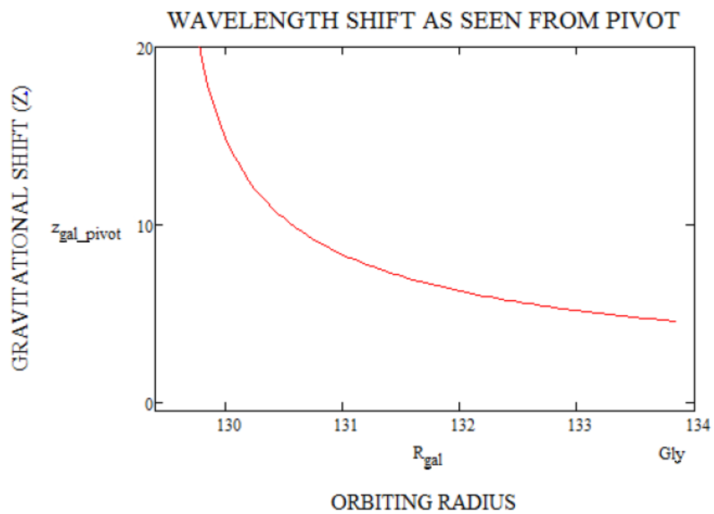

Fig. 10.2 – z shift in the Pivot's gravitational field.

The next step is finding the z shift of Galaxies as seen from the Milky Way (Z_{gal}). This is done by using the following assumption: Galaxy GN-z11 was found to have the highest z shift ever measured $Z_{gal} = 11.09$. It is **assumed** that GN-z11 is located on the outside radius of the Universe R_{out}. On the other hand, from equation (10.1), the z shift of GN-z11, as seen from the Pivot, is 4.527. Thus, the z shift of the Milky Way Z_{mw}, as seen from the Pivot, can be calculated by equation (10.2). Note: Should Galaxies with higher z shift, will be found in the future, Z_{mw} be corrected accordingly.

$$Z_{mw} = 11.09 + 4.527 = 15.617 \qquad (10.2)$$

Having Z_{mw} the orbiting radius of the Milky Way R_{mw} is calculated by (10.3)

$$R_{mw} = \frac{2 \cdot G \cdot M_p}{\left(1 - \frac{1}{(Z_{mw}+1)^2}\right) \cdot C^2} = 129.954703 Gly \quad (10.3)$$

Now, the z shift of any Galaxy, as seen from the Milky Way Z_{gal} is calculated from (10.4).

$$Z_{gal} = Z_{mw} - Z_{gal\_pivot} \qquad (10.4)$$

Having Z_{gal}, the orbiting radius of any Galaxy R_{gal} can be calculated by (10.5) and shown in Fig. 10.3.

$$R_{gal} = \frac{2 \cdot G \cdot M_p}{\left(1 - \frac{1}{(Z_{gal}+1)^2}\right) \cdot C^2} \qquad (10.5)$$

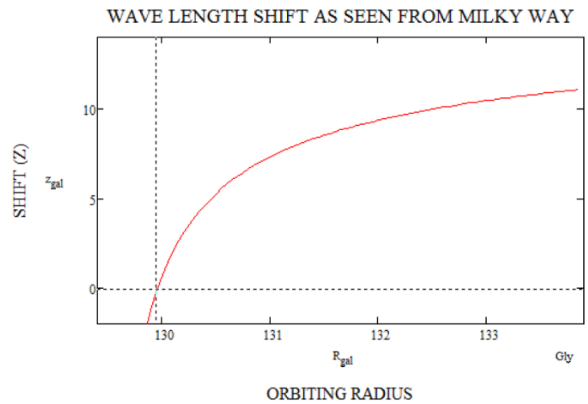

Fig. 10.3 – z shift of Galaxies as seen from Milky Way. The dashed lines relate to the Milky Way: $Z_{mw}=0$ and $R_{mw} = 129.95 Gly$

11. Blue shifted Galaxies

Fig. 10.1 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, $Z_{gal} < 0$. Galaxies that are orbiting the Pivot at a radius larger than the Milky Way radius are red shifted $Z_{gal} > 0$. Had the Milky Way been located on the outer radius of the Universe ring, all Galaxies would have been blue shifted. Referring to Fig. 10.1, GAL-A and GAL-B are shown to have different distances from the Milky Way. Nevertheless, they have the same z shift, because both are located on the same orbit. In order to determine whether the observed Galaxy is approaching or receding the Milky Way the change in the measured distance should be found.

It is clear that the Milky Way orbiting radius is between R_{in} and R_{out}. The distance of the Milky Way from R_{in} is: $R_{mw} - R_{in} = 129.954703 Gly - 129.4840 Gly = 0.471 Gly = 471 Mly$. The distance of the Milky Way from R_{out} is $R_{out} - R_{mw} = 133.868 Gly - 129.954703 Gly = 3.91 Gly$. This result explains why there are more observed red-shifted Galaxies than blue-shifted Galaxies.

12. Andromeda Galaxy

Andromeda Galaxy is blue shifted. For Andromeda, it was measured: $Z_{gal} = -0.001001$, distance - 2.5Mly and it is predicted, by others, that the Milky Way and Andromeda will collide in 4Gly.

See Wikipedia [14]. It is interesting to examine the prediction of a collision between Andromeda and the Milky Way, based on the Pivot theory. The orbiting radius of Andromeda R_{andro} is calculated by (12.1):

$$R_{andro} = \frac{2 \cdot G \cdot M_p}{\left(1 - \frac{1}{(Z_{mw} + 0.001001 + 1)^2}\right) \cdot C^2} = 129.95465 Gly \quad (12.1)$$

The difference in orbiting radiuses of the Milky Way and Andromeda is:
$R_{mw} - R_{andro} = 129.954703\, Gly - 129.95465\, Gly = 56.914\, Kly$. The disk diameter of Andromeda is 220Kly and the disk diameter of the Milky Way is 180Kly. The result is that there is a chance of collision, because (220Kly +180Kly)/2 =150Kly > 56.914Kly. A collision will occur if Andromeda and the Milky Way are located on the same plane. However, if the two Galaxies are located on different planes that are separated more than 150Kly, no collision is expected to occur.

To find the time to collision, first the velocity of each Galaxy is found (12.2) and (12.3), then the relativistic velocity between the two Galaxies is calculated (12.4) and finally, the time is calculated (12.5).

$$V_{mw} = \left(\frac{G \cdot M_p}{R_{mw}}\right)^{0.5} \quad (12.2\ ) \qquad V_{andro} = \left(\frac{G \cdot M_p}{R_{andro}}\right)^{0.5} \quad (12.3)$$

$$V = \frac{V_{mw} - V_{andro}}{1 - \frac{V_{andro} \cdot V_{mw}}{C^2}} = 0.092 \frac{km}{\sec} \quad (\ 12.4\ ) \qquad t = \frac{2.5 Mly}{V} = 8 \cdot 10^{12}\, yr \quad (12.5)$$

The time for a collision between Andromeda and the Milky Way calculated by the Pivot theory differs significantly from the prediction of the BB cosmology: $4 \cdot 10^9\, yr$

13. Time dilation in the visible Universe

The Pivot is a Kerr black hole. The time dilation equation of Kerr metric takes the form of:

$$t_f = \frac{t_0}{\left(1 - \frac{2 \cdot G \cdot M_p \cdot R_{gal}}{C^2 \cdot \rho^2}\right)^{0.5}} \quad \text{where} \quad \rho^2 = R_{gal}{}^2 + \frac{J_P}{M_P \cdot C^2} \cdot \cos^2\theta \quad (13.1)$$

The parameters of the Pivot are such that it can be considered as a Schwarzschild black hole. Assuming ($\cos\theta = 1, R_{gal} = R_s$) .

Calculating (13.1) gives: $\frac{J_P}{M_P \cdot C^2} = 9 \cdot 10^{48} m^2 << R_{gal}{}^2 = 1.5 \cdot 10^{54} m^2$ therefore (13.1) becomes:

$\rho^2 = R_{gal}{}^2$

and Schwarzschild time dilation equation (13.2) can be used:

$$t_f = \frac{t_0}{\left(1 - \frac{2 \cdot G \cdot M_p}{C^2 \cdot R_{gal}}\right)^{0.5}} \qquad (13.2)$$

Assuming the time elapsed at the Milky Way is 1 sec, then the time of other Galaxies in the visible Universe is calculated by (13.3) and is shown in Fig. (13.1):

$$t_f = \frac{1\sec}{\left(1 - \frac{2 \cdot G \cdot M_p}{C^2 \cdot R_{mw}}\right)^{0.5}} \cdot \left(1 - \frac{2 \cdot G \cdot M_p}{C^2 \cdot R_{gal}}\right)^{0.5} \qquad (13.3)$$

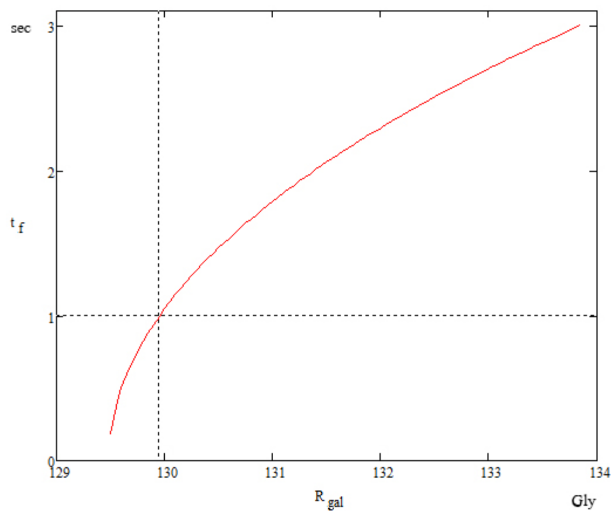

Fig 13.1 – Time dilation in the visible Universe

Assuming the elapsed time in the Milky Way is 1 sec, the elapsed time for a Galaxy located at R_{out} is 3 sec. A Galaxy near R_s the elapsed time approaches 0 sec.

14. Doppler shift Vs. gravitational shift

This paragraph calculates the contribution of the Doppler effect to the observed z shift of a Galaxy. For finding the Doppler shift of an observed Galaxy, first, the orbiting velocities around the Pivot of the Milky Way (14.1) and the observed Galaxy (14.2) should be found. Then, the relativistic velocity of the two Galaxies is calculated (14.3). Subsequently, the Doppler shift is calculated (14.4). Finally, the ratio of the doppler shift to the total z shift is calculated (14.5) and shown in Fig. 14.1. The Doppler effect contribution to the z shift is less than 0.2%.

$$V_{mw} = \left(\frac{G \cdot M_P}{R_{mw}}\right)^{0.5} = 0.706C \quad (14.1) \qquad V_{gal} = \left(\frac{G \cdot M_P}{R_{gal}}\right)^{0.5} \quad (14.2)$$

$$V = \frac{V_{mw} - V_{gal}}{1 - \frac{V_{gal} \cdot V_{mw}}{C^2}} \quad (14.3)$$

$$Z_{doppler} = \frac{V}{C} \quad (14.4) \qquad Ratio = \frac{Z_{doppler}}{Z_{gal} + Z_{doppler}} \quad (14.5)$$

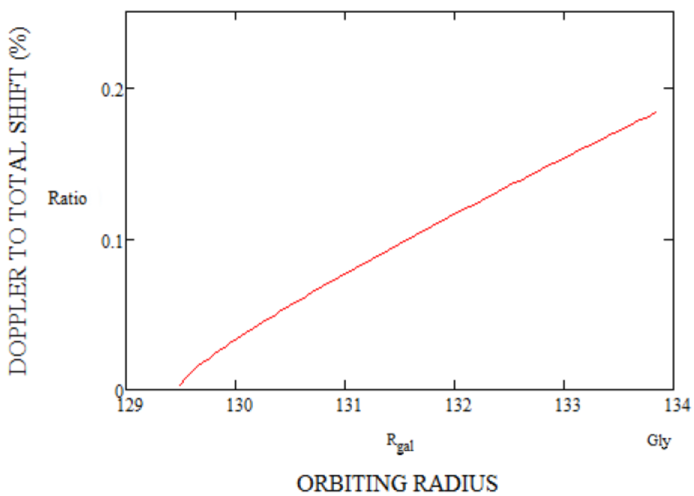

Fig. 14.1 - The ratio of Doppler shift to the total shift

15. Hubble's observations

This paragraph's aim is to show that Hubble's law is wrong. The cosmological principle is supported by Hubble's law. This is in 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. Nevertheless, I claim 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 relation 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. 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 [11]. The accelerated expanding Universe gives rise to yet another theory claiming that in order 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 [12] relates to Hubble's diagram (Fig. 15.1): "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."

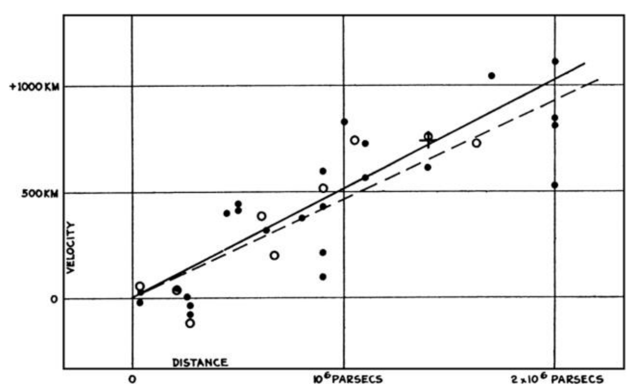

Fig. 15.1 – Hubble's original graph (1929)

Hubble's graph (Fig. 15.1) shows that there is a significant scatter of the measurements. There are Galaxies that are located at the same distance from the Milky Way but have different velocities. The Pivot theory can explain Hubble's observations. Fig. 10.1 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 special 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, whereas in the Pivot theory the linear relation is between the velocity and the difference in the orbiting radiuses. The relation between the relativistic velocity of a Galaxy and its radius is calculated by (14.3) and the linear relation is shown in Fig. 15.2.

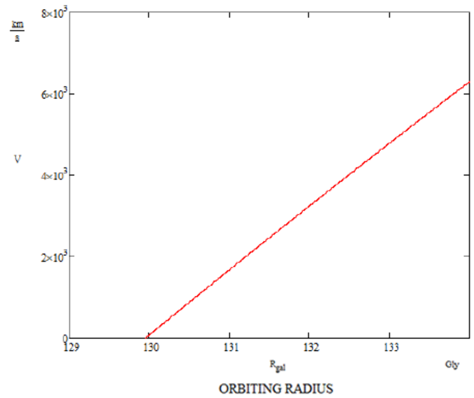

Fig. 15.2 – Linear relation between Galaxy's velocity and its orbiting radius.

From Fig. 15.2 - The linearity constant is $5.1km/s/Mpc$. (This is in comparison to Hubble's constant, that is $70km/s/Mpc$). The maximal and constant recessional velocity of a Galaxy located at R_{out} is ~6200km/s.

From the Pivot model, the relation between the recessional velocity and z can be found by combing (10.4) and (14.3) and the result is shown in Fig. 15.3. Clearly, this is not a linear relation as claimed by Hubble's law.

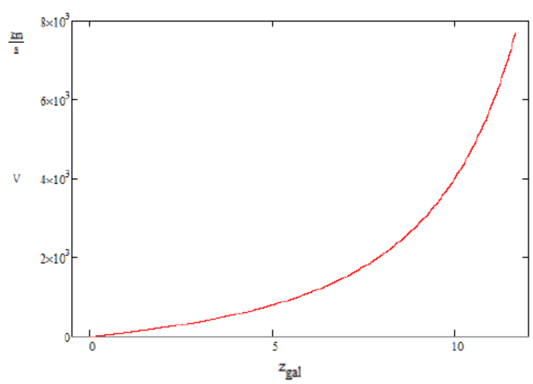

Fig. 15.3 – Velocity of a Galaxy as function of z shift

16. Cosmic Microwave Background (CMB)

A known paradigm in modern cosmology is the cosmological principle. It states that at a “large-scale” (hundreds of million light years), the spatial distribution of matter in the Universe is isotropic and homogeneous. The strongest 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 claim that even though the Pivot Universe has a preferred axis, it still agrees with the CMB observation. It is demonstrated in this article, that the Milky Way is located inside a huge observable Universe. The observable Universe is a sector of a ring having a cross section of 4.9Gly x 4.4Gly. According to the calculation based on z shift, shown in paragraph 10, the Milky Way is located 470Mly from R_{in} . This means that the Milky Way is located inside a “large-scale Universe”. A Milky Way observer sees a huge 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 surface of the ring, the Universe is not isotropic and homogenous. In one direction, he will be facing the vacuum which is totally 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 a total darkness and measures the temperature of the Pivot that is practically absolute zero (~1.5*10^-31K). 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.

17. Olbers' paradox

The paradox is that a static, 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 the paradox by the fact that space is expanding and therefore the emitted light is reduced via redshift. The Pivot Universe, on the other hand, is a finite Universe with a finite number of stars and Galaxies. Outside the ring of the visible Universe there is the infinite darkness of the vacuum and the darkness of the Pivot. An observer located in the visible Universe sees a huge number of Galaxies in whatever direction he looks, but eventually, in the background, he sees the total darkness.

18. Handedness of Galaxies

The Pivot theory explains yet an additional observation related to the handedness of the Universe. Longo and others [5] found abundance of left-handed, or counter-clockwise (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. 18.1 shows that the observable Universe is contained within a sector of the visible Universe ring. It shows the equatorial plane of the visible Universe 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. The Pivot theory postulates that all Galaxies rotate in the same direction, opposite to the Universe ring rotation. The location of the Galaxies in relation 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 counter clockwise (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 than the number of CCW Galaxies and CW Galaxies will differ by 7%.

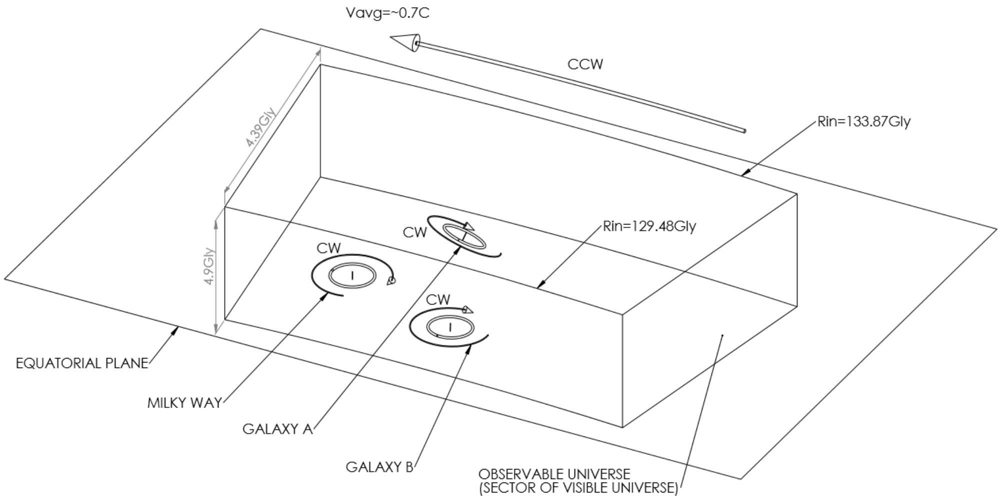

Fig. 18.1- Handedness of Galaxies

19. Formation of Galaxies, Clusters of Galaxies and Solar systems

In paragraph 8 and 9, the shape of a Galaxy was calculated. It was assumed there that the distance between the Milky Way and the Galaxy is 150Mly, so that the gravitational pull between the Galaxies, in comparison to the gravitational pull of the Pivot, can be neglected. In this paragraph, the distance between Galaxies was reduced to 2.5Mly.

The explanation of formations of galaxies, clusters of Galaxies and Solar systems is based on calculating the gravitational pull between celestial bodies. Newton's law of universal gravitation states that a particle attracts every other particle in the universe by a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. The force on each celestial body is the sum of all the forces exerted on it by all other celestial bodies. It has been claimed earlier that the Pivot influences every celestial body in the Visible Universe. However, celestial bodies are also influenced by other celestial bodies. In this paragraph the gravitational pull between celestial bodies is compared to the gravitational pull exerted on them by the Pivot. Three cases are calculated:

1) The gravitational pull on Galaxies 2) The gravitational pull on Galaxies in clusters and 3) The gravitational pull on planets and stars.

1) Gravitational pull between the Milky Way and Andromeda Vs. the Pivot pull:

(Note: Andromeda Galaxy is the closest Galaxy to the Milky Way).

$M_{mw} = 2 \cdot 10^{42} kg$ ….. Mass of Milky Way

$M_{andro} = 3 \cdot 10^{42} kg$ ….. Mass of Andromeda

$R_{andro} \cong R_{mw} = 129.95 \cdot Gly$ ….. Orbiting radius of Milky Way around the Pivot

$D_{mw\_andro} = 2.5 \cdot Mly$ ….. Distance of Andromeda from Milky Way

$$F_{p\_mw} = \frac{G \cdot M_p \cdot M_{mw}}{R_{mw}^{\ 2}} \qquad (19.1)$$ …The Pivot gravitational pull on the Milky Way

$$F_{mw\_andro} = \frac{G \cdot M_{andro} \cdot M_{mw}}{D_{mw\_andro}^{\ 2}} \qquad (19.2)$$ … The force between the Milky Way and Andromeda

The ratio between (19.1) and (19.2) gives: $R1 = \frac{F_{p\_mw}}{F_{mw\_andro}} = 101$. The meaning is that the Pivot gravitational pull is 100 times higher than the gravitational pull between neighboring Galaxies. Note: Andromeda is the closest Galaxy to the Milky Way. The average distant between Galaxies is ~6Mly. This means that the influence of the Pivot on Galaxies is even higher than the ratio R1.

2) Gravitational pull between Milky Way and Sagittarius Dwarf Spheroid Vs. the Pivot pull:

Note: Sagittarius Dwarf Spheroid is the closest Galaxy to the Milky Way in the Milky Way local group.

$M_{mw} = 2 \cdot 10^{42} kg$ ….. Mass of Milky Way

$M_{sagit} = 1 \cdot 10^{33} kg$ ….. Mass of Sagittarius Dwarf Spheroid

$R_{sagit} = R_{mw} = 129.95 \cdot Gly$ ….. Orbiting radius of Sagittarius around the Pivot

$D_{mw\_sagit} = 0.08 \cdot Mly$ ….. Distance of Sagittarius from Milky Way

$$F_{p\_sagit} = \frac{G \cdot M_p \cdot M_{sagit}}{R_{sagit}^{\ 2}} \qquad (19.3)$$ …The Pivot gravitational pull on Sagittarius

$$F_{mw\_sagit} = \frac{G \cdot M_{sagit} \cdot M_{mw}}{D_{mw\_sagit}^{\ 2}} \qquad (19.4)$$ … The force between Milky Way and Sagittarius

The ratio between (19.3) and (19.4) gives: $R2 = \frac{F_{p\_sagit}}{F_{mw\_sagit}} = 0.16$. The meaning is that the Pivot gravitational pull is smaller than the pull between local group Galaxies. Therefore, clusters of galaxies can be formed where Galaxies orbit the center of the cluster.

3) Gravitational pull between Earth and Sun Vs. the Pivot pull:

$M_{earth} = 6 \cdot 10^{24} kg$ ….. Mass of Earth

$M_{sun} = 2 \cdot 10^{30} kg$ ….. Mass of Sun

$R_{earth} = R_{mw} = 129.95 \cdot Gly$ ….. Orbiting radius of Earth around the Pivot

$D_{earth\_sun} = 150 \cdot 10^6 \cdot km$ ….. Distance of Earth from Sun

$$F_{p\_earth} = \frac{G \cdot M_p \cdot M_{earth}}{R_{mw}^{\ 2}} \qquad (19.5)$$ …The Pivot gravitational pull on Earth

$$F_{sun\_earth} = \frac{G \cdot M_{sun} \cdot M_{earth}}{D_{earth\_sun}^{\ 2}} \qquad (19.6)$$ … Gravitational pull between the Sun and Earth

The ratio between (19.5) and (19.6) gives: $R3 = \frac{F_{p\_earth}}{F_{sun\_earth}} = 6 \cdot 10^{-9}$. The meaning is that the Pivot's influence in a solar system is negligible to the Sun's influence.

Conclusion: It was shown that the Pivot Universe structure can explain the formations of Galaxies, Clusters of Galaxies and solar systems. The formation of the various structures of celestial bodies depends on the masses and distances of the celestial bodies. It was shown in paragraph 5 that the magnitude of the gravity of the Pivot in the visible Universe is very small. Nevertheless, for Galaxies, the main gravitational pull is caused by the Pivot. The Galaxies in a cluster may orbit around the center of the cluster, but the gravitational pull of the Pivot must also be taken into consideration. On the other hand, for a solar system the main gravitational pull is between the star and its planets and between the planets themselves. The influence of the Pivot in solar system is negligible. For example, the trajectory of a man-made satellite can be calculated quite accurately when considering only the gravitational pull on the satellite by the Sun and the planets.

20. Mach's principle Vs. Newton’s bucket

There is an ongoing profound debate in the scientific community relating to the issue whether the Universe is absolute or relative.

Newton conducted an experiment with a bucket containing water. He filled a bucket with water and suspend it from a fixed point with a rope. He rotated the bucket, twisting the rope more and more. When the rope has taken all the twisting that it can take he released the bucket. What happened? The bucket started to rotate because of the twisted rope. At first, the water in the bucket did not rotate with the bucket but remained fairly stationary. Slowly, however, the water began to rotate with the bucket and as it did so the surface of the water become concave. At that stage, the water and vessel rotated together, and there was no relative motion between them. Yet somehow the water "knows" to create a concave surface. Newton concluded from the bucket experiment that the concavity must be due to the water's rotation with respect to something else—absolute space. In other words, the rotation is absolute, not relative. That answer stood largely unchallenged for two centuries until Mach flatly declared Newton to be wrong.

Mach never gave a precise formulation of what became known as Mach's Principle. He claimed that Inertia—that is the tendency of massive objects to move at constant velocity—must depend on other bodies because motion itself must be measured relative to other bodies. In other words, local inertial frames are determined by the large-scale distribution of matter, as exemplified by this anecdote: You are standing in a field looking at the stars. Your arms are resting freely at your side, and you see that the distant stars are not moving. Now start spinning. The stars are whirling around you and your arms are pulled away from your body. Why should your arms be pulled away when the stars are whirling? Why should they be dangling freely when the stars don't move?

The Pivot theory claims that Newton is correct. The absolute rotating frame of the Universe is the Pivot. On the other hand, the Pivot theory can explain the anecdote given above. You, as well all the celestial bodies in the Universe are orbiting the Pivot at approximately the same orbital speed. During the time you spin (even if you spin for millions of years) celestial bodies, because of the huge radius of the Universe, are hardly moving relative to each other. So, for you, the distant stars and Galaxies are not moving. When you spin around yourself the distant stars seem to whirl around you.

21. Summary

The Pivot theory describes a Universe that began as a primeval hadron. It originated from the vacuum as can be explained by QFT. This primeval hadron can be modeled by GR as a KNBH. Or, it can be modeled as a super dense hadron by quantum physics. For reasons that are not clear to me, it exploded ending in the current structure of the Universe. The current Universe is composed of a massive spinning Kerr black hole, or super dense hadron, the Pivot, and a ring of visible Universe orbiting it in an opposite direction to the Pivot's spin. This structure describes a Universe that is in a state of dynamic equilibrium. I postulate that although the Pivot is very massive it occupies a very small volume of the Universe. In this sense, the Universe resembles the structure of the atom. The Pivot can be compared to one proton in the nucleon of the atom. The Pivot, as the proton will 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.

It is shown that the Pivot Universe structure explains, quite strikingly, many known cosmic observations. This is done without using the theories of dark matter and dark energy.

It is shown, in the article, that the Pivot theory connects GR and quantum physics, into a unified theory. The gravitational constant G is expressed by other fundamental physical constants.

The issues of the dynamic process that started with the primeval hadron and ended with the current Universe are not addressed here in a satisfactory manner, for example, 1) What is the mechanism that caused the primeval hadron to explode when its mass reached the total mass of the current Universe? 2) How long did it take the primeval hadron to reach this mass?

22. References

1. R. M. Muradian (1980) – "The primeval hadron: origin of stars, Galaxies and astronomical Universe" http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1980Ap%26SS..69..339M&db_key=AST&page_ind=0&plate_select=NO&data_type=GIF&type=SCREEN_GIF&classic=YES
2. R. M. Muradian (1987) - "The primeval hadron: origin of rotation and magnetic fields in the Universe" http://adsabs.harvard.edu/full/1987IAUS..121..341M
3. R. L. Oldershaw (2006) - "Hadrons as Kerr-Newman Black Holes" https://arxiv.org/ftp/astro-ph/papers/0701/0701006.pdf
4. S. Hod (2016) – "Analytic treatment of the system of a Kerr-Newman black hole and a charged massive scalar field" https://arxiv.org/abs/1609.07146
5. M. J. Longo (2007) - "Evidence for a Preferred Handedness of Spiral Galaxies" https://arxiv.org/ftp/arxiv/papers/0707/0707.3793.pdf
6. P. Birch (1982) – "Is the Universe rotating?" http://buildengineer.com/www.paulbirch.net/IsTheUniverseRotating.pdf
7. Wikipedia - https://en.wikipedia.org/wiki/Observable_Universe#cite_ref-15

8. Wikipedia – https://en.wikipedia.org/wiki/Dark_matter
9. R.F. Sistero (1982) "Roation of the Universe and the Universal Angular Momemtum-Mass Relationship" http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1983ApL....23..235S&db_key=AST&page_ind=0&plate_select=NO&data_type=GIF&type=SCREEN_GIF&classic=YES
10. Y. Sofue (1999) – "Central Rotation Curves of Spiral Galaxies" arXiv:astro-ph/9905056
11. T.M. Davis & C.H. Lineweaver (2004) "Expanding Confusion: Common Misconception of Cosmological Horizons and the Superluminal Expansion of the Universe". http://www.publish.csiro.au/AS/pdf/AS03040
12. R.P. Kirshner (2003) "Hubble's diagram and cosmic expansion". http://www.pnas.org/content/101/1/8.long
13. B. Nodland & J.P. Ralston (1997) "Indication of Anisotropy in Electromagnetic Propagation over Cosmological Distances" https://arxiv.org/pdf/astro-ph/9704196.pdf
14. Andromeda Galaxy https://en.wikipedia.org/wiki/Andromeda_Galaxy
15. Ma & Wang "Duality Theory of Strong Interaction" http://www.ejtp.com/articles/ejtpv11i31.pdf#page=113