Is Hubble's law an evidence for the Big Bang theory?

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ABSTRACT

Hubble's law is considered the first and most cited observational basis for the Big Bang (BB) theory. Hubble, relying on observations made by him and by others, postulated that galaxies are receding from each other at a velocity that is linear to their relative distances. He used the Doppler effect for finding the receding velocity. He claimed that there is a linear relation between the galaxy's receding velocity and the measured redshift of the galaxy. These observations led to acceptance of the BB theory. The linear relation seemed valid for galaxies relatively close to the Milky Way with small redshifts. However, later measurements done on distant galaxies with high redshift show that the linear graph curves up. These later observations led to the theory that the universe is expanding at an ever-accelerating rate and subsequently to the theory of Dark Energy to account for this accelerated expansion. These new theories related to the accelerated expanding universe has raised controversies among the scientific community. The Pivot theory is a new theory, that I originally suggested for solving the dark matter problem. I claim that the current structure of the universe structure is a huge black hole, the Pivot, where all the dark matter is concentrated, and a ring of a visible universe is orbiting it. In the current article, I claim that the observed z shift of galaxies is caused by gravitational shift of the Pivot rather than by Doppler shift suggested by Hubble. A detailed description of this theory is presented by Sher [1]

INTRODUCTION

Hubble's law is a cornerstone in the Big Bang (BB) theory. In the face of Hubble's evidence, Einstein was forced to abandon his idea of a static universe, calling it the "biggest blunder" he had ever made. Hubble's law that states that galaxies are receding from each other at a velocity that is linear to their relative distances $(V = H_0 \cdot d)$, led to acceptance of the BB theory that was suggested by Friedmann and Lemaitre, that the universe started with an explosion of an infinite small and super dense ball and since then is expanding in all directions. An important conclusion that can be derived from the BB theory is that the universe on large scale is isotropic and homogenous. Hubble's law 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 paradigms: 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 [2]. This theory asserts that galaxies will get farther and farther apart and the universe will grow entirely cold and eternally black. The accelerated expanding universe gives rise to yet another theory that claims that in order to accelerate the universe expansion at the observed rates, despite the gravitational pull of all matter in the universe, there must be an additional force. This force is called the dark energy. The quantity of this dark energy, which nature is unknown, was calculated to be ~70% of all the material in the universe.

The confusion, among the scientific community, that the accelerated expanding universe have caused is shown in many articles relating to Hubble's law. For example, by noticing how many times the word "misconception" appears in an article by Davis & Lineweaver [2]. They suggested that the relation velocity-redshift is complicated and depends on cosmological parameters that determine what happened to the universe when the light was emitted and when it is received. It depends on the matter density, dark energy density and the current Hubble parameter.

Harrison [3] claims that cosmologists fail to distinguish between the linear redshift-distance that is an empirical approximation of limited validity and the velocity-distance law that is a theoretical derivation of unlimited validity.

An additional article by Collins [4] states that "It has been assumed that the red shift is wholly Doppler, although it is known that gravity also leads to a red shift. Until now, there has been found no way to extract Doppler velocity from the measured red shift, and this biases the Hubble constant, upwards."

The issue of blue shifted galaxies was swept by Hubble under the rug. The blue shift contradicts the BB theory. If all galaxies after the explosion according to BB are receding from each other, how come that there are galaxies approaching each other? A famous example is the Andromeda galaxy that is moving towards the Milky Way with a probability that the two galaxies will eventually collide. An explanation given by cosmologists for the approach of the galaxies is that sometimes the gravitational field between neighbor galaxies exceeds the expansion of the universe.

Kirshner [5] relates to Hubble's diagram (Fig. 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."

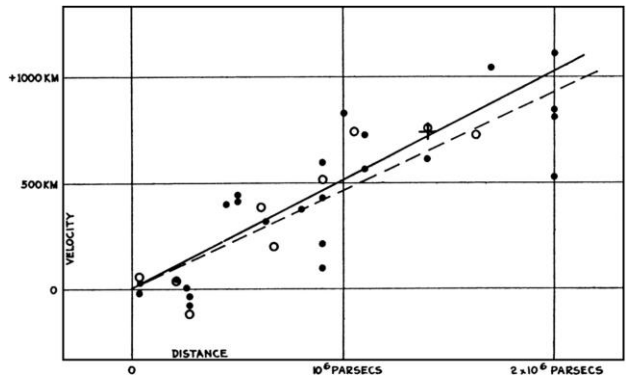

Fig. 1 – Hubble's original graph (1929)

The current article claims that Hubble's law is not correct, because he is using the Doppler effect rather the gravitational shift. Based on the Pivot theory, it will be shown that Hubble's linear relation between velocity to distance of galaxies is correct only for a special case.

The Pivot theory also relates to the issue of the blue shifted galaxies and will address the question whether Andromeda galaxy will collide with the Milky Way.

It will be explained why the observations of Hubble have such a big scatter. Hubble's graph is actually a fitting of a straight line through his data. It is seen in the graph that there is a large scatter in velocities of galaxies that are located at the same distance from the Milky Way. The scatter can be explained by measurements errors that Hubble did. But this scatter is repeatedly shown by others that used more advanced instruments. Today, the scatter is explained by the peculiar velocity, that is the component of the galaxy's velocity that deviates from Hubble's law. The reason for the peculiar velocity is that the galaxies are not distributed evenly but typically found in group of clusters so galaxies have a significant gravitational effect on each other. Contrary to peculiar velocity explanation, the Pivot theory claims that the scatter in Hubble's diagram is a systematic error.

Gravitational z shift

The Pivot theory claims that the z shift of galaxies is caused by the gravitational field, or Einstein shift, around the Pivot. The gravitational z shift is calculated in the framework of general relativity. It states that electromagnetic radiation originating from a source that is in a gravitational field is reduced in frequency, or redshifted, when observed in a region at a higher gravitational potential. 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, but its contribution to the measured z shift is small, as will be shown later.

The following data is used in the calculations of the gravitational z shift (Note: part of this data is calculated in [1]):

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

$M_{vu} = 1.5 \cdot 10^{53} kg$ …Mass of visible universe [1].

$R = \frac{26.8\%}{4.9\%} = 5.47$ … Ratio of dark matter mass to visible universe mass, [1].

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

$R_{in} = 129.4840 \cdot Gly$ … The inner radius of universe ring (calculated in [1]).

$R_{out} = 133.868 Gly$ … The outer radius of universe ring (calculated in [1]).

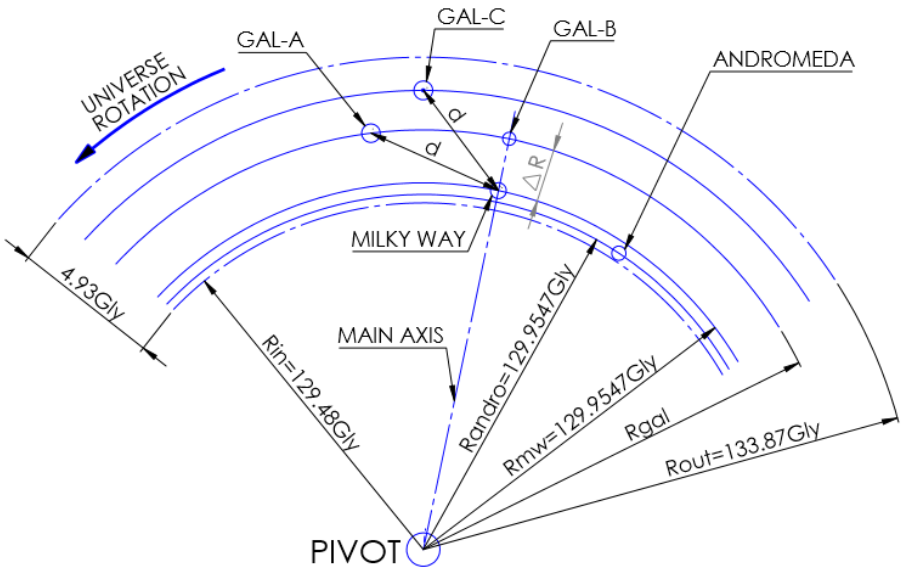

Fig. 2 – The Pivot universe structure shows Galaxies orbiting the Pivot

Fig. 2 is a schematic structure of the Pivot universe. It includes a huge black hole, the Pivot, that contains the entire dark matter in the universe, with a ring of the visible universe orbiting it. The inner radius of the ring must be greater than the event horizon of the Pivot. A detailed description of the Pivot universe structure is given by Sher [1].

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 (1) and shown in Fig. 3:

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

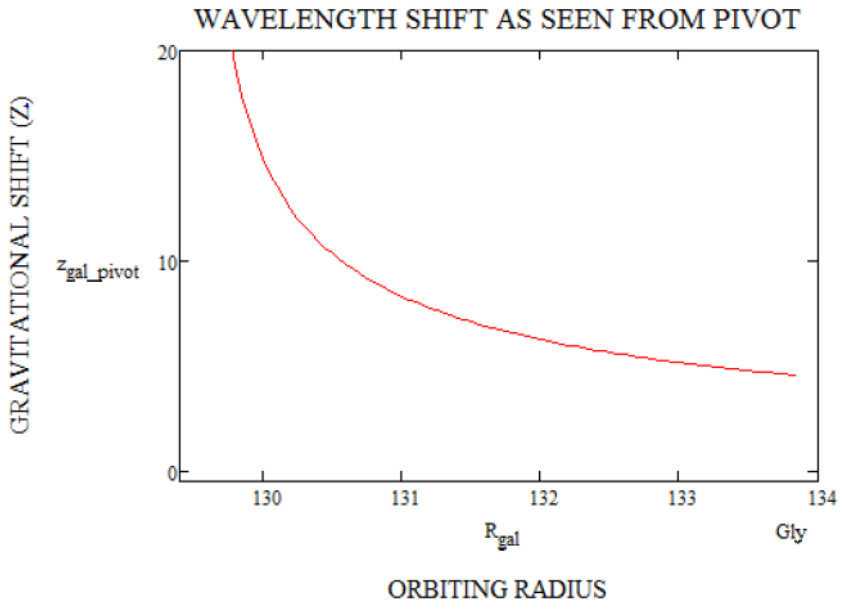

Fig. 3 – z shift in the Pivot's gravitational field.

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 (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 (2). Note: Should galaxies with higher z shift, will be found in the future, Z_{mw} be corrected accordingly.

$$Z_{mw} = 11.09 + 4.527 = 15.617 \qquad (2)$$

Having Z_{mw} the orbiting radius of the Milky Way (R_{mw}) is calculated by (3)

$$R_{mw} = \frac{2 \cdot G \cdot M_p}{\left(1 - \frac{1}{(Z_{mw}+1)^2}\right) \cdot C^2} = 129.954703 Gly \quad (3)$$

Now, the z shift of any galaxy, as seen from the Milky Way (Z_{gal}) is calculated by (4).

$$Z_{gal} = Z_{mw} - Z_{gal\_pivot} \qquad (4)$$

Having Z_{gal}, the orbiting radius of any galaxy R_{gal} can be calculated by (5) and shown in Fig. 4.

$$R_{gal} = \frac{2 \cdot G \cdot M_p}{\left(1 - \frac{1}{(Z_{gal}+1)^2}\right) \cdot C^2} \qquad (5)$$

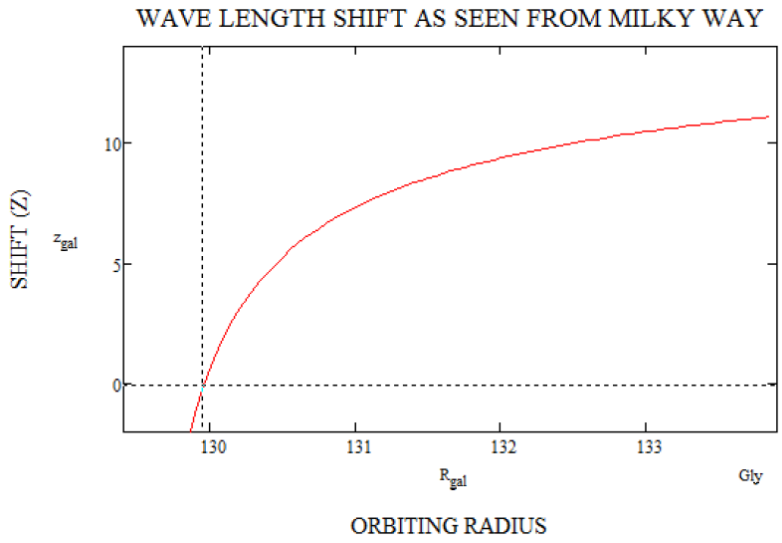

Fig. 4 – z shift of galaxies as seen from Milky Way.

The dashed lines relate to the Milky Way: $z_{mw=0,\ and\ Rmw=129.95Gly}$

Blue shifted galaxies

Fig. 4 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 $Z_{gal} > 0$. It should be noted that a mandatory difference exists in the interpretation of the sign of z shift between the BB and the Pivot theories. The BB theory claims that negative z shift (blue) means that the observed galaxy is approaching the Milky Way. A positive z shift (red) means that the observed galaxy is receding from the Milky Way. Contrary to that, according to the Pivot theory the meaning of a negative z sign is that the observed galaxy orbits the Pivot at a radius that is smaller than the radius of the Milky Way. A positive z sign means that the observed galaxy orbits the Pivot at a radius that is larger than the radius of the Milky Way. Had the Milky Way been located on the outer radius of the universe ring, all galaxies would have been blue shifted. Referring to Fig. 2, 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 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: $R_{mw} - R_{in} = 129.954703Gly - 129.4840Gly = 0.471Gly = 471Mly$. The distance

of the Milky Way from R_{out} is $R_{out} - R_{mw} = 133.868Gly - 129.954703Gly = 3.91Gly$. This result explains why there are more observed red-shifted galaxies than blue-shifted galaxies.

A famous blue shifted galaxy is Andromeda. For Andromeda, it was measured: $Z_{gal} = -0.001001$, distance 2.5Mly and it is predicted that the Milky Way and Andromeda will collide in 4Gly. (https://en.wikipedia.org/wiki/Andromeda_Galaxy)

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 (6):

$$R_{andro} = \frac{2 \cdot G \cdot M_p}{\left(1 - \frac{1}{(Z_{mw} + 0.001001 + 1)^2}\right) \cdot C^2} = 129.95465Gly \quad (6)$$

The difference in orbiting radiuses of the Milky Way and Andromeda is:
$R_{mw} - R_{andro} = 129.954703Gly - 129.95465Gly = 56.914Kly$. 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 rotate at the same plane around the Pivot. However, if the two galaxies rotate at different planes that are separated more than 150Kly be no collision is expected to occur.

Doppler 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, the orbiting velocities around the Pivot of the Milky Way (7) and the observed galaxy (8) should be found, first. Then, the relativistic velocity of the two galaxies should be calculated (9). Then, the doppler shift is calculated (10). Finally, the ratio of the doppler shift to the total z shift is calculated (11). The Doppler effect contribution to the z shift is less than 0.2% as shown in Fig. 5.

$$V_{mw} = \left(\frac{G \cdot M_P}{R_{mw}}\right)^{0.5} = 0.706C \quad (7) \qquad V_{gal} = \left(\frac{G \cdot M_P}{R_{gal}}\right)^{0.5} \quad (8)$$

$$V = \frac{V_{mw} - V_{gal}}{1 - \frac{V_{gal} \cdot V_{mw}}{C^2}} \quad (9)$$

$$Z_{doppler} = \frac{V}{C} \quad (10) \qquad Ratio = \frac{Z_{doppler}}{Z_{gal} + Z_{doppler}} \quad (11)$$

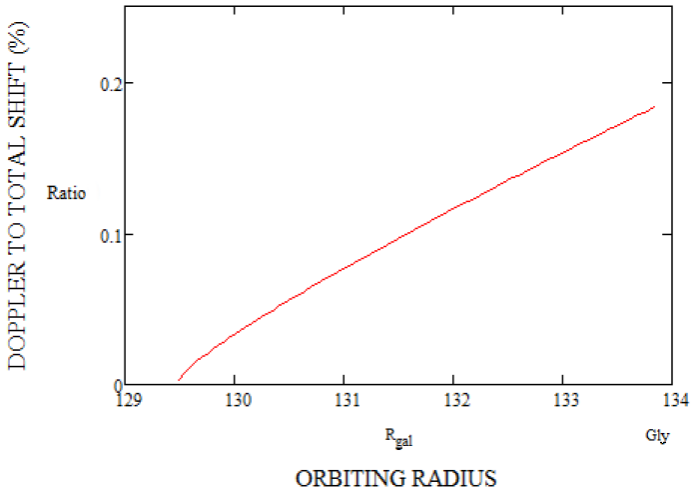

Fig. 5 - The ratio of doppler shift to the total shift

Hubble's law

Hubble's graph (Fig. 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. Fig. 2 presents 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's 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, $\Delta R=d$ 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 (9) and the linear relation is shown in Fig. 6.

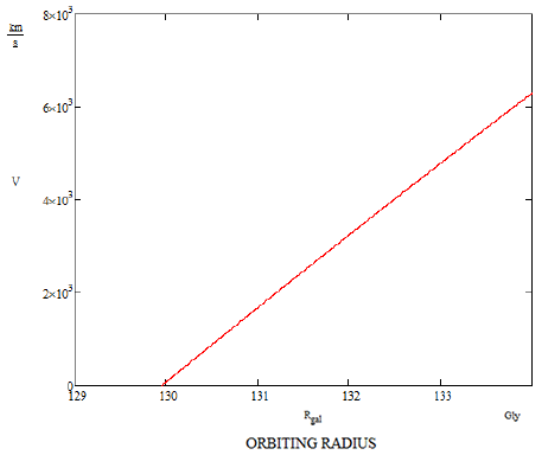

Fig. 6 – Linear relation between galaxy's velocity and its orbiting radius.

Analyzing Fig. 6 - 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. The dark energy theory is not needed to explain these results, as the galaxies are not accelerating.

Many theories have tried to find the relation between the recessional velocity and z shift but no exact solution has been found. The Pivot model finds this relation by combing (4) and (9) and the result is shown in Fig. 7. It is shown that even the farthest galaxies located at the outer radius of the visible universe ring, with a z shift of 11.09, have a receding velocity of ~6200km/s relative to the Milky Way. On the other hand, the BB theory based on Hubble's law claims that galaxies with such high z shift are receding at velocities that are several times the speed of light.

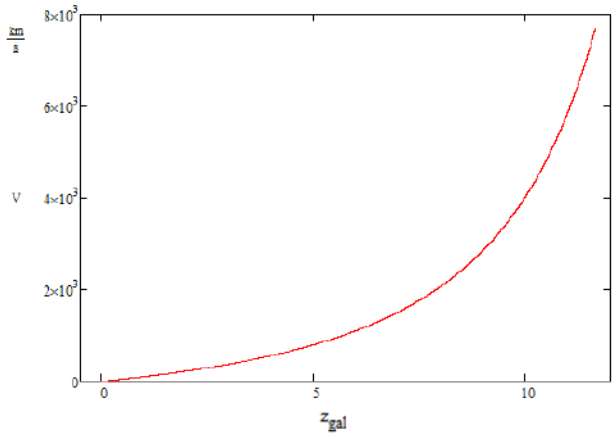

Fig. 7 – Velocity of a galaxy as function of z

Summary

Hubble's law is wrong. This has been confirmed by observations of galaxies with high red shifts. This means that the BB theory, that relies on Hubble's law, is questionable. Cosmologists are reluctant to give up on the BB theory and, in face of new observations, suggest additional theories to prove the BB's validity. To name two; The dark energy and the expansion of space at velocities higher than speed of light. The Pivot universe structure claims that the gravitational shift around the Pivot can explain Hubble's observations.

1) Hubble's law $V = H_0 \cdot d$ is wrong. The correct relation for the linear recessional velocity is $V = K \cdot (R_{gal} - R_{mw})$, where $K = 5.1 km/s/Mpc$
2) The large scatter in Hubble's diagram is a systematic error. It originates from the assumption that the z shift is caused by Doppler shift, rather than the gravitational shift.
3) A galaxy with Blue shift is not necessarily approaching the Milky Way. The blue shift results from the fact that the galaxy is orbiting the Pivot at a radius smaller than the Milky Way's radius. A red shifted galaxy is orbiting the Pivot at a radius greater than the Milky Way's radius.
4) No galaxy is receding from the Milky Way at a velocity greater than the speed of light. The maximal recessional velocity of a galaxy is ~6,200km/s.
5) The Doppler shift's contribution to the total z shift is small, no more than 0.2%.

A note in regard to the Pivot theory

In my article "The structure of the Pivot universe" [1], I relate briefly to Hubble's law, noting that Hubble's law is wrong as it is based on the Doppler effect. I decided to elaborate on this issue in the current article due to responses I received, from which I've learned that people are reluctant to doubt the validity of Hubble's law. Hubble's law is considered to be one of the most important evidences of the BB theory, and is treated much like a dogma. The Pivot theory claims that the cause of the z shift is gravitational shift, whereas Hubble's law is based on the Doppler effect. The structure of the Pivot universe explains Hubble's observations.

Most people are reluctant to accept the Pivot theory because the BB theory paradigm states that at a "large scale" (hundreds of million light years), the universe is observed to be isotropic and homogeneous. Therefore, the Pivot universe, that has a preferred axis seems improbable. This hypothesis of isotropic and homogeneous universe can be derived from Hubble's law. But, the strongest evidence for it is the Cosmic Microwave Background Radiation (CMBR). I claim that the Pivot theory can agree with the CMBR. I demonstrated that the Milky Way is located inside a huge observable universe, that is a sector of a ring with a cross section of 4.9Gly x 4.4Gly. According to the above calculation of z shift, 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 homogenic. 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. 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.

From responses I received, I understand the Pivot theory is "out of the box", mainly because the BB theory is perceived as a fact. The Pivot theory may be "out of the box" but it is not out of the blue - it relies purely on observations and known accepted cosmological parameters.

The Pivot theory consists of two parts. The first part describes the current structure of the universe - a huge black hole with a ring of a visible universe orbiting it. I suggested this theory in order to explain the existence of dark matter. The dark matter is vital in explaining the flattening of velocity curves in galaxies. The Pivot theory has an important modification from the BB theory. The BB claims that the dark matter is spread in the entire universe inside and around galaxies. Its nature is unknown and until now has not been observed. The Pivot theory claims, in contrast, that all the dark matter is concentrated in one huge black hole – the Pivot. Being located in a black hole is the reason why the dark matter cannot be observed. The Pivot's mass is so huge that it influences any celestial body, starting from dust and ending in the largest structures in the universe. The Pivot structure, as described in [1] answers observed and unsolved issues in cosmology- the high z shift galaxies, flattening of velocity curves in galaxies, spiral shape of galaxies, handedness of galaxies in the universe. The Pivot theory also answers the two most mind-boggling theories in cosmology: the dark matter and the dark energy. The solution for the first is described above and the second is simply not needed in the Pivot theory.

The second part relates to the questions: how did it all begin and how did it evolve into this structure. This part, I admit, is speculative, but, once again, it is not out of the blue. It is based on the theory of the primeval hadron that is described in [1]. Evolving from a primeval hadron does not forbid asking questions relating to time: what happened at t=0 and, more importantly, what happened before t=0. These questions cannot be answered by the BB. However, more theoretical work must be done on this issue.

References

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