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The Missing Mass Problem

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Abstract

In this paper a possible solution to the missing mass problem is proposed.

Keywords

The Missing Mass Problem

1. Introduction

After the red shifts in galaxies' spectral lines were observed in 1912, in 1920-1929 decade it was discovered the evolutionary phenomenon known as the ***Expansion of the Universe***. In the scope of Astronomy, attention was particularly directed toward the beginning and the final fate of the ***Cosmos***; as well as to the proposition of some theoretical models, based on ***A. Einstein's General Theory of Relativity***, in order to explain the behavior of the Universe as a whole. Concerning the beginning of the ***Universe***, G.E. Lemaitre stated an interesting physical theory. He proposed that in the beginning all the galaxies in the ***Universe*** were concentrated in a single lamp, which he called the ***Primeval Atom***. This primeval atom then exploded, in the most fantastic and catastrophic explosion called by G. Gamow the ***Big Bang***, flinging the galaxies off into space. The ***Big Bang*** sent all the fragments of the primeval atom moving away from one another; and this motion is still visible at present. It was established that the more distant a galaxy, the greater, in direct proportion is its speed of recession, as determined by the shifts of its spectral lines to the longer or red wavelengths. According to Lemaitre, the velocities of recession of those galaxies were in fact, proportional to their distances. This relationship is now known as ***the law of red shifts***, or sometimes ***Hubble's law*** [1].

Concerning the final fate of the ***Universe***, two alternatives seem ultimately possible. Either gravity is strong enough so that the universal expansion will slow down, stop, and become a contraction; or the expansion is sufficiently rapid that the rapidly increasing distances between the galaxies will overcome gravity, and the ***Universe*** will go on expansion forever. The ***Universe*** that stops expanding is called a ***closed Universe***, and the ever expanding one is an ***open Universe***. However, there is a borderline case, in which gravity is just strong enough that the distances between any two galaxies increases towards a limiting value, but gravity is not strong enough

to bring the ***Universe*** back together again. On the other hand, the present shape of the ***Universe*** is also related to its future if gravity is assumed to be the only force governing its evolution. Apparently, the future of the ***Universe*** also depends critically on its curvature, because the curvature in turn depends upon the mean density of matter in space. Anyway, if the ***Universe*** is open, it will go expanding forever, whereas if it is closed, its present expansion will eventually cease and be succeeded by a general contraction. In the evolutionary cosmologies the ***Universe*** is now expanding. Whether or not the expansion will continue or will eventually stop and give way to contraction, depends on the existence in space of a huge amount of matter. Unfortunately, that amount of matter needed to stop the expansion has not been found yet. This fact is what is called sometimes ***the missing mass problem***.

2. The Missing Mass

If some results of ***Einstein's Special Theory of Relativity*** are used, it is possible to propose a solution to the missing mass problem. According to Einstein's theory no material particle could possible travel with a velocity greater than the velocity of light in vacuum. Thus it becomes obvious that no material particle could be accelerated beyond the light barrier [2]. This argument still stands. On the other hand, the ***Universe*** contains many types of bodies: ***galaxies, clusters of galaxies, stars, planets, dust and gas***, and also many other bodies like ***black holes and quasars***. All of them are bodies which have a proper mass different from zero; so that, are bodies which can only travel at velocities smaller than the velocity of light in the empty space; in such a way that the only way by which they can move is by means of an acceleration process. Moreover, in his original paper on relativity, Einstein said that there is an upper limit of the velocity for the material bodies. In fact, the mass of those bodies would get infinitely large upon approaching the velocity toward the upper limit c; as it is easy to see from the following relativistic mass transformation equation.

$$m = \frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}} \tag{1}$$

where m_o is the proper mass and m is the observed mass of the body which travels at the velocity v. An examination of the previous equation, shows that when $v \to c$, $m \to \infty$. Thus as the velocity of a body increases toward the velocity of light in the empty space, the mass of the body increases toward infinity. An infinite mass moving at a very low velocity would have infinite energy. Since it is absurd for any body with finite proper mass *mo* to have infinite energy, it must conclude that it is impossible for such a body to move with the light velocity in the empty space (see the following graphics); and this is valid for all the bodies contained in the ***Universe***. Thus anyone of them could travel at velocities equal to the light velocity in vacuum. However, the relativistic mass transformation process produces an increase of the inertial mass with velocity; in such a way that this fact seems to be another force capable to stop the expansion and bring the ***Universe*** back together again.

Finally, when the ***Principle of The Equivalence of Gravitation and Inertia*** is applied, it is easy to see that the gravitational mass needed to slow down and stop the expansion process is just the increase of the inertial mass with velocity of the bodies contained in the ***Universe***. See **Figure 1**.

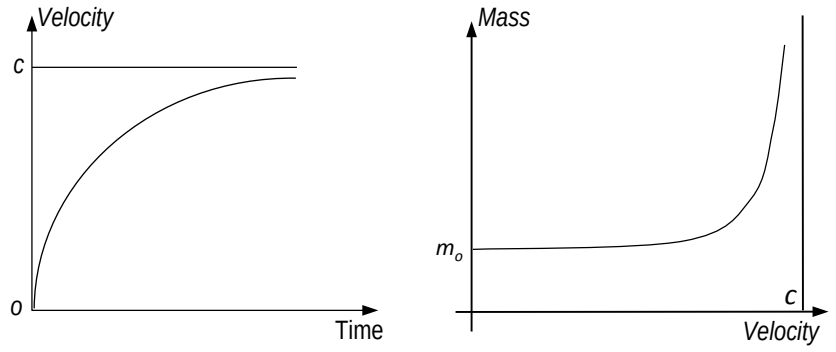

Figure 1. The relativistic velocity, and the relativistic transformation of the mass.

3. Conclusions

The evolution of the ***Universe*** was revealed in 1920s when ***E.P. Hubble*** extended earlier measurements of the distant galaxies spectra and found that all but a few of the nearest galaxies were speeding away from ***Earth***. Hubble and his colleagues discovered the law that bears Hubble's name: ***Velocity of recession equals Hubble's constant times distance***.

The ***Universe*** is expanding now and has been expanding for a long time. Following the expansion backward, it is found that there was a time when all the matter and the energy in the ***Universe*** were packed tightly together. The explosion of that ***Primeval Atom*** provided impetus for the expansion that it is now observed. The explosion which marked the beginning of the evolution of the ***Universe*** is called the ***Bing Bang Theory***. Anyway, if the Universe is open it will go expanding forever, whereas if it is closed the expansion will slow to a stop, and then will become a contraction [3].

According to the previous arguments given in the former paragraph, it seems that the relativistic mass transformation process just produces the missing mass needed to slow down and stop the expansion, in such a way that this is something ***to be and not to be*** in the Universe. Moreover, this picture apparently points out toward a closed Universe model.

References

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