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Novel Way of Explaining the Theory of the Expansion of the Universe in the Absence of Dark Energy

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Abstract- In this work, a new theory is shown in which the approach that leads to this would be relatively easier to demonstrate experimentally. In this theory, we propose that we should carefully observe the fundamental forces and constants of the universe, since the answer to the problem of the behaviour of expansion of the universe, may lie in the functioning of these fundamental forces and constants. We currently take as the fundamental forces, they carry with them constant values assigned to these forces, as for example the constant of universal gravitation, the electric constant, etc. Despite this, a doubt arises in our knowledge and is: What would happen in the event that these constants that we usually take as fixed values were variable, but with constant "patterns" throughout certain periods of space-time (on a cosmological scale)? In this article we can take as a point of reference the fundamental forces that we have as concepts today, which would be the electromagnetic force, the gravitational force, the strong and weak nuclear force, however we deal with gravity as if it were a property of the matter instead of a fundamental force, the constants related to the fundamental forces, even the same speed of light, can change depending on the place where they are measured, the scale and the conditions in which these measurements are realized. For this reason, that we propose the possibility of undergoing certain changes as they advance on a reference scale with respect to time and space, based on this we propose an alternative to dark energy (theory of the modified gravity MOG) arguing how, from tiny changes in the values of these fundamental forces would appropriately justify inflation of the early universe, the subsequent deceleration and the acceleration that we show today of the universe. (Dark matter, dark energy, expansion of the universe, theory of modified gravity MOG, early universe.)

I. INTRODUCTION

Since the emergence of physics between the past century and the present, with the advent of the theory of general relativity and quantum theory, we have learned a new way of seeing the universe and our understanding has changed with respect to past ages. Now we can observe different aspects of the universe that we can explain with the two theories mentioned above. However, today, there is a phenomenon which is difficult to ignore, and it is the case of the expansion of the universe.

With the cosmological constant introduced in the equations of Einstein's general relativity, to the observations we have today thanks to Saul Perlmutter, Brian P. Schmidt and Adam G. Riess (winners of the Nobel Prize in physics in 2011) [1], it has been shown that the universe expands rapidly instead of contracting or staying static [2], based on this it is usually associated with dark energy as the main way to explain this event.

However we cannot say that we know a lot about this concept, we can only assume based on the observations that dark energy is a form of energy that is present in all space and that tends to exert negative pressure as opposed to gravitation, and it is presumed that it is the cause of the accelerated expansion of the universe [3]. However, this is a way of explaining the expansion of the universe in an incomplete way, therefore, many theories have arisen that propose an accelerated expansion like the current one without using this concept of dark energy.

As alternative theories, we find the expansion using modified gravity [4] a very promising approach in which he explains how making some modifications to Newton's laws and other proposed approaches based on possible alterations of gravity, can be explained more concrete both cosmic inflation and the subsequent slowdown and accelerated expansion, which we observe today, however, this theory although promising still presents some drawbacks so we cannot accept it as a definitive theory that can explain the accelerated expansion of the universe.

We can also find theories that have reached more disclosure, such as string theory and M theory [5, 6], brane cosmology [7] and the holographic principle [8]. Nevertheless, these theories, although coherent and possible, have the same problem as the aforementioned one, about the modified severity and it is the impossibility to demonstrate them experimentally. Discarding theories that have turned out to be equivalent to the fifth essence or inconsistent with the observations.

We can see that the main problem of the theories raised to explain this problem of accelerated expansion, present the same drawback and is that using current technology, we do not have the possible means to demonstrate which of all these theories is experimentally correct, and not only based on mathematical approaches since these, although it may be adaptable to observations, we have seen from a higher plane on a large scale or also from quantum mechanics that may be incorrect, therefore we cannot rely solely on the mathematical approaches as such , based on this, we must adapt our theories and mathematical approaches to the experimental observations and not the observations of our theories.

II. THEORETICAL FRAMEWORK

As mentioned in the previous section, the present theory shows that the expansion of the universe (See Equation (1)), that is to say this positive pressure thrust that we observe today, based on works such as the study of modified gravity (MOG, See Equation (2)), we analyze that if it is possible that the gravity when changing in different points of the space can generate alterations in this, if we modify the fundamental forces, we can achieve these same changes.

$$\eta(z)=\int da/(a^2)H=\int dz'/H(Z'),(1)$$

Where η is the conformal time, $d\eta=dt/a$. the Hubble parameter is $H=\dot{a}/a$ and $\tau=1/(1+z)$ is the scale factor at the time of emission?

We can written the action of F(R) gravity in a scalar-tensor form:

$$S=\int d^4x\sqrt{-g}\left[R/2k^2+1/2\,\partial_\mu\partial^\mu\varphi-\tilde{V}(\varphi)\right],(2)$$

Where;

$$\varphi=\frac{\sqrt{3}}{k}\sigma,\ \tilde{V}(\varphi)=V\left(\frac{k}{\sqrt{3}}\varphi\right)$$

When we use the conformal transformation of F(R) gravity in a scalar-tensor form and using the conformal transformation, we have:

$$g_{\mu\nu}\rightarrow e^{\pm k\varphi\sqrt{2/3}}g_{\mu\nu},$$

One form to make the kinetic term of φ vanish. Then, we obtain:

$$S=\int d^4x\sqrt{-g}\cdot\left[\frac{e^{\pm k\varphi\sqrt{2/3}}}{2k^2}R-e^{\pm 2k\varphi\sqrt{2/3}}\tilde{V}(\varphi)\right].(3)$$

The action (2) is called the ‘‘Jordan frame action’’, whereas the action (3) is the ‘‘Einstein frame action’’ due to either the non-minimal coupling or the standard coupling in front of the scalar curvature. Because φ now becomes an auxiliary field, which does not have a kinetic term, one may delete φ by using the corresponding equation of motion:

$$R=e^{\pm k\varphi\sqrt{2/3}}\left(4k^2\tilde{V}(\varphi)\pm 2k\sqrt{3/2}\,\tilde{V}'(\varphi)\right),$$

Which can be solved with respect to φ as a function of R as φ = φ(R). Thus, we can rewrite the action (3) in the form of F(R) gravity:

$$S=\int d^4x\sqrt{-g}F(R),$$

$$F(R)=\frac{e^{\pm k\varphi\sqrt{2/3}}}{2k^2}R-e^{\pm 2k\varphi\sqrt{2/3}}\tilde{V}(\varphi)(4).$$

We can rewrite the scalar-tensor theory (2) as:

$$S=\int d^4x\sqrt{-g}\cdot\left[R/2k^2+1/2\,\partial_\mu\partial^\mu\varphi-\tilde{V}(\varphi)\right],(5)$$

Que corresponde al escalar fantasma [9]. In other words, despite the mathematical equivalence between two frames there occurs some kind of physical non-equivalence [10].

In actuality the gravity is introduced as property of the matter, therefore although capable of distorting the space-time, being only a property of this would not be a fundamental force, therefore we would only have left, electromagnetism, strong and weak nuclear force as forces to be taken into account, but in the same way that they interact in an attractive way, at have a certain intensity, if we vary the scales of these intensities, we could take them as variables at different points in space and move forward different levels on larger scales of space-time such as cosmic scales.

Explaining a little more this detail we observe as first evidence, that galaxies far from ours are separated in an accelerated way directly proportional to the distance they are located (See Equation (6)), however, it has been concluded that this expansion in a fact known as the Big rip (See Equation (7)), will drastically influence the separation of nearby galaxies, passing through solar systems and finally separating exponentially both the atomic structures and the fundamental particles that make up these structures.

Hubble's law is a statement of a direct correlation between the distance to a galaxy and its recessional velocity as determined by the red shift. It can be stated as:

$$v = H_0 D, (6)$$

Where v is the recessional velocity, H0 is Hubble's constant, D is the proper distance. Take a count that Hubble's law is considered a fundamental relation between recessional velocity and distance. However, the relation between recessional velocity and redshift depends on the cosmological model adopted and is not established except for small redshifts.

The authors of the Big Rip theory are led by Robert R. Caldwell of Dartmouth College, calculate the time from the present to the end of the universe as we know it, of this form:

$$t_{rip} - t_0 \approx \frac{2}{3|1+w|H_0\sqrt{1-\Omega_m}} (7).$$

Where parameter w is the ratio between the dark energy pressure and its energy density, H0 is Hubble's constant and Ωm is the present value of the density of all the matter in the universe.

Overcoming the gravity we observe today, however, if this thrust force is capable of defeating gravity, electromagnetism and even the strong and weak nuclear forces that hold the atomic structures together. we have that it is a force considerably superior to those currently known, all specified in time scales of the order of the hundreds of billions of years, what would happen if the force causing this separation was not really a force of its own as such, but on the contrary a variation in the scales of the forces that we know today?

If we take this as a starting point we would realize that by analyzing the fundamental forces that hold the atomic structures together, if we have a constant relationship in the weak nuclear force that holds the electrons together to an atom, we would have this structure eternally, but if varies the intensity (on a negative scale) with which this force maintains the atomic union, we would result in the same way that the weak nuclear force would stop holding the electrons to the atom and these, they would end up separating, if this wave tendency of the forces, happen, in a space or infinity or in movement, and in all the fundamental forces, we would see the effects on a cosmological scale as a separation.

In addition to this we deduce that if we use time as a meter in these proposed scales, that is, if we take as time discrete packages, which measure the intensity of each proposed wave, we would be talking about these fluctuations could be assimilated both in a certain amount of space and in an exact amount of time, and the interactions between these fundamental fields and the mediators of these, that is, the forces, would occupy besides a certain space, a determined time, where it could demonstrate these fluctuations in the fundamental forces.

III. ANALYSIS AND DISCUSSION

We can take Figures 1-3, which represent the current variation of the euro-dollar as a good example, and make an analogy of the behavior of the stock market with the proposed model of the fundamental forces and their respective variations in the scale of planck , both time and space and lower would be represented by the graph of one day (See Figure 1) marking clear trends but that being at such small scales we cannot observe the small variations of this behavior.

Figure 1. Comparison of the temporal evolution of the fundamental forces in the planck model using the behavior of the stock exchange.

These "minimal" variations would mark a different trend for higher scales, for example: in the graph of three months in the graph (See Figure 2), a totally different trend can be observed, this would be what we could see reflected in a cosmological scale, some changes or tendencies in the variations of the forces totally different to the aforementioned scale, but that without the first variations, the changes in these scales could not be given, explaining with this the main problem of this article that was the expansion of the universe without the need for dark energy, if not on the contrary as a variation of the attractive and repulsive fundamental forces in different points of space.

Figure 2. Behavior of the stock exchange. For 3 months of variation.

However, if we move the perspective further, at a scale where we could observe the whole space on a scale superior to the cosmological one, this would result in an analogy with the 5-year graph (See Figure 3), in which we observe a totally different trend, even in some cases "opposite" to the previous ones, but this scale could not exist in the same way without the changes in the forces represented in the previous figures.

Figure 3. Behavior of the stock exchange. For 5 years of variation.

Now, if we look at the three figures above proposed to make an analogy to the model proposed in this article, the trends from one scale to another vary their tendencies which in emphasis would give us that at different scales, we would observe different effects on the fundamental forces , depending on the perspective we have, since this perspective would vary the observations obtained, however we can also realize that in the 3 graphics of the images, although they are different, and have different periods of time in which they are evaluated, they maintain a The factor of union by which the 3 are related independently of the scale and at what time they are evaluated and is that for the 3 graphs the factor that relates them is the price, it is their meter, although they have different tendencies, the price is still Even if the scale increases or decreases, in this model the evaluator we propose is time.

According to what scale we observe, the intensity of the forces would vary throughout space, but would maintain a point in common with all scales and observations, and it would be time, according to the way in which time advances, this will be the same in the 3 perspectives that we take, and the only way to modify the time, that is to say to make it advance in one way or another is with gravity, and it is curiously, it would also mark us the perspective that we would be taking according to its intensity from the point of the space what we measure.

On the other hand, time would be "divided into discrete packages" in which they will be stored according to a certain amount in the perspective we take, obtaining a result that could not be modified in "packages" that have already passed, the only ones that could suffer from certain modifications would be the packages that mark the current trends from the perspective from which we started, and as we mentioned earlier, gravity would be the only observable property that would help us to "modify" or at least to give different periods of time, according to the point where we locate ourselves "historically".

IV. CONCLUSIONS

The highlight of our research is, to give an explanation seen from a different perspective, to improve the understanding that we have about the expansion of the universe, and how this could be involved and affected in a different way to the theory of dark energy that we have today, and that has certain parameters that even with current studies we have not understood.

Since this new explanation seems quite promising, there is still a need for a phase of experimentation to help us evaluate these situations to verify their complete veracity, which empirically demonstrates to us that the values associated with the intensities of the fundamental forces of the universe can vary in certain time scales, therefore, a more precise future observation about whether it is possible that there is a variation in these forces could clarify this doubt.

Finally, the most relevant thing about our article is that by proposing a new idea we are able to explain the initial inflation, the subsequent deceleration, and the expansion we are currently experiencing starting from the big bang, without using dark energy, freeing ourselves from a process that we have not been able to adapt in its entirety to the observations obtained so far.

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