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Concerning Dark Matter after excluding the FLRW metric (and with it, Dark Energy)

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ABSTRACT

We will discuss the existence of Dark Matter and show how much this entity is mainly necessary to justify the *FLRW* model. Speaking about galaxies, of recession, orbits and gravitational lenses, we will also show that, once we hypothesize a different velocity for the Galactic Recession, its introduction into our physics is probably no longer necessary.

DISCUSSION

As an alternative to *FLRV*, this brief analysis refers to the cosmological model 4-Sphere described in [viXra:2209.0098].

Dark Energy has been excluded in 4-Sphere among the forces that govern the equilibrium of the Universe in its shape. More precisely, the conjecture predicts that the Universe in its expansion crosses a continuum of states of equilibrium between gravity and pressure of the *CMB*.

Due to the Universe expansion every point recedes together with the *CMB* that surrounds it. By construction of this model, a traveler perceives the CMB as if every point of the Universe were a source. For a particle with its own peculiar velocity, it follows that effects such as radiation friction cannot be attributed to *CMB*, even in a minimal form.

Between two approaching stars, the only force that opposes gravity is the radiation pressure which they exercise over each other. But then, before the first star appeared and neglecting the radiation of the gas, no force could counteract the gravity between two particles moving away from each other due to the Galactic Recession.

It is in this context that we must consider Dark Matter, that is how, in its absence, a primordial halo of gas formed and evolved.

We can see that, while with $FLRW$ the Recession Velocity v_r increases over time, as a force against gravity $a(t)$, with 4-Sphere it remains constant, resulting also much smaller. This is a major drawback to Dark Matter.

In 4-Sphere, we get a sense of the problem by simplifying math to the maximum:

Assuming a current matter density of $3 * 10^{-28} Kg\ m^{-3}$ conserved over time and made up in the early days of 75% of Hydrogen and 25% of Helium, the mean weight of an atom of gas is $2.92 * 10^{-27} Kg$. Then, considering two alone neighboring atoms soon after the Last Scattering, we get to the condition $v_r = \int a(t)dt$ a few years later. (The math expression of $a(t)$ contains a not negligible recursion term, and the result is highly dependent on the initial density and its fluctuations, but acceptable with respect to secular evolution of galaxies).

The execution of the few lines of code [1] give us an idea of how much the Recession Velocity itself makes the Dark Matter necessary or not.

Furthermore, as far as astronomical observations are concerned, although physical models are built such to resolve any inconsistency [*], the presence of Dark Matter is not yet proven, being the effects attributed to it also explained differently. The case in point concerns the rotation curve of galaxies in which the expected decrease in speed in the orbits of stars, beyond a certain distance from the center, does not appear, in contravention of Kepler's laws.

An explanation for this is given in [**]:

“In particular, the measured rotation curve of galaxies provided much experimental support to the dark matter concept. However, most theories used to explain the rotation curve have been restricted to the Newtonian potential framework, disregarding the general relativistic corrections associated with mass currents.”

This is a new approach in which, due to the coexistence of stars, gas and dust in the galaxy, the classical concept of balance between gravitational and centrifugal forces is replaced by a set of equations for the motion of a perfect fluid in a gravitational field. The approximation applied is that of the weak fields, through the analogy named “Gravitoelectromagnetism”.

“In the present article a new model for the rotation curve of galaxies is developed including the effects associated with mass currents. A set of equations that govern the motion of a weakly relativistic perfect fluid is introduced …”

The article in question was chosen among others because it proposes a solution inside General Relativity, not wanting (for now) to resort to modified gravitational theories as “Bigravity” [***] or others, which also offer different explanations to Dark Matter.

Speaking of different observational evidence, the results from measurements are sometime affected by the assumptions of the cosmological model used. In gravitational lenses [****], similarly to classical optics, the geometry of the lens, in its equation, relates the distances between star, lens and observer as explained in [*****] at point 2 “Basic of Gravitational Lensins”.

Now, to calculate the angle of deflection we must know the distances from the observer to the plane of the source, where the star lies, and to the plane where lens is. Their estimate, given the order of magnitude, could only be calculated starting from the respective Redshifts, according to the metric used.

In the lens equation, the smaller the ratio between the distances from the "lens" and from the "source", the more the mass of the "lens" and its distance from us become directly proportional. In the practical case however, this dependence on the model is not too accentuated.

The article [****] in TABLE 1 lists a set of lens systems. The first it is about SDSS J0029-0055, a source object placed at $z = 0.931$ in alignment with the observer and with a foreground $z = 0.227$ elliptical galaxy working as a lens.

With $H_0 = 70\ Km\ s^{-1}\ Mpc^{-1}$ for $FLRW$ the distances are:

— $FRLW$ $d_{source} = 10{,}211\ Mpc$ $d_{lens} = 1{,}895\ Mpc$
— 4-Sphere $d_{source} = 1.856\ Mpc$ $d_{lens} = 773\ Mpc$

Applying now the lens equation to get the same Einstein Angle we find the relation between the lens masses computed by the two models, for the case in question:

$$\frac{m_{4-Sphere}}{m_{FLRW}} = 0.57 \text{ approximately}$$

But different assessment of the stellar distances between the two models is not limited to this.

Knowing the Mass-to-light ratio Υ of the study and assuming its constancy, we could find another relationship between the two models that links the mass of the elliptical galaxy (the lens) to its Luminosity:

$$\text{if } \frac{m}{L} = \Upsilon = const \qquad \text{then } \frac{m_{4-Sphere}}{m_{FLRW}} = \frac{L_{4-Sphere}}{L_{FLRW}}$$

but the calculation of the K correction is different between 4-Sphere and FLRW and this does not allow to "convert" the Absolute luminosity computed for the lens.

Even if we have no comparison for the over 27% expected extra mass by the authors (which we lack instead) we showed the dependence of the lens on the model.

Furthermore, a difference in the light deflection angle, as for the stars orbit, could also be due to the fact that, inside the galaxy and just outside its surface, the spacetime geometry could not be based on the Schwarzschild line element. It is true that Gravitoelectromagnetism analogy gives the same light deflection of Schwarzschild metric but, as an approximation, it might not yet provide all the answers to the galaxy's unexpected behavior.

To conclude, the objective of this brief analysis is not to refute the existence of Dark Matter (since it is not a directly measurable entity, it is up to others to prove its existence). Here, I wanted to bring to attention how much functional it is to the hypothesized model chosen for galactic recession, while probably it is not to our physics. Talking about it is a must because of its importance.

[*] – [The Astrophysical Journal, Volume 880, Number 2] - The Motions of Dark Matter

[**] – The European Physical Journal C volume 81, Article number: 186 (2021) - Galactic rotation curve and dark matter according to gravitomagnetism

[***] – [arXiv:1809.05318] - Long Range Effects in Gravity Theories with Vainshtein Screening

[****] – [arXiv:astro-ph/0701589] - The Sloan Lens ACS Survey. IV. The Mass Density Profile of Early-Type Galaxies out to 100 Effective Radii

[*****] – [DOI:10.3390/universe2010006] - The Scales of Gravitational Lensing

[1] - Here the VBNET code used to check my conclusions about Dark Matter (In the interval studied, the velocity of recession decreases slightly over time but we are interested in verifying that the approach between the atoms begins in an acceptable time. The exact calculation would increase the processing time.):

```
'
'   Number of atoms 7.24e11/m^3 at Last Scattering (with timeLine = 720,000 years)
'
Const recessionVelocity As Single = 4.90437E-18
Const atomsInitialDistance As Single = 0.000111349
'
'   Need Dark Matter? (for a WinForms project)
'
Private Sub NeedDarkMatter(recessionVelocity As Single, atomsInitialDistance As Single)
    Const gravityComponent As Double = 1.94511E-37  ' gravitationalConstant * one mass
    Const timeIncrement As Integer = 100            ' in seconds
    Dim atomsDistance As Double = atomsInitialDistance
    Dim incrementDistance As Double
    Dim relativeVelocity As Double = recessionVelocity
    Dim gravityAcceleration As Double = gravityComponent / atomsDistance ^ 2
    Dim timeElapsed As Single = 0
    For i As Long = 0 To 100000000000000
        timeElapsed += timeIncrement
        incrementDistance = relativeVelocity * timeIncrement
                          - 1 / 2 * gravityAcceleration * timeIncrement ^ 2
        atomsDistance += incrementDistance
        gravityAcceleration = gravityComponent / atomsDistance ^ 2
        relativeVelocity -= gravityAcceleration * timeIncrement
        If incrementDistance <= 0 Then
            Dim years As Integer = timeElapsed / 31500000.0    ' seconds per years
            MessageBox.Show("Start of approach after " + years.ToString + " years.")
            Exit Sub
        End If
    Next
    MessageBox.Show("Approach not started within the execution time limit")
End Sub
```