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Dark Matter Does not Exist at all

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Abstract Several aspects of the dark matter proposal are discussed. It is shown that the existing baryonic mass in galaxies is sufficient for closing the Universe. It is concluded, then, that dark matter does not exist at all in the Universe.

Keywords Dark matter, WIMPs, Closed Universe, Peculiar velocities of galaxies

1. Introduction

It has been proposed by many researchers [1-4] that a mysterious kind of matter, called dark matter, exists inside galaxies and also in the space among galaxies. According to its proponents dark matter would have an important role in the dynamics of spiral galaxies [4], in the dynamics of galaxy clusters [3, 5], in galaxy formation [6], in the large-scale-structure formation [6], and would provide 26.8% for the mass of the Universe in order to have a closed Universe, according to the Standard Cosmological Model, the so-called Lambda-CDM [7]. These seven references in this paragraph are just examples of a vast literature on the subject and some of these are pioneering articles.

Dark matter would have very unusual properties as it would not suffer the electromagnetic interaction, and would be, thus, completely invisible. It is supposed existence would be inferred only from its gravitational effects in galaxies and galaxy clusters. This means that it would have to be extremely stable. It would be composed of weakly interacting massive particles (WIMPS) that would interact only through gravity and the weak interaction. This means that WIMPS would have to be very special heavy fermions because they would be completely stable and neutral.

Other researchers have proposed that WIMPS could be composed of axions [8]. This particle is a hypothetical elementary particle postulated within the framework of the Peccei-Quinn Theory [9, 10]. Currently there are the proposals of Kim-Shifman-Vainshtein-Zakharov [11, 12] and of Dine-Fischler-Srednicki-Zhitnitsky [13, 14]. My criticism in this case is that the axion is a spin 0 boson and matter is composed of fermions, such as in atoms, nuclei, nucleons. Bosons take part in matter intermediating fermionic states. Thus, it does not make any sense to consider a large volume of bosons. And there is an additional serious drawback: All bosons with mass are unstable.

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2. Leptonic WIMPs Have no Place in Particle Physics

Any matter is composed of particles and this should hold for dark matter, of course. As discussed above, leptonic WIMPS would have to be very stable neutral leptons. This means that there would be another family of special leptons, and this would cause a change in the symmetry of the Weinberg-Salam electroweak theory which is a very precise theory.

As above discussed dark matter particles would have to be very heavy leptons, but a basic fact of Particle Physics is that the heavier a particle is, the more unstable it is. It is hard to figure out where the WIMP would fit in the table of leptons below. In the table below the muon and the tau are unstable, and, thus, only the lightest lepton (with proven mass) is stable.

Table 1. The leptons of Nature

e^-	υ_e	e^+	$\overline{\upsilon}_e$
μ^-	υ_μ	μ^+	$\overline{\upsilon}_\mu$
τ^-	υ_τ	τ^+	$\overline{\upsilon}_\tau$

It is also very important to have in mind that all neutral particles (not leptons, of course) with mass are composed of charged constituents and, thus, all neutral particles with mass interact by means of the electromagnetic interaction.

Therefore, we can justly say that leptonic WIMPs have no place in Particle Physics.

3. Dark Matter does not Exist in Spiral Galaxies

As it has been shown by de Souza [15] the constancy of the tangential velocity in spiral arms of spiral galaxies can be explained by the outward expulsion of matter from their centers. And this constancy generates their splendid spiral structure which can be a logarithmic spiral within certain conditions.

4. Dark Matter does not Exist in the Milky Way's Neighborhood

Kroupa et al. [16] show that "the shape of the observed distribution of the Milky Way (MW) satellites is inconsistent with their being drawn from a cosmological substructure population with a confidence level of 99.5 per cent. Most of the MW satellites therefore cannot be related to dark-matter dominated satellites".

5. The Lambda-CDM Cosmological Model Has too many Flaws

Kroupa [17] raises many important issues on the existence of dark matter and shows that the so-called Lambda-CDM cosmological model has too many flaws and thus does not describe reality at all.

6. Recent Null Results of Dark Matter

At the IDM2016, the LUX Collaboration reported null results for WIMPs [18]. It is important to emphasize that LUX sensitivity was pushed to a point which is four times better than that originally projected. This is a result for WIMPs masses of 50 GeV/c^2. The null results in the low mass region up to 2014 have been analyzed by Cerdeño [19] and Cline [20].

7. The Existing Baryonic Mass in Galaxies is Sufficient for Closing the Universe

The Universe is full of voids which are regions with much less galaxies than the regions surrounding the voids which are galaxy sheets and walls stretching up to many tens of megaparsecs. Over time as voids expand, matter gets squeezed in between them, and sheets, walls and filaments build the void boundaries [21]. El-Ad et al. [22] have reported an average diameter of about 57 Mpc (for h=0.7) for voids and Giovanelli [23] has reported that voids have an average density of only 1/10 of the overall average density. The mean density in walls and sheets is at least 3×10^{-28} kg/m^3 [24] which is much smaller than the so-called critical density given by

$$\rho_c = \frac{3H^2}{8\pi G} \tag{1}$$

which is equal to 10^{-26} kg/m^3 and is calculated considering that ρ_c is valid everywhere inside a homogeneous sphere of radius r and that Hubble's (H) constant has the same value everywhere inside the sphere, but Hubble's constant has different values for galaxies inside voids and is different from its value for galaxies in walls and sheets due to the peculiar velocities of galaxies. Therefore, ρ_c makes no sense because the expansion is not homogeneous on the scale of a void, and it is exactly the expansions of voids that concur to the whole expansion of the Universe. Such a calculation with a homogeneous and isotropic spherically symmetrical ρ and with a constant value for H only makes sense in the beginning of the Universe, and in this case, the density was much larger than its value in the local Universe. Since galaxies are attracted more and more to the sheets and walls, there is a steep increase in the density in the walls and sheets.

In the calculation below we take into account the fact that ρ is much larger in the void boundaries and consider a certain void of radius R surrounded by a wall of thickness Δt which is much smaller than R. Thus the total mass of the wall is about

$$M_W = 4\pi R^2 \Delta t \rho \tag{2}$$

where ρ is the density of matter in the wall (3×10^{-28} kg/m^3). Therefore, the potential energy of a galaxy of mass m in the wall is

$$E_p = -\frac{Gm4\pi R^2\Delta t}{R} = Gm4\pi R\Delta t \tag{3}$$

and thus the total energy of a galaxy in the wall is

$$E = \frac{1}{2}mv^2 - Gm4\pi R\rho\Delta t \tag{4}$$

in which v is the peculiar velocity of the galaxy in the wall. We have used Newtonian Mechanics because, of course, the gravitational field in the wall is weak. In order to have a closed Universe, E should be slightly less than zero, so that the limiting velocity, V, is

$$V = \left(\rho 8\pi G R_M \Delta t\right)^{1/2} \tag{5}$$

in which R_M the maximum radius that the void can attain in the future which is an unknown quantity, but we can calculate a lower bound for V by making $2R_M = 57$ Mpc. We take $\Delta t = 7.1$ Mpc [25] and obtain V= 313 km/s which is of the order of the peculiar velocities of galaxies in the local Universe. Tully et al. have reported that "galaxies bounding the Local Void have peculiar velocities +300 km/s" [26]. Let us have in mind that ρ may be much larger because galaxies may have large amounts of gases around them. Gupta et al. [27] have recently found a huge reservoir of hot gas around the Milky Way, a gas halo, extending to over a distance of 100 kpc. The cloud contains large amounts of hydrogen and oxygen. It is not known yet how far the cloud goes to and it may extend farther into the surrounding local group. This gas is probably leftover gas from the original gas cloud from which the Milky Way was born. Of course, all galaxies should also have gases around them. An indication of this is the hot gas seen in clusters [28].

There may also be many dwarf galaxies that have not yet been seen. In a very recent article from last November, Homma et al. [29] report the discovery of a faint satellite of the Milky Way. Therefore, V may be larger than 313 km/s, but still of the same order of magnitude. For example, if the density is doubled, than $V \approx 450$ km/s. Of course, larger values of ρ make E in Eq. 4 negative and, thus close the Universe. These numbers above may be indicating that galaxies in sheets may be reaching their largest velocities and that the Universe is beginning to close.

It is important to emphasize that other peculiar velocities have the same order of magnitude of the calculated peculiar velocity above. For example, The Milky Way is falling towards the Virgo cluster with a velocity of about 300 km/s and the Local Supercluster is falling towards the Hydra-Centaurus Supercluster with a velocity of about 500 km/s [28].

8. Conclusions

As shown above dark matter does not exist in the Universe and there is no need for it anyway, for closing the Universe. Besides the gases surrounding galaxies there may also be many dwarf galaxies which have not yet been accounted for. It is clearly shown that the peculiar velocities of galaxies in the local Universe have the same order of magnitude of the peculiar velocities of galaxies in the walls for closing the Universe. The simple calculation above indicates that the Universe may be beginning to close.

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