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Zwicky's Coma-Observation and MOND

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Abstract

Fritz Zwicky observed that the velocity dispersion of galaxies in the Coma galaxy-cluster appeared to be much too high to keep the galaxies together in a cluster. This conclusion was derived from the virial theorem by assuming that the interstellar gravitational force can be derived from a potential. At the time it was not recognized that this is an unjustified assumption, a fact that is still not properly appreciated nowadays. In this note we show that the Coma cluster actually stays together because pairs of stars in an inter-galactic arrangement attract each other essentially by a force decaying according to a 1/r law, where r is the distance of the pair. This type of behaviour has originally been proposed by Milgrom to account for galaxy rotation curves. For such a law there are no free bodies at all! Actually, there is already a crossover to this law within a single galaxy. Here, we show that a mechanism of counter-flowing massless gravitons and anti-gravitons leads to such a behaviour, namely when this interstellar mechanism starts to obtain competition from the acceleration processes provided by the direction-unspecific cosmic gravitational background radiation.

Keywords: Fritz zwicky; Coma cluster; Velocity dispersion; Virial theorem; Interstellar gravitational force, 1/r law; Milgrom

Introduction

Structure and action of the gravitational field

A gravitational field consists of a counter-flow of gravitons and anti-gravitons where flow is understood as energy flow of a massless field. This definition requires the acknowledgment of converging flow of anti-gravitons towards a body and gravitons towards an anti-body. If two bodies are (hypothetically) held at rest, there is no net kinetic-energy transfer between them [1-7].

The gravitons and anti-gravitons also produce the momentum transfer rate of the gravitational field. But here the contributions of the counter-flowing fields point in the same direction, yielding the full force between the bodies but in opposite (attractive) directions. As an aside, we mention that this view of the gravitational field contrasts with General Relativity (GR), the fundamental defect of which we have repeatedly pointed [8].

The basic process of gravitation is the simultaneous absorption of a graviton and emission of an anti- graviton by a massif body, e.g. a star. Simultaneity is required because of graviton conservation. For a massive antibody the corresponding process is simultaneous absorption of an anti-graviton and emission of a graviton.

We must distinguish two types of fields. Firstly, an omnipresent uniform background field (gravitons and anti-gravitons) that exists in all space and in all directions. Obviously, this background field must be in equilibrium with the corresponding 2.730 cosmic electromagnetic background radiation, because charges are always associated with massive particles.

The second type of gravitational fields is generated by the stars of galaxies. These fields are strong on the one hand but are very thin and selective in directional distribution. In other words, they cover only a tiny fraction of directions. This, because galaxies are essentially transparent; only a very small fraction of the directions towards a visible galaxy is covered by one of its stars. This is obvious when looking at our nearest greater galaxy, the Andromeda Galaxy (AG) which we will take as illustrative example in the following (see second-next paragraph).

Graviton dynamics

Now we must acknowledge that gravitons and anti-gravitons move in opposite direction such that, when emitter and acceptor move at different speed, Doppler-shift vectors for graviton and anti-graviton show essentially in opposite directions. If the speed difference would point precisely from one star to the other, this would pose no problem. At that point, we must give a detailed explanation what we mean here by precise, namely that the angular width, say β, under which the diameter of one star is seen from

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the others position must be at most of the order of their perpendicular speed difference, say w, measured in units of the speed of light. Now, a star has a diameter of about 5 light seconds while nearest star spacings (in the sun's neighborhood) are about 5 ly (light years). For this example we have a typical width $\beta\text{sun} = 6\times10^{-9}$, such that the limiting value for the perpendicular speed component is 2 m/sec, namely β times the speed of light. For larger values the observer can only be hit by one component, graviton or anti-graviton, the necessary partner, anti-graviton or graviton, must come from the unspecific background radiation or possibly from a different star.

In the centers of galaxies (central bulge) the star densities are about a factor 1000 higher than in the neighborhood of the sun which would yield typical average distances of 0.5 ly and correspondingly a typical star-width of nearest neighbors $\beta\text{bulge} = 6\times10^{-8}$. Correspondingly, the critical difference in perpendicular speed components of neighbors, v_{cb}, is ten times larger, i.e.

$$v_{cb} = 20\ \text{m/sec} \tag{1}$$

Stars in a galactic bulge have random velocities of about 150 km/sec, some 7000 times higher than this value. Thus, only a tiny fraction, φ, of about of all stars move sufficiently directly towards an elected bulge-star such that gravitons and anti- gravitons from one of them hit this elected star [9].

$$\varphi = 2 \times 10^{-8} \tag{2}$$

Now, within the bulge we have stars in all directions, each covering a fraction, σ, of about of the unit sphere.

$$\sigma = 0.5 \times \pi \times \beta\text{bulge } 2/(4\pi) = 4 \times 10^{-16} \tag{3}$$

Together with the above fractional value for a sufficiently low speed-difference, a coincidental hit by a graviton of a different star would have a probability of

$$p = \varphi \times \sigma \times N \tag{4}$$

where N is the number of stars in the galactic bulk.

Example, the Andromeda Galaxy (AG)

The Andromeda Galaxy, which "covers" a surface comparable to the sun is just about visible by eye under good viewing conditions (magnitude 3.4). However, we must appreciate that most of this radiation originates from AG's central bulge with an angular diameter about ten times smaller than that of the sun. Now, AG is about 30 magnitudes fainter than the sun (factor 10^{12}). Taking into account the 100 times smaller angular area of its central bulge, the surface brightness of its bulge is still about a factor of 10^{10} lower than the sun's.

Evaluating p (4) for this example with $N = 10^{10}$ bulge stars, we get a very small value of $p = 10^{-11}$ for the probability that graviton and anti-graviton originate from different stars. Differently stated, the stars of AG's central bulge cover such a tiny angular area that the small percentage of gravitons reflected with suitably small frequency shift does not allow for accidental coincidence of graviton and anti- graviton. Consequently, a reflected graviton always combines with a (on average direction independent) background anti-graviton and vice versa.

Obviously this must lead to inter-galactic stellar attraction by a law, decaying with distance like 1/r. This is precisely what Milgrom's Modified Newtonian Dynamics (MOND) proposes. Quite obviously, there can be no free stars or galaxies at all when they are hold back with an attractive force of this type [9-11].

Conclusions

Two stars of different galaxies in the Coma cluster attract each other with a force that decays according to a 1/r law. Thus, the energy needed to separate them diverges logarithmically with increasing final distance. This argument was unknown to Zwicky which lead him to assume that the Coma cluster would decay, essentially into single galaxies, unless there was an additional source of attraction.

Consequently, he postulated the existence of a non-visible substance, which he called "dark matter", to account for the missing attraction. We have shown here that there is no need for such a postulate.

Now, it also follows that matter and anti-matter must repel each other and must occur in exactly equal overall densities. Otherwise, the energy per galaxy would diverge with the size of the universe, and this the stronger, the greater the imbalance between matter and anti-matter! We have repeatedly pointed at the fact that the universe is populated by seemingly empty voids that cover about the same volume as galaxies and we postulate here once more that these voids are preferentially filled with antimatter-galaxies. The calculations presented here strongly support this view.

References

1. Zwicky F. Die rotverschiebung von extragalaktischen nebeln. Helv Phys Acta. 1933;6:110-27.

2. Paillet JL, Meulenberg A. Highly relativistic deep electrons and the Dirac equation. J Condens Matter Nucl Sci. 2020;33(1):278-95.
3. Milgrom M. A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis. Astrophys J.1983;270:365-70.
4. Gerber PR. Design GM. Mercury in a Quantum-Gravitational Field. J Phys Astron. 2023;11(4):333.
5. Gerber PR. On Representations of the Lorentz Group. Journal of Advances in Mathematics and Computer Science. 2023;38(7):76-82.
6. Gerber PR. Design GM. Static Fields as Mass-Currents and Mercury's Perihelion Shift. Gerber Mole Des.
7. Gerber PR. Physics with Negative Masses. Gerber Mole Des.
8. Gerber PR. Design GM. What's Wrong with General Relativity?
9. Solis AL. Contribution to the energy and time measurement of electrons and photons in the ATLAS experiment and search for dark matter production is association to a Higgs boson. 2017.
10. Gerber PR. “Black Holes” from a Viewpoint of Matter-Antimatter Repulsion.
11. Gerber PR. Design GM. Static Fields as Mass-Currents and Mercury's Perihelion Shift. Gerber Mole Des.