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SOME INTERESTING CONSEQUENCES FROM NEWTON'S MODIFIED EXPRESSION OF GRAVITATIONAL FORCE IN THE VECTOR MODEL FOR GRAVITATIONAL FIELD

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Abstract. *In this paper, based on the Vector model for gravitational field we show some interesting consequences from Newton's modified expression of gravitational force: dividing the space into regions around galaxies, maximal size of stable galaxies.*

I. INTRODUCTION

In the previous paper[1], we have obtained Newton's modified expression of gravitational force in the vector model for gravitational field. In this paper, we use the expression to deduce some interesting consequences: dividing the space into regions around galaxies, maximal size of stable galaxies.

II. NEWTON'S MODIFIED EXPRESSION OF GRAVITATIONAL FORCE AND CONSEQUENCES

II.1. Newton's modified expression of gravitational force

When noticing to the existence of the Universal energy(normal matter, dark matter and dark energy), we obtained Newton's modified expression of gravitational force between a galaxy with the gravitational mass M_g and a star with the gravitational mass m_{g1} as follows

$$F_g = -\frac{GM_g m_{g1} b}{r} sinbr - \frac{GM_g m_{g1}}{r^2} cosbr \tag{1}$$

We rewrite (1) in the following form

$$F_g = F_v + F_N \tag{2}$$

Here

$$F_v = -\frac{GM_g m_{g1} b}{r} sinbr \tag{3}$$

is called "the vacuum gravitational force"
and

$$F_N = -\frac{GM_g m_{g1}}{r^2} cosbr \tag{4}$$

is called "the Newtonian gravitational force".
The constant of b in the above formulas is evaluated about $b \approx 3 \times 10^{-21} m^{-1}$.

II.2. Consequences

1) Dividing the space into regions around galaxies

When the distance from the galaxy to the star increases, due to the correlation of the magnitude between F_v and F_N, the space region around the galaxy is divided into regions as follows

a. The Newtonian region

When $br \ll 1$ we have $sinbr \approx 0; cosbr \approx 1$ therefore $F_v \ll F_N$

We have

$$F_g = F_N = -\frac{GM_g m_{g1}}{r^2} \tag{5}$$

We return the classical Newtonian force of gravitation.

b. The dark matter region

When $br \approx \frac{\pi}{2} \pm \varepsilon$ we have $sinbr \approx 1; cosbr \approx 0$ therefore $F_v \gg F_N$

We have

$$F_g = F_v = -\frac{GM_g m_{g1} b}{r} \tag{6}$$

A star with the gravitational mass of m_{g1} moves in this region with a velocity of v satisfying

$$m_{i1}\frac{v^2}{r} = \frac{GM_g m_{g1} b}{r} \tag{7}$$

Due to the close proportion between the inertial and gravitational masses,i.e.$m_i/m_g \cong 1$, we have

$$v^2 = GM_g b \tag{8}$$

Thus, the velocity of the star is independent to the distance of r from the center of the galaxy. This explain simply the flatness of motion curves of galaxies.

c. The dark energy region

When $|cosbr| > brsinbr$ or $br > \pi$, the gravitational force of F_g becomes repulsive force. When a star or an other galaxy moves in this region, it is repulsed away and increases its velocity. We consider two close galaxies, if a galaxy is in dark energy region of other one, they repulse mutually and increase their velocities. **d. The far attractive region**

When br increases more, force of F_g becomes attractive force again. The attractive region is outside of the dark energy region.

2) The size of the first basic area

We call the basic area which includes four regions: the Newtonian region, the dark matter region, the dark energy region and the far attractive region. Now we evaluate the size of the basic area. The first basic area originates from $br = 0$ to $br = 2\pi$ i.e. $r \approx 2 \times 10^{21} m$.

The current size of the Universe is about $R \approx 143 \times 10^{24} m$, so each galaxy has about 7×10^4 the basic areas. The galaxy LMC is far away from us about $0.049 Mpc$.ie. about $r = 1.47 \times 10^{21} m$ and the galaxy SMC is far away from us about $0.058 Mpc$.ie. about $r = 1.74 \times 10^{21} m$, both are in the dark energy region of the first basic area. Therefore, we can find the increase of their velocities.

3) Maximal size of stable galaxies

We consider the first basic area of each stable galaxy. Because of dividing the space into regions, stars of this galaxy can locate only in the Newtonian region or the dark matter region, they can not locate in the dark energy region because they will be pushed away from the galaxy.
Thus, stars of the galaxy locate primarily in a region that its radius satisfies the following relation

$$br_{DM} \simeq \frac{\pi}{2} \Rightarrow r_{DM} \simeq 0.5236 \times 10^{21} m \tag{9}$$

(the distance to the center of dark matter region)
Thus, the radius of a stable galaxy must satisfy the relation

$$2R \leq 2r_{DM} = 1.0472 \times 10^{21} m \tag{10}$$

Astrophysical observations show that the diameter of most typical galaxies in the Universe are about 100000 light years i.e. $2R \approx 0.95 \times 10^{21} m$.[2]

III. CONCLUSION

In conclusion, based on the Vector model for gravitational field, we have deduced Newton's modified expression of gravitational force. From this expression we have deduced two interesting consequences: dividing the space into regions around galaxies and maximal size of a stable galaxy.

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