Effective mass of dark matter and dark energy

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Abstract—Theoretically, we discovered very unusual properties of the effective mass of dark matter and dark energy. If dark energy increases the effective mass, as is currently assumed, then dark matter reduces it. In the extreme case, the effective mass of an object can be zero and therefore can move at incredibly high speed, comparable to the speed of light.

In 1905, Einstein derived a law we still use today, based on one of the simplest yet most powerful equations ever written: $E = mc^2$. But at that time the existence of dark matter and dark energy was not yet known and therefore it was not directly included in the expression for energy, which depends only on the mass and speed of light. Recently, in work [1] the four-dimensional mass tensor M_{ik} was defined as:

$$M_{ik}=\begin{pmatrix} m & dm_1 & dm_2 & dm_3 \\ -dm_1 & m & -de_3 & de_2 \\ -dm_2 & de_3 & m & -de_1 \\ -dm_3 & -de_2 & de_1 & m \end{pmatrix}$$

where dm_1, dm_2, dm_3 are the components of dark matter, and de_1, de_2, de_3 are the components of dark energy. Now dark matter $dm_{1,2,3}$ and dark energy $de_{1,2,3}$ have a direct physical meaning: time mass $tm_{1,2,3}$ and space mass $sm_{1,2,3}$. Further, we will use terminology with a physical meaning. Covariant and contravariant four dimensional tensors of mass can be written in form:

$$M_{ik}=\begin{pmatrix} m & tm_1 & tm_2 & tm_3 \\ -tm_1 & m & -sm_3 & sm_2 \\ -tm_2 & sm_3 & m & -sm_1 \\ -tm_3 & -sm_2 & sm_1 & m \end{pmatrix},\quad M^{ik}=\begin{pmatrix} m & -tm_1 & -tm_2 & -tm_3 \\ tm_1 & m & -sm_3 & sm_2 \\ tm_2 & sm_3 & m & -sm_1 \\ tm_3 & -sm_2 & sm_1 & m \end{pmatrix} \tag{1}$$

We will write the dependence of energy and mass $E^2=m^2c^4$ using the mass tensor in the form: $E^2=\frac{1}{4}c^4 M_{ik}M^{ik}$. After summing over the indices *i* and *k*, we obtain the following expression:

$$E^2=\frac{c^4}{4}\left(4m^2-2tm_1^2-2tm_2^2-2tm_3^2+2sm_1^2+2sm_2^2+2sm_3^2\right) .$$

Let's enter the total time mass $tm^2=tm_1^2+tm_2^2+tm_3^2$ and the total space mass $sm^2=sm_1^2+sm_2^2+sm_3^2$, then the energy squared will be converted to the form:

$$E^2=c^4\left(m^2-\frac{1}{2}tm^2+\frac{1}{2}sm^2\right) \tag{2}$$

We define the effective mass as:

$$m_{eff}=\sqrt{m^2-\frac{1}{2}tm^2+\frac{1}{2}sm^2} \tag{3}$$

and we get the Einstein equation $E=m_{eff}c^2$. We highlight the main properties of the effective mass. Effective mass greater than or equal to zero, $m_{eff}\geq 0$. If time mass and space mass are equal to zero, the effective mass is equal to the normal mass, $m_{eff}=m$. Space mass increases the effective mass.

Time mass, on the contrary, reduces the effective mass. In the critical case, if $m^2+\frac{1}{2}sm^2=\frac{1}{2}tm^2$, the effective mass is zero, $m_{eff}=0$.

The last property leads us to a very interesting thought – UFO (Unidentified Flying Object). A UFO can calmly hang above the ground without moving, while it does not use any engines visible to us, but, as expected, it uses engines based on physical principles unknown to us. Let's imagine that a UFO can generate time mass tm and space mass sm, theoretically this is possible, since these masses are nothing more than derivatives of the four-dimensional potential A with respect to the components of the four-dimensional velocity u. Then if $m^2+\frac{1}{2}sm^2=\frac{1}{2}tm^2$, then the effective mass of the UFO is zero, therefore the gravitational field of the earth does not act on it and it can remain at rest above the earth's surface for as long as desired. If a small force is applied to a UFO with zero effective mass, it will quickly accelerate and move at a very high speed, reaching the speed of light.

At the end we will make brief conclusions in the terminology of dark matter dm and dark energy de. The effective mass of an object m_{eff} consisting of usual mass m, dark matter and dark energy is determined by the simple expression $m_{eff}=\sqrt{m^2-\frac{1}{2}dm^2+\frac{1}{2}de^2}$. If the quantity of dark matter satisfies the condition $dm^2=2m^2+de^2$, then the effective mass of the object becomes zero and, therefore, the object can move at the speed of light c.

REFERENCES

1. Yuri Mahotin, The Classical Theory of Dark Matter and Dark Energy, viXra:2211.0065, 2022.