Gravitational mass defect

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Abstract

The article describes the kinetics of transformation of energy in the collision of material bodies.

Let us examine one phenomenon, which refers straight to the case of liberating the large quantities of energy. Let us take the case, when trial body with the mass m falls on the very massive body with the mass M, whose radius is equal R (subsequently the body m and the body M). Let us assume that at the initial moment of time the distance between the bodies is very great and that is fulfilled the relationship $M \gg m$. Let us also consider that the density of the massive body ρ. The rate of the fall of the body m on the body surface M in this case can be found from the relationship:

$$v = \sqrt{\frac{2\gamma M}{R}}, \quad (1)$$

where γ - gravitational constant. If we switch over to substance density of massive body, then relationship (31.1) can be rewritten as follows:

$$v = 2R\sqrt{\frac{2\pi\gamma\rho}{R}}. \quad (2)$$

Is obvious that kinetic energy, which possesses the falling body, it obtained from the gravitational field of the body M. This kinetic energy of the falling body with its drop on the surface of massive body to become thermal energy will be radiated into the surrounding space in the form of electromagnetic waves.

From the aforesaid it is possible to conclude that the final summary mass of two bodies will not be equal to the sum of the masses of bodies prior to the beginning of the drop:

$$M_\Sigma \neq M + m,$$

i.e. there is a gravitational mass defect. The relationship of the honey M_Σ and $M + m$ can be found, knowing that kinetic energy, which possessed the body m with the drop on the body M. This energy can be calculated from the relationship

$$E_k = m_0 c^2 \left(\left(1 - \frac{v^2}{c^2} \right)^{-\frac{1}{2}} - 1 \right) .$$

During the record of this expression is taken into account the circumstance that with the fall of body in the gravitational field the acceleration of this body does not depend on its mass. Therefore relationships (1) and (2) are accurate even for the relativistic speeds. It is now not difficult to calculate gravitational mass defect.

$$\Delta m = \frac{E_k}{c^2} = m_0 \left(\left(1 - \frac{v^2}{c^2} \right)^{-\frac{1}{2}} - 1 \right) . \qquad (3)$$

This effect comprises with the drop on the earth's surface ~ $m \times 10^{-9}$.

From relationship (3) is evident that the addition Δm can be both less and it is more than m. If $\Delta m < m$, then with the fall of body summary mass increases. But if $\Delta m = m$, then an increase in the summary mass ceases, and entire mass of the falling body is converted into the thermal radiation. In this case massive body is converted into the ideal anvil, which converts entire mass of the falling body into the energy of electromagnetic radiation.

as can easily be seen of relationship (3), the rate of the fall of the body m (let us name this speed of critical) to the body surface M will be determined by the relationship

$$v_{кр} = \frac{c\sqrt{3}}{2} , \tag{4}$$

i.e. it is considerably less than the speed of light.

If the density of massive body is known, then, using relationships (2) and (4), it is not difficult to find a critical radius of this body:

$$R_{кр} = \frac{3c}{4\sqrt{2\pi\gamma\rho}}$$

By this concept we will understand the value of the radius, with reaching of which further increase in the mass of the body of M due to the fall on it of another body becomes impossible.

Can occur the situation for the space objects examined, for example for the neutron stars. It is known that the neutron stars (pulsars), have very high density [1]. So pulsar with a mass ~ 2×10^{30} kg (mass of the sun) would have a radius a total of near 10 km. Its density in this case would compose ~5×10^{17} kg/m^3. With this density a critical radius would comprise near 15 km ; and mass would compose ~ 3.4 of masses of the sun. This means that with reaching of such sizes and this mass the neutron star no longer can increase neither its sizes nor its mass, since any falling to it objects will be completely converted into the radiant energy.

According to preliminary calculations in our galaxy is counted about 300 thousand neutron stars [1]. What to happen, if neutron star does encounter the same neutron star as it itself? It is obvious that the complete annihilation of neutron substance and its transformation into the energy will occur. Taking neutron star with a critical radius 15 km of. and with the mass ~ 3.4 of masses of the sun, we obtain the value of energy 5×10^{47} J. This value of energy is very close to that energy, which characterizes explosion in the nucleus of galaxy NGC 3034 [1]. During this explosion from the nucleus of galaxy was rejected a huge quantity of material throughout its mass equal 59×10^{6} of the masses of the sun. This of phenomenon does not find its thus far explanation and are not known those energy sources, which can lead to so immense an explosion. The process of the collision of neutron stars examined can be precisely such source.

In its essence this explosion - this is the explosion of the nuclear charge of very large power. The isolation of such significant quantities of energy will be accompanied by warming-up and transformation into the plasma of large quantities of surrounding material. This in turn will lead to the appearance of the same electrical pour on as with the explosion of nuclear bomb, only much more significant. The presence of such pour on in the surrounding space they must lead to the appearance of specific polarization effects. To them can be attributed polarization in the electric fields of atoms and molecules and the appearance of the electric dipoles, which will lead to the polarization of the electromagnetic waves of those extending in the plasma.

1. Агекян Т. А. Звёзды, галактики, метагалактика. Изд. Наука, 1981. - 415 с.