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Some Considerations on the Process of Interaction of a Gamma Quantum with a Gravitational Field

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ABSTRACT

The founder of Extragalactic Astronomy, Edwin Hubble, believed that the red shift of light is due to the Doppler effect. Hubble's well-known dependence is based precisely on this effect. But the red shift of light causes not only the Doppler effect, but also the process of increasing the distance to the light source.

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Some considerations on p. 114 a simple description of the process of interaction of γ−gamma quantum with the gravitational field is given [1]. So let −quantum have energy E_γ, then it should be assigned mass $\Delta M = E_\gamma / c^2$ according to Einstein's formula. And let this quantum move upward from the surface of some cosmic body according to the opinion of an observer located on the surface of this object. Therefore γ quantum moving from bottom to top and reaching a height H in meters (against the forces of the gravitational field of this object) must lose energy equal to $\Delta M g_t H = E_\gamma g_t H / c^2$, where tg− is the acceleration of gravity on the surface of this body, which is equal to $g_t = \gamma_c \frac{M_t}{R_t^2}$, where $\gamma_c = 6.67 \times 10^{-11} meter^3 / kg \sec^2$ − is the gravitational constant, tM− the mass of the space body in kilograms and R_t−is the radius of the space body in meters. And according to the law of conservation of energy γ -a gamma quantum must lose energy $\Delta E_\gamma = E_\gamma g_t H / c^2$.

And since the energy of γ−quantum is inversely proportional to the wave length ($E = h\nu = hc/\lambda$, where h −is Planck's constant [h]= J x sec, symbol [] means dimension and λ - is the wave length, [λ]= meters) ,then the decrease in energy leads to a shift of the spectral lines towards longer wave lengths (the so-called red shift). But $\Delta E_\gamma = -\frac{hc}{\lambda^2}\Delta\lambda$ and therefore $\left|\frac{\Delta E_\gamma}{E_\gamma}\right| = \frac{\Delta\lambda}{\lambda}$.

Thus, the red shift near the surface of the cosmic body and, in particular, the Earth, is

$$\frac{\Delta\lambda}{\lambda} = \frac{gH}{c^2}. \qquad (1)$$

And this conclusion was confirmed experimentally. A negligibly small change in the energy of the γ −quantum was discovered by employees of Harvard University in a 23-meter tower using the Mössbauer effect. Let us repeat once again that formula (1) is suitable only for calculating the red shift directly near the surface of a cosmic body. At any distance from the cosmic body, this formula, in my opinion, should look like:

$$\frac{\Delta\lambda}{\lambda} = \gamma_c \frac{M_t}{R_t c^2}\sqrt{\frac{r}{R_t}}\ln\left(\frac{r}{R_t}\right), \quad r \ge R_t \qquad (2)$$

where all the designations have already been mentioned, with the exception of one r – the distance from the center of the cosmic body to the point of observation. Of course dissatisfaction that this formula is not derived from physical considerations, but has a phenomenological character. But on the other hand, the well-known Edvin Habbl'es formula has the same character. On the surface of the body, this expression vanishes. Let's write the expression

$f(r) = \alpha\sqrt{\frac{r}{R_t}}\ln(\frac{r}{R_t})$. Then $f'(r) = \frac{\alpha}{\sqrt{Rr}}(\frac{1}{2}\ln(\frac{r}{R_t})+1)$ and $f'(R) = \frac{\alpha}{R}$. For small values H = r – R we have $f(r) = f(R) + f'(R)(r-R) = \frac{\alpha}{R}(r-R) = \frac{\alpha}{R}H$, which for formula (2) gives $\frac{\Delta\lambda}{\lambda} = \gamma_c \frac{M_t}{R_t^2 c^2} H = \frac{g_t H}{c^2}$ and this is exactly the same as (1). Consider how formula (2) describes the red shift value for other space objects observed from the Earth

For the Sun

$$M_t = M_{sn} = 2\times 10^{30} kg; R_t = R_{sn} = 6.95\times 10^8 meter; r = 1.5\times 10^{11} meter.$$

As a result, we have

$$\frac{\Delta\lambda}{\lambda} = 1.675\times 10^{-4}. \qquad (3)$$

For the Sirius

$$M_t = M_{sn} = 4\times 10^{30} kg; R_t = R_{sn} = 1.19\times 10^9 meter; r = 8.1\times 10^{16} meter.$$

As a result, we have

$$\frac{\Delta\lambda}{\lambda} = 0.364. \tag{4}$$

For the Betelgeuse.

$$M_t = M_{sn} = 6\times10^{32}kg; R_t = R_{sn} = 2.09\times10^{11}meter;$$

$$r = 6.05\times10^{18}meter.$$

As a result, we have

$$\frac{\Delta\lambda}{\lambda} = 1.961. \tag{5}$$

For the One of the Quasars

$$M_t = M_{sn} = 4\times10^{39}kg; R_t = R_{sn} = 2\times10^{17}meter;$$

$$r = 1.23\times10^{26}meter.$$

As a result, we have

$$\frac{\Delta\lambda}{\lambda} = 7.413. \tag{6}$$

These results could be verified, but those organizations that lease the James Webb telescope have not been able to do so.

These figures qualitatively reflect the picture observed from the Earth. Despite this, such a number of checks is clearly not enough, and I urge interested readers to further and more thorough checks, for which the author of these lines has neither the means nor the opportunity. Let us pay attention to one more circumstance: formula (2) can be rewritten as follows

$$\frac{\Delta\lambda}{\lambda} = \frac{v_t^2}{2c^2}\sqrt{\frac{r}{R_t}}\ln(\frac{r}{R_t}), \quad r \geq R_t \tag{7}$$

Where $v_t = \sqrt{2g_tR_t}$ – the second cosmic velocity for a given body and, if this body is a black hole, then for it

$$\frac{\Delta\lambda}{\lambda} > \frac{1}{2}\sqrt{\frac{r}{R_t}}\ln(\frac{r}{R_t}), \quad r \geq R_t \tag{8}$$

which is a very large value, for example, it is believed that there is a black hole in the center of our galaxy, the radius of which is less than 1 light year, and the distance from the Earth to the center of our galaxy is 25,000 light years, then $\frac{\Delta\lambda}{\lambda} \geq 16,$, but such huge red shifts have never been seen anywhere. So something is wrong here.

Reference

1. Mukhin KN (1969) Entertaining nuclear physics. Energy publishing house: 311. (Russian language). http://becquerel.jinr.ru/text/books/K.N%20Mukhin%20Entertaining%20nuclear%20physics%201969.pdf