Burago Sergey G.

# On the nature of the engine thrust EmDrive

The draft article NASA about the controversial performance of engine EmDrive (1), which flowed In the Internet, caused a stir. This engine allegedly requires no fuel [1]. According to the experts of Eagleworks laboratory, the engine develops a thrust of 1.2 milliNewtons per kilowatt. And it works is probably using a vacuum energy. Should we believe this? (The big supporter of engine Phil Wilson (Phil Wilson) had published on this site of forum NASA post Spaceflight under the name The Traveller. However the moderators removed it, explaining that the article should be published by the American Institute of Aeronautics and Astronautics officially in December 2016. However, the site the Next Big Future has provided access to documents and diagrams, contained in them. It finally do its available to the public).

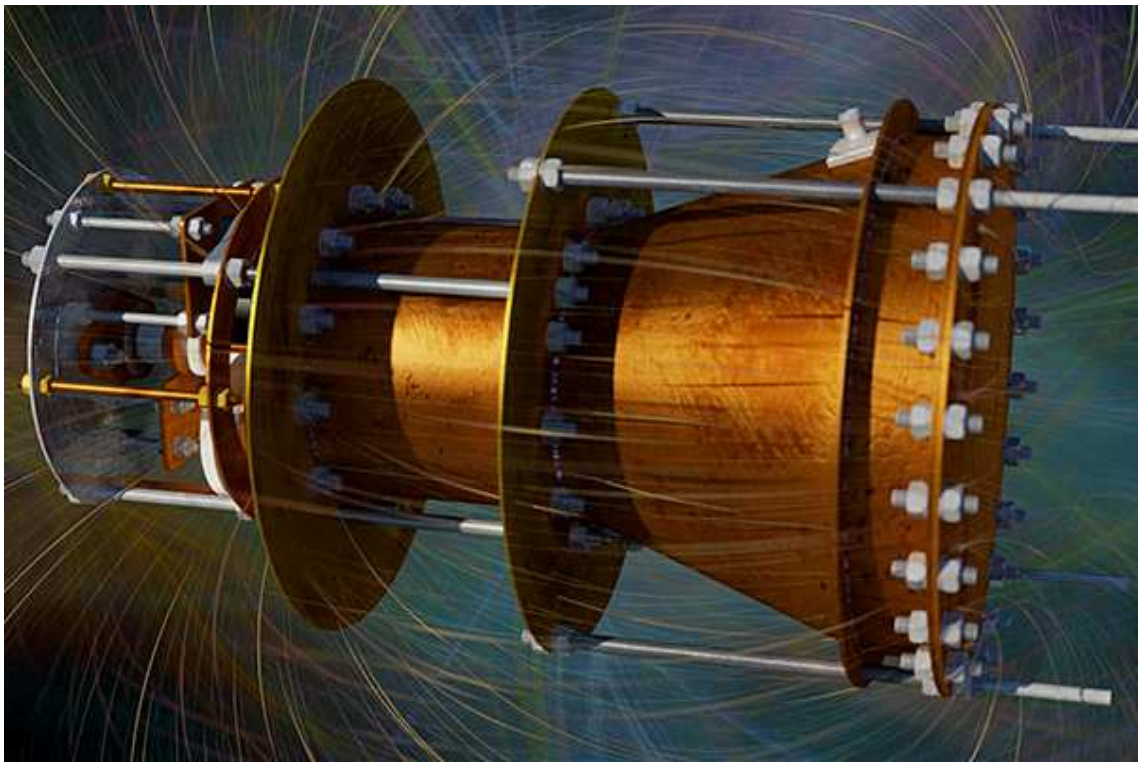

Fig.1

The NASA researchers have reported the successful repetition of the experiment conducted by the British engineer Roger Scheuer in 2006 year. He managed to create a rotary engine that produces no emissions, and to show that the device is subject to the laws of Newtonian mechanics. According to the developer, the device converts the electricity into microwaves. Their energy is stored in the resonator. A

little thrust of the engine is the result. Since then, scientists are struggling with the mystery EmDrive: if it works, and if so, why? After all, according to the law of conservation of momentum, the thrust is due of jet stream. In other words, in order to the object moved forward, it is necessary that from him something bounced in the opposite direction.

In the study used a torsion pendulum - aluminum construction, mounted on a slippery table in a vacuum chamber. Such a device is capable of measuring even very weak engine thrust. On one arm of the pendulum was EmDrive, and as a result it is a series of tests at 40, 60 and 80 watts power in 1.2 showed milliNewtons per kilowatt in vacuo. The tests did not reveal any unaccounted sources of motion, but experts have recognized the need for additional research to eliminate distortion from factors such as thermal expansion.

The last version of the engine was patented by its inventor Roger Scheuer at the end of October 2016. The new modification is characterized by the presence of superconducting plate.According to the scientist, this can reduce the relatively casual observer the change the frequency of the electromagnetic wave as it propagates in the engine cavity and thus increase the traction EmDrive.

The scientists, which are trying to understand the principles of operation of the engine, is believed that the law of conservation of momentum is maintained, but easy to explain it is quite difficult. So, Michael Makkalosh from the University of Plymouth (UK), admits the existence of photons with mass, and changing the speed of light inside the device. Another hypothesis suggests repayment of microwaves, resulting the pairs of photons is born and transfer momentum. This can happen only in the cone-shaped cavities.

Some scientists suggest the existence in the space around us of quantum vacuum environment that supports the acoustic oscillations, and that the components of any such medium is capable of exchanging by the momentum. So, you can to make a work into the vacuum and extract from it the energy that determines the performance of the engine. However, these assumptions are beyond the scope of modern concepts of physics, which is rejecting the presence of a continuous space of the gaseous medium, and are unlikely they may to convince other professionals.

Contrary to this view the article NASA states that the engineers have achieved a positive result. It is assumed that these engines can be used on spacecraft for interplanetary missions. Theoretically, the flight to Mars with this engine would only lasted ten weeks.

We also believe that modern physics, rejecting the existence in the space of continuous gaseous medium, itself creates its own problems.By this the physics impoverishes its tools to solve these problems. Author of this article has shown in his works [2,3,4,5,6], that the recognition by the physics of the presence in the surrounding space of a gaseous dark matter allows to reveal the nature of gravity, inertia, or differently to look at the nature of the "Big Bang" and many other mysterious phenomena in physics and astronomy. In these papers it was theoretically determined the physical parameters of the interstellar gaseous of dark matter. It is shown in particular that it has a density, a mass inertia interacts with ordinary baryonic matter and may exert force effect on a baryonic body.

Next, based on the ideas of [2,3,4,5,6], we will consider the nature of the forces thrust EmDrive from the standpoint of the theory of the interstellar gas of dark matter that fills all the space around us. For this we turn to Fig.2. If at some point O a small change in pressure occurs, then this the change will

spread further from the source O in the form of a spherical wave of compression or vacuum (weak perturbation) thanks to the elasticity of gas.

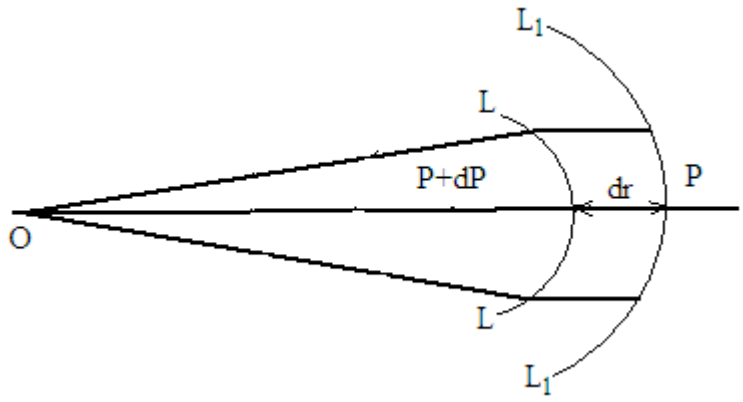


Fig.2

Assume that L is the position of the wave at time t, and $L_1$ is position at time t+dt. If the wave propagation speed of weak perturbation is equal to the speed of light in vacuum $C = 3 \cdot 10^8$ m/s, then the distance between L and $L_1$, is equal to $dr = C \cdot dt$. Assume further that $p_e + dp_e$ is pressure to the left of the line L, and p is pressure to the right of the line $L_1$, then the composition

$$dp_e \cdot \Delta s \cdot dt$$

will give us the momentum of pressure forces acting along the radius r on the considered column of gas during the time dt. Under the influence of this impulse the mass of column gas $dm = \rho_e^* \cdot \Delta s \cdot dr$, expressed in units of baryons [2], will get in the direction of radius r the speed dw and the corresponding the amount of the movement

$$dm \cdot dw = \rho_e^* \cdot \Delta s \cdot dr \cdot dw$$

Equating the pressure pulse forces to a change of momentum and taking into account that $dr = C \cdot dt$, after minor cuts we get

$$dp_e = \rho_e^* \cdot C \cdot dw,$$

from where the velocity of gaseous dark matter, induced by wave in the direction of its movement, will

$$dw = dp_e / \rho_e^* \cdot C.$$

where $C = 3 \cdot 10^8$ m/s - the speed of light (in a vacuum). The density of gaseous dark matter $\rho_e^* = 3{,}54 \cdot 10^{-9}$ kg/m$^3$ expressed in terms baryonic matter [2]. The density was obtained in [2]. The previous expression in the finite-difference can be written as

$$V_e = \Delta W = \frac{\Delta p_e}{\rho_e^* \cdot C}\ , \qquad (4.15.1)$$

The pressure force in one direction accelerates the gaseous particles of dark matter, and in the opposite direction the pressure force acts on the elements of engine design EmDrive and creates thrust force

$$F = \Delta p_e \cdot S \qquad (4.15.2)$$

As the area S we will take the area of the cross sectional nozzle engine EmDrive. In the absence of accurate data about the size of the engine we will take $S = 1\,\text{m}^2$. The force applied to the nozzle section of the engine is equal to the pressure multiplied by the cross-sectional area, which is equal to $S = 1m^2$. Of course, the pressure is not created by a single wave. As noted in [1], the motor unit continuously converts electricity into microwaves, their energy is stored in the resonator. The pressure of all the microwaves around the cross-section of the nozzle of the engine remains the same as in the case of a single wave. As a result of this pressure on the engine design elements is a slight force of the engine thrust.

This power (on 1 kilowatt) according to [1] is equal to

$$F = \Delta p_e \cdot S = 1{,}2 \cdot 10^{-3} \quad [\text{N}] \qquad (4.15.3)$$

From this the excess pressure behind the wave will

$$\Delta p_e = 1{,}2 \cdot 10^{-3} = 0{,}00012 \quad [\text{N/m}^2] \qquad (4.15.4)$$

According to the formula (4.15.1), we define the speed of the gaseous dark matter behind the wave

$$V_e = \frac{1{,}2 \cdot 10^{-3}}{3{,}54 \cdot 10^{-9} \cdot 3 \cdot 10^{8}} = 0{,}113 \cdot 10^{-2} = 0{,}00113 \ [\text{м/с}] \qquad (4.15.5)$$

These pressure and velocity gaseous dark matter after a wave is provide the emergence of the force acting on the engine nozzle section. (The value of this force was given by NASA considered in the article). These values of velocity, and force pressure are not large. But in [2] shown, that a small radial velocity gas streams of dark matter $V_r = 9{,}8$ m/s to the Center of the Earth creates the power of the Earth gravity.

If beforehand we would have known the value of the differential pressure □pe in the wake of weak disturbances, emitted by the engine device, wich converts electricity into microwaves, it would be possible to determine the speed of gaseous dark matter and traction of engine. It is unclear how, regardless of the NASA article about EmDrive engine to find the pressure drop and the speed of dark gaseous matter after wave, obtained in (4.15.4) and (4.15.5)? In [1] correctly notes that according to the law of conservation of momentum, the thrust is due to the jet stream. To object moved forward, it is necessary that from him something "bounced" in the opposite direction. The cork of mass of a gaseous of the dark matter, wich is moving behind the wave, "bounces" in this case. Under the influence of the

pressure inside the engine nozzle has local gas jet stream of dark matter. Thus, it is clear that the engine EmDrive can create traction, without violating the laws of physics.

The invention EmDrive engine from our point of view, is have more than the practical significance of the invention of a new economical propulsion. For physics, this is a great ideological breakthrough in the understanding of the world order, wich is opening the way to use the inexhaustible dark energy of the cosmos [2,3,4,5,6].

## Bibliography


1. https://lenta.ru/articles/2016/11/09/emdrive/
2. Burago S.G. Gravity, dark matter and dark energy balance. The General Science Journal. Astrophysics. 2014. April. Paper ISSN 1916-5382 pp. 20.
3. Burago S.G. The dynamics of the interstellar a dark matter. Working Paper. Apr 2016 DOI: 10.13140/RG.2.1.5058.6003
4. Burago S.G. The circulation of the interstellar dark matter. Working Paper. May 2016 DOI: 10.13140/RG.2.1.2068.8247
5. Burago S.G. The secrets of nature, caused by the propagation of light into the interstellar dark matter. Working Paper . Jun 2016 DOI: 10.13140/RG.2.1.1370.0727
6. Бураго С.Г. Космические объекты в океане межзвездной темной материи. ResearchGate. Working Paper Oct 2016 DOI: 10.13140/RG.2.2.16857.52327
7. С.Э.Фриш и А.В.Тиморевой Курс общей физики Том 3. М: Физматгиз 1961.



Сергей Г. Бураго

D.Sc., Prof.

State University of Aerospace Technology, Moscow, Russia

**Email**: buragosg@yandex.ru

**Site**: http://buragosg.narod.ru/