Dark Matter Gravity Waves Propel the EM Drive

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Abstract

In this article it is shown that it is possible to explain the thrust generated by the EM Drive as a reaction force of emitted gravitational waves. This eliminates the controversy that surrounds the experiments performed with this device showing positive results that seemingly violate the Newton's third law of action and reaction.

Keywords: EM Drive, Hubble constant, dark matter mass density, dark matter mass quantum, Cosmic Microwave Background Radiation temperature, finite space model of the universe

1. Introduction

There have been many publications and presentations in conferences related to this topic. The device was invented by Roger Shawyer (Patent GB2229865) and a detailed description of most recent version can be found for example in a paper by (Shawyer, 2015) and in another on line publication by (Shawyer, 2009) that also includes numerous additional references. Since the device invention there were many theories and test results published that have been trying to explain the effect (Fetta, 2014) including NASA (NASA). However, the controversy remains, which is due to the fact that all the presented theories violate the Newton's third law. The typical claim is that there is a force propelling the device without expelling any propellant that would represent the reaction force. In this paper it is proposed that there are gravitational waves generated in the device that fulfill this requirement.

2. Theory

The author of this paper has established in previous publications (Hynecek, 2013a) and in several others that the universe we are living in is finite in size and filled with a material entity called Dark Matter (DM), which is transparent and has a mass density m_0. This DM supports the propagation of light as transversal electromagnetic (EM) waves and the propagation of gravity as the longitudinal waves, both with the same velocity c when measured away from gravitating bodies. The DM model of the universe thus assumes that the DM is deformable and that both the electromagnetic field and the gravitational field are essentially the deformations of this DM.

From this assertion it is thus easy to understand how the propelling force might be generated. The key problem, however, is that the EM waves are transversal and the gravitational waves are longitudinal. It is thus necessary to somehow convert or generate from the transversal EM field the longitudinal EM field that would couple to

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gravitational waves. This conversion cannot happen by itself or simply by shaping the EM field in various ways, it is necessary to include an intermediate material particle that would couple to both fields and this obviously is the particle of DM. The simplified device model that will be analyzed and used for the derivation of force equation for the EM Drive is shown in Fig.1.
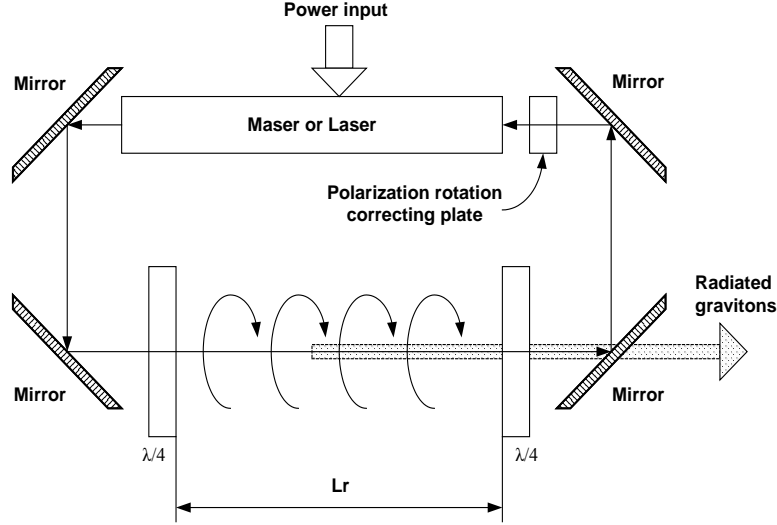

Fig.1 The linearly polarized EM wave resonator is excited by a Laser or a Maser. In the space between the quarter wavelength plates the linear EM wave (photons) is transformed into a circularly polarized EM wave that causes the DM particles to vibrate in a longitudinal direction thereby exciting the gravitational waves (gravitons).

The key point indicated in Fig.1 is the interplay between the circularly polarized and the linearly polarized EM waves. The linearly polarized EM waves do not generate the gravitational waves in the direction of their propagation and therefore can be sent back to the Laser without reduction of thrust.

3. The thrust formula derivation

In the previous publication (Hynecek, 2014b) has derived the relation between the DM mass density m_0 and the Hubble constant H_0 according to the formula:

$$H_0 = \sqrt{\frac{8}{3} \pi \, \kappa \, m_0} \tag{1}$$

where κ is the gravitational constant. The paper has also presented the derivation and the final formula for the fundamental DM mass quantum $m_{q\lambda}$ as follows:

$$m_{q\lambda} = \sqrt[4]{\frac{3}{8} \frac{h^3}{c^3} m_0} \tag{2}$$

The DM mass density can also be expressed in terms of the cosmic microwave background radiation (CMBR) temperature T_0 as:

$$m_0 = \frac{8}{3} \frac{c^3}{h^3} \left(\frac{k_B T_0}{c^2 g_{tt}} \right)^4 \tag{3}$$

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where k_B is the Boltzmann constant, c the vacuum speed of light, and $g_{tt} = 0.030586$ is the time coordinate metric coefficient evaluated at the boundary region of the finite size universe. By substituting this value into Equation 2 the DM mass quantum becomes equal to:

$$m_{q\lambda} = \frac{k_B T_0}{g_{tt} c^2} \tag{4}$$

and its momentum that is transferred to gravitons that propagate with the velocity c equal to:

$$m_{q\lambda} c = \frac{k_B T_0}{g_{tt} c} \tag{5}$$

It will now be assumed that the circularly polarized photons transfer their linear momentum to the DM mass quanta and the mass quanta then transfer their momentum to gravitons. The gravitons are considered massless particles similar to photons but with the zero spin. It will also be assumed that a single photon upon its completion of one circular motion will generate the graviton with a probability ξ. The formula for the force generated by the photon power P_w is well known and is equal to:

$$F_p = \frac{P_w}{c} \tag{6}$$

The number of completed circles of the circularly polarized photon n_α is obtained by dividing the resonator length L_r where the EM waves with the circular polarization propagate by the EM radiation wavelength λ:

$$n_\alpha = \frac{L_r}{\lambda} \tag{7}$$

The number of photons per second that flow in the resonator section with the length L_r is then equal to:

$$n_p = \frac{P_w}{h\nu} \tag{8}$$

where h is the Planck constant. It is then simple to see that the formula for the graviton force that is balancing the force transferred from the photons to the dark matter quanta and then to gravitons will be:

$$F_g = \xi \frac{P_w}{h\nu} \frac{L_r}{\lambda} \frac{k_B T_0}{g_{tt} c} = \frac{\xi k_B T_0 L_r}{g_{tt} h c} F_p \tag{9}$$

In this formula it was also used the well-known relation between the photon wavelength and its frequency:

$$\nu = \frac{c}{\lambda} \tag{10}$$

It is important to realize that the DM mass itself is quantized while the photon mass depends on frequency.

4. Another method of formula derivation

It is also possible to derive the formula in Equation 10 in another way where the conservation of momentum between the photon and the DM particle is explicitly shown.

The reaction force of DM particles caused by the impinging photons can be expressed as follows:

$$F_d = \frac{P_w}{v_d} \tag{11}$$

where v_d would be the DM particle velocity if no gravitons were emitted. The virtual velocity of the DM particle is obtained from the conservation of linear momentum between the photon and the DM particle assuming that the collision is inelastic and the mass of photon is much smaller than the mass of the DM particle. The following momentum conservation relation thus must hold:

$$h\nu / c = m_{q\lambda} v_d \tag{12}$$

Including now the efficiency of the graviton generation ξ_λ normalized to a photon wavelength:

$$\xi_\lambda = \frac{\xi L_r}{\lambda} \tag{13}$$

the graviton force that compensates the photon force acting on the DM particles, which is eventually transferred to the mass of the resonator through the DM-visible matter interaction becomes:

$$F_g = \xi \frac{L_r}{\lambda} \frac{P_w m_{q\lambda} c}{h\nu} = \frac{\xi k_B T_0 L_r}{g_{tt} h\, c} F_p \tag{14}$$

It is interesting to find from this result that the force is independent of the RF frequency and that it depends only on the resonator length. However, the factor ξ may also depend on the resonator length but in an inverse proportion relationship, so it would be worthwhile to conduct experiments to determine this dependency.

5.   Comparisons with experiments

There have been several experiments carried out to detect and measure the EM Drive force with different results. However, it is difficult to judge the value of the probability factor ξ for each experiment and if any circularly polarized photons can actually be generated in the given apparatus. It is also difficult to judge from the pictures of the apparatus how long the resonator cavity is. The data for the comparison were taken from the paper by Brady (Brady et.al. 2014) where the power used was 16.92W and the measured force was 91.2μN.

6.   Calculation details of the EM Drive force

The Mathcad 15 symbolic program was used for a quick calculation and it seems that the result agrees quite well with the measurement. The values of the fundamental constants were obtained from the NIST (CODATA) reference.

h	Planck constant	$h := 6.62606896 \cdot 10^{-34}\,\mathrm{J \cdot sec}$ $gtt := 0.030586$
c	velocity of light constant	
kb	Boltzmann constant	$c := 2.99792458 \cdot 10^{8}\,\mathrm{m \cdot s^{-1}}$ $Lr := 0.75 \cdot \mathrm{m}$
To	CMBR temperature	
Lr	resonator length	$kb := 1.3803806504 \cdot 10^{-23}\,\dfrac{\mathrm{J}}{\mathrm{K}}$ $\xi := 0.348$
Pw	RF power	$To := 2.72548 \cdot \mathrm{K}$ $Pw := 16.92 \cdot \mathrm{W}$
Fp	photon force	
Fg	graviton force	$Fp := \dfrac{Pw}{c}$ $Fp = 5.643904 \times 10^{-8}\,\mathrm{N}$
gtt	time metric coefficient	
η	graviton efficiency factor	$Fg := \dfrac{\xi \cdot kb \cdot To \cdot Lr}{gtt \cdot h \cdot c} \cdot Fp$ $Fg = 9.121425 \times 10^{-5}\,\mathrm{N}$
ξ	coupling coefficient	
		$\eta := \dfrac{\xi \cdot kb \cdot To \cdot Lr}{gtt \cdot h \cdot c}$ $\eta = 1616.155078$

7. Conclusions

The paper presented a possible explanation of the EM Drive operation without violating the Newton's third law, momentum conservation law, and the energy conservation law. A simple formula was derived for the force based on the assumption that the propellant that actually drives the EM Drive is the flow of emitted gravitons. The formula was used to calculate the expected value of force, which was then compared with the value obtained from the experiment. An excellent agreement was obtained. It is interesting to compare the force generated by only the photons to the force generated by gravitons. From this comparison it is clear that the gravitons generate much more force than the photons for the same amount of input power.

The significance of this derivation and its agreement with the measurement is not only the possible explanation of the EM Drive operation but also the terrestrial confirmation of existence of the DM including the correctness of the finite size model of the universe from which the DM formulas were obtained. More information written on this topic can be found at (Hynecek, 2015).

References

Shawyer, R. (2009) http://www.emdrive.com/

Fetta, G.P. (2014) http://arc.aiaa.org/doi/abs/10.2514/6.2014-3853

Shawyer, R. (2015) http://www.emdrive.com/IAC14publishedpaper.pdf

NASA http://gravitymodification.com/nasa-tests-emdrive-propellantless-propulsion/

Hynecek, J. (2013a) http://ccsenet.org/journal/index.php/apr/search (enter search term Hynecek)

Hynecek, J. (2013b) http://www.ccsenet.org/journal/index.php/apr/article/view/21114

Brady, D.A., White, H. G. March, P., Lawrence J. T., Davies F. D. (2014) http://www.libertariannews.org/wp-content/uploads/2014/07/AnomalousThrustProductionFromanRFTestDevice-BradyEtAl.pdf

NIST (CODATA) http://physics.nist.gov/cuu/Constants/

Hynecek, J. (2015) http://vixra.org/author/jaroslav_hynecek