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NASA EM Drive via E-Infinity Cantorian-Fractal Space-Time Theory

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ABSTRACT

We give a condensed account for NASA's revolutionary spacecraft proposal and its theoretical justification by E-infinity theory. It is argued that the energy density gradient between cosmic ordinary energy density of the quantum particle of the universe and the cosmic dark energy density of the Hartle-Hawking wave function can produce sufficient thrust to make the EM drive proposal possible and feasible. This conclusion was recently reinforced by the Egyptian engineering scientist and theoretical physicist, M.S. El Naschie, who invoked a celebrated measure theoretical theorem due to the outstanding Israeli mathematician I. Dvoretzky. The hot topic of EM drive invited a great deal of claims and counter claims [1-6] connected mainly to the conservation of momentum [3]. The present short Letter demonstrates that EM is consistent with the accepted principles of modern quantum cosmology and does not violate Newton's third law of classical mechanics.

Keywords:*EM drive, Interstellar flight, Vacuum energy, Dark energy, Cantorian space-time, Hartle-Hawking wave function of the cosmos, Cantorian plasma, Quantum cosmology, Casimir-dark energy nano-reactor.*

INTRODUCTION

In the present short Letter we follow El Naschie in advancing the thesis that EM drive is in principle not only possible but more than that. To show that nothing is simpler than appealing to the Hartle-Hawking universe wave function theory as used in a few recent publications by El Naschie concerned with ordinary cosmic energy density and dark cosmic energy density [4-29]. The first, in the meantime well known, is the energy density of the quantum particle which amounts to 4.5% of the total while the rest of 95.5% is related to the quantum wave side of the universe [10,11]. This gradient is sufficient to support a fuelless EM drive enabling interstellar navigation from anywhere to infinity. In fact we need an engine for navigation only, the thrust comes naturally from the local form of one sided Casimir effect of space-time as discussed sometime ago by El Naschie [11-13]. There is a simple picture associated with the energy density gradient from 4.5% to 95.5% which we will attempt to explain in what follows in general terms while detailed mathematical equations are given in the Appendix [4,11,13]. This picture is based on the quantum E-infinity fact that the quantum wave surrounds and guides the quantum particle [7-29]. Applying all that to the entire universe we see that a point inside the universe could be thought of as 4.5% quantum particle energy density location while any point at the hyperbolic horizon and the holographic boundary of the universe may be regarded as the 95.5% quantum wave energy density [4,7,11]. The same idea is expressed in a different language when one invokes Dvoretzky's theorem as done by El Naschie and reason that 95.5% of the volume of the higher dimensional (i.e. a five dimensional Kaluza-Klein space-time) universe of our real existence lies at a thin layer of the surface [12,13]. Consequently one expects that any spacecraft will be pulled from any point of the interior of the universe towards the hyperbolic boundary of the universe so that a skilful navigation technique could get it from anywhere to any destination and practically without fuel except for navigation. This conclusion is reinforced completely by Dvoretzky's theorem [12,13]. That is essentially all that we need for the theoretical justification of EM drive. We stress once more that El Naschie's theory goes as far as saying that the thrust is inbuilt into the geometry and topology of the five dimensional vacuum of a fractal space-time so that the motion of the spacecraft is in principle possible with or without an engine. In his formal and

informal talks he stresses that solving the main theoretical problem is probably 1% of the difficulties. The rest of the 99% is engineering. We note on passing and in very general terms that dark energy, Hawking vacuum fluctuation, Casimir force and the like differ only with regard to boundary conditions [8]. In other words, the present theory for interstellar flight is a relative of El Naschie's theory for a Casimir-dark energy nano energy reactor [14,15]. For details of the exact calculation of dark matter energy and pure dark energy, the reader may consider Fig. 1 of Ref. 5 as well as the references contained therein. Finally by invoking the self-similarity of Cantorian-fractal space-time one can apply the same reasoning to the EM drive devise itself so that the spacecraft is really subjected to global and local thrust.

CONCLUSION

The quantum topology of the universe makes it inevitable that it must be made up of two parts (a) a low density interior with 4.5% energy density and (b) a high energy density surface with 95.5% of the total energy. El Naschie stressed that this gradient is what makes fuelless interstellar journeys possible so that we can state without any doubt that in principle EM drive is science and not science fiction. On the other hand any ordinary EM engine can be used because it is needed for navigation only. However to enhance the local cosmic thrust El Naschie proposed that it may be possible to design an EM drive which does exactly that but this is another major engineering problem which is not the main concern of the present paper. It seems to us however that we have just seen the tip of the quantum vacuum iceberg and that the future will hold many more astonishing applications of the Aether. The details of the present calculations are given in the Appendix.

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APPENDIX

This Appendix is intended to quantify the picture described in the main body of the present Letter. Following El Naschie, there are various spacetime theories which can be used to compute the three sectors of cosmic energy densities, namely the ordinary energy, the dark matter energy and the pure dark energy density. We will opt here to use the fractal Kaluza-Klein theory of El Naschie with the remarkable Hausdorff dimension [19,24]

$$\begin{aligned} D &= 5+\cfrac{1}{4+\cfrac{1}{4.....}} \\ &= 5+\phi^3 \\ &= 5.236067977 \end{aligned} \tag{1}$$

Next we adopt El Naschie's interpretation of Einstein's E = mc^2 as being the maximal possible energy density when we set $k=1$ into Nikolay Umov's equation [20,29]

$$\begin{aligned} E &= kmc^2 \\ &= mc^2 \\ &= E(\max) \end{aligned} \tag{2}$$

On the other hand $k=1$ may be interpreted as [22,24,29]

$$\begin{aligned} k &= \frac{5+\phi^3}{5+\phi^3} \\ &= 1 \end{aligned} \tag{3}$$

while the exact ordinary energy density was shown by El Naschie to be given by

$$\begin{aligned} k &= \gamma(O) \\ &= \phi^3 \Big/ \left(5+\phi^3\right) \\ &\cong 4.50849\% \end{aligned} \tag{4}$$

in full agreement with previous results apart from the remarkable proximity to cosmic measurements and observations [20-29]. The preceding result naturally suggests that $5+\phi^3-\phi^3=5$ may be decomposed into a one

dimensional string plus four dimensional Einstein space which will lead to the exact corresponding energy densities provided. We take care of the Cantorian Unruh radiation ϕ^4 and a coupling term $\Delta = 0.161377$ which will turn out to play a fundamental role in the theoretical justification of NASA's EM drive proposal [30,31]. Proceeding in this manner we see that

$$k = \frac{4 + 1 + \phi^3}{5 + \phi^3} \tag{5}$$

leads to $k_1 = \phi^3 / \left(5 + \phi^3\right)$ as given by equation (4) while we have two more similar terms given by

$$\begin{aligned} k_2 &= \left(1 + \phi^4 + \Delta\right) / \left(5 + \phi^3\right) \\ &= 0.2218 \\ &= 22.18\% \end{aligned} \tag{6}$$

And

$$\begin{aligned} k_3 &= \left(4 - \phi^4 - \Delta\right) / \left(5 + \phi^3\right) \\ &= 0.73311 \\ &= 73.311\% \end{aligned} \tag{7}$$

The idea is now quite clear since the sum of k_i is unity and the Unruh term as well as Δ cancels out

$$\sum_{i=1}^{i=3} k_i = 1 \tag{8}$$

There is a remarkable picture not entirely obvious immediately implicit in the preceding analysis, namely that Δ like ϕ^4 has the potential of being interpreted physically as Hawking radiation, similar to the ϕ^4 Unruh temperature. In fact it is straight forward simple computation to show that [19,20,24]

$$\Delta = k - \frac{\left[\frac{\left(8 + k^2\right)}{100}\right]}{4 + \phi^3} =$$

$$= k - 0.01896221225 \tag{9}$$

where k is 'tHooft'srenormalon and $1/\phi^3 = 4 + \phi^3$ is the Hausdorff dimension of the core of El Naschie's E-infinity Cantorian space-time [24,27]. Clearly it is $\pm\Delta$ and $\pm\phi^4$ that creates the action and reaction, which produces the forces acting on the EM drive devise. In fact due to the self similarity of the fractal-Cantorian space-time of our actual universe [16-26], the preceding analysis applies in the large, i.e. by taking our entire universe into account as well as on the much smaller scale taking only the EM drive and the spacecraft and its immediate surroundings into account as we stress in the main body of the present Letter. In other words, the spacecraft is not simply a photon rocket for that would be an extremel weak force to push forward a large spacecraft. The strongest thrust acting on the spacecraft is coming from the gradient produced from the density difference between the ordinary energy density of the bulk and the dark energy density of the holographic boundary at the surface of the space-time manifold [31].