Can Nano-Materials Push Off the Vacuum?

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The theory of quantised inertia (QI), which predicts galaxy rotation without dark matter, also predicts that electromagnetic energy input into an asymmetric cavity perceives a gradient in the quantum vacuum in the cavity producing a force on that cavity. Here it is shown that if the cavity is less than 129 nm in scale, then no input power is needed and the predicted thrust can be comparable to gravity. Arrays of these nano-cavities could produce a self-thrusting material.

1 Introduction

Many astrophysical observations show that stars at the outer edges of galaxies orbit far too fast to be gravitationally bound to the galaxy [1, 2] and an identical phenomenon is observed for globular clusters [3] and wide binaries [4]. On a much smaller scale, some laboratory experiments have shown that asymmetric metal cavities of various types with strong electromagnetic fields resonating within them (emdrives) show an unexpected thrust towards their narrower ends [5, 6].

All these phenomena can be predicted by a theory called quantised inertia, which assumes that the inertial force arises because the Rindler horizon that objects see when they accelerate damps the excited zero point field (Unruh radiation) behind them creating an imbalance which pushes them back against their original acceleration [7, 8]. This model successfully predicts galaxy and wide binary rotations without any adjustment [9, 10]. Quantised inertia also predicts that an artificial horizon can be produced when high acceleration matter or electromagnetic radiation is confined inside an asymmetric cavity, producing a new kind of thrust [11, 12] that may already have been seen in the emdrive. It was pointed out by [13] that using light and supermirrors to contain it, might enhance this force.

It is shown here that QI also predicts that if the asymmetric metal cavities are as small as 129 nm then a thrust comparable to gravity can be obtained even from the unexcited zero point field. This implies that if a material was constructed with arrays of asymmetric nano-cavities, then the force would be enough to levitate that material.

2 Method & result

We start with Heisenberg's uncertainty principle for a single photon inside a double-cavity that has a wide part and a narrow part (see Figure 1). A photon oscillates repeatedly along a distance d between the wide and narrow cavities as shown by the arrow. The uncertainty principle states that the uncertainty in momentum (Δp) and position (Δx) of the photon in each cavity is

$$\Delta p \Delta x \geq \hbar/2\,. \tag{1}$$

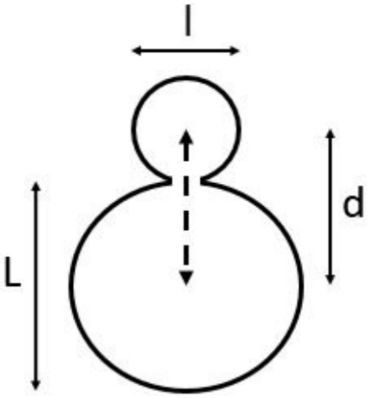

Fig. 1: The asymmetrical metal cavity. A photon moves back and forth along the dashed arrow.

The uncertainty in position is assumed, in quantised inertia, to be the size of the cavity the photon is in. [14, 15] pointed out that Heisenberg's original form for the uncertainty principle intended an equal sign, not an inequality so that in the wide cavity we can write

$$\Delta p_w = \frac{\hbar}{2L} \tag{2}$$

and for the narrow cavity

$$\Delta p_n = \frac{\hbar}{2l}\,. \tag{3}$$

The force is the change of momentum with time

$$F = \frac{\Delta p}{\Delta t} = \frac{c(\Delta p_n - \Delta p_w)}{d} = \frac{\hbar c}{2\left(\frac{L}{2} + \frac{l}{2}\right)} \left(\frac{1}{l} - \frac{1}{L}\right). \tag{4}$$

If we assume that the width of the smaller cavity is half that of the larger ($l = L/2$) then

$$F = ma = \frac{2\hbar c}{3L^2}\,. \tag{5}$$

The mass of the cavity, assuming it is two hollow spheres, is $m = 5\pi L^2 \rho\delta/4$ where ρ is the density of the metal walls and δ is their thickness. So

$$L^2 = \frac{2\hbar c}{3ma} = \frac{8\hbar c}{15\pi L^2 \rho\delta a}\,. \tag{6}$$

Rearranging, we can now calculate the size of cavity at which the energy solely from the zero point field ($\hbar$) is enough to produce acceleration a

$$L = \sqrt[4]{\frac{8\hbar c}{15\pi\rho\delta a}}\,. \tag{7}$$

Assuming that the density of the metal is 2000 kg/m^3, its thickness is 1 mm and the acceleration to be overcome is that of gravity at the Earth's surface, $g = 9.8$ m/s^2, then we get

$$L = 129\,\mathrm{nm}\,. \tag{8}$$

The implication is that if we build an asymmetric metal cavity such as that shown in Figure 1, with its narrow end upwards and on a scale of 129 nm or less, then it should levitate simply from the already-present zero point field without any input power.

3 Discussion

It follows from the above that if a material can be manufactured that is composed of an array of asymmetric nanostructures of size 129 nm or less then the material will levitate without input power.

One difficulty will be that, on the nanoscales considered here, other thermal or plasmonic effects will become important so the effectiveness of this approach will be dependent on these other effects cancelling out.

4 Conclusions

Quantised inertia predicts that asymmetric metal cavities make a gradient in the quantum vacuum, causing thrust.

The smaller the cavity, the larger the predicted thrust. At scales of 129 nm, the thrust equals gravity at the Earth's surface.

If a material can be constructed with arrays of such asymmetric nano-cavities then it should levitate without input power.

Acknowledgements

Thank you to M. Fiddy and J. Lucio for useful discussions and to DARPA grant HR001118C0125.

Submitted on May 20, 2020

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