Torque Generator by Casimir Conversion

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Abstract. Potential application of special surface geometries to generate a horizontal Casimir force component parallel to the overall surface. Proper alignment of surfaces with these geometries generates an angled force component that can be reduced to the horizontal force alone (the Casimir force component parallel to the overall surface) by an additional external force. Configurations are based on a pair of straight and parallel surfaces with such geometries that the geometry of one is a mirror image of the other with respect to an axis perpendicular to their overall surfaces. Both surfaces face each other with the aforementioned mirrored geometric structures. For example, by appropriately placing such surfaces on the bases of two rollers, which are directed towards each other with their bases and separated by a vacuum (also in the surrounding space), it is possible to obtain a controlled torque of these rollers, whereby they rotate in opposite directions. The presence of a vacuum eliminates friction between the elements and the air and avoids weakening the Casimir force. This makes it possible to use the Casimir force as a source of mechanical energy and, in the example discussed, as a source of torque that can be converted into useful energy.

1. Introduction

In recent times, human civilization has dramatically increased its demand for energy. Conventional sources, while still dominant, are an exhaustible resource. There are, of course, well-known alternatives, namely nuclear power or future fusion reactors, which in time will become operational on an industrial scale. These are as viable solutions as possible, but they come with certain limitations, e.g. the large size of the infrastructure, the need to exploit natural resources that will also run out sooner or later, etc. Because of these limitations, it is worth looking for other potential energy sources that can solve these problems.

One possible alternative approach is to use the quantum phenomenon known as the Casimir effect. In this paper, I present the concept of converting this effect into useful mechanical energy.

2. Physical phenomenon

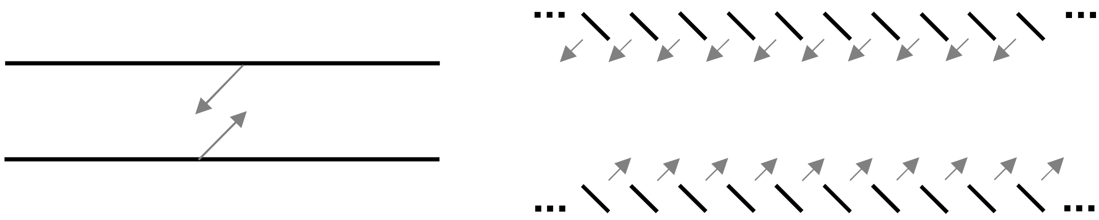
The Casimir effect [1] in its simplest form consists of two perfectly conductive, electrically neutral, parallel plates in a vacuum limiting the number of possible electromagnetic field states in the space between them. This causes a difference in vacuum energy between the internal and external space, resulting in a force that attracts the plates to each other. In practice, using this simple example of the Casimir effect, it is possible to develop a method for creating special surfaces which, when positioned correctly in relation to each other, can become a source of useful mechanical energy through the conversion of vacuum energy.

The Casimir effect is a well-established physical phenomenon, supported by many years of theoretical research and a series of precise experiments conducted on a nano- and micrometric scale, ranging from the work of H. B. G. Casimir (1948) [1] to modern measurements using atomic force microscopy and torsion resonators [2–6].

3. Method for creating geometry with conversion potential

Geometries capable of generating convertible force are relatively simple, and the example with two plates is sufficient to illustrate the principle of operation. In practice, this means that plates on a macro scale must be replaced with a very large number of micro- or nanoplates (From now on I'll call them tiles), positioned at an angle to the overall surface of the entire plate, which is composed of such tiles. To simplify the description of the principle of operation, I assume that tiles within a single plate are connected to each other, and I also ignore the forces acting between individual tiles belonging to the same structure.

Entire surfaces of the plates: Surfaces when zoomed in:



- Casimir force vector (for illustration, not to scale) * Drawings for illustration, Not to scale

The above illustrations show the general principle of generating force at an angle, even though it is essentially the classic Casimir effect. On this basis, it is possible to design an example geometry that allows vacuum energy to be converted into mechanical energy, assuming the existence of an additional external force preventing the plates from colliding. There are many possible sources for this external force, but I will leave this for further research by those interested in the subject.

Now I will give examples of static solutions (i.e., solutions for a stationary system) with the angle of the tiles relative to the entire plate surface equal to 45 degrees for the horizontal force and the required external force (equal to the vertical component) and the smallest distance between the corners of the tiles depending on the distance between opposite tiles. So I will use the Casimir force formula for two plates with the variables appropriately described for this example:

$$F = \frac{A\hbar c\pi^2}{240a^4}$$

A – The surface area of all tiles on one of the plates

$\hbar$ – Dirac constant

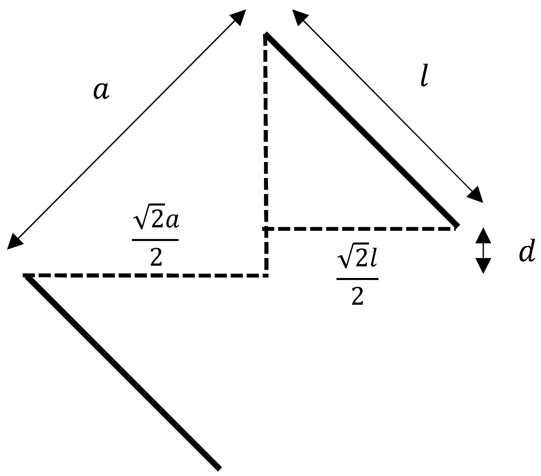
c – Speed of light

a – The distance between tiles that are opposite each other

d – The smallest distance between tile corners

l – Length of tiles

$$d = \frac{\sqrt{2}}{2}(a - l)$$

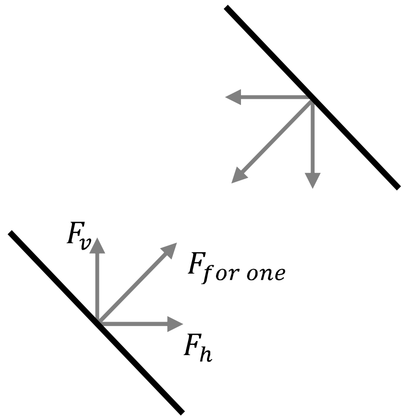


* Drawing for illustration, Not to scale

$F_{for\ one}$ – Casimir force acting between individual tiles

$F_{v\ and\ h}$ – Vertical and horizontal components of Casimir force

$$F_{v\ and\ h} = \frac{\sqrt{2}}{2} F_{for\ one}$$



* Drawing for illustration, Not to scale

So by adopting the most optimal arrangement of tiles next to each other, in which the tiles are as close to each other as possible, without covering those from the opposite plate. Then, at an angle of 45 degrees, the area of all tiles is $\frac{\sqrt{2}}{4}$ general area of the entire plate:

$$F_{for\ all} = \frac{\sqrt{2}A_{main}}{4}\frac{\hbar c\pi^2}{240a^4} = \frac{\sqrt{2}}{960}\frac{A_{main}\hbar c\pi^2}{a^4}$$

A_{main} – General area of the entire plate

$F_{for\ all}$ – Casimir force acting between all tiles

So, the static formula for the horizontal and vertical components of the Casimir force acting between all tiles for a tile inclination of 45 degrees relative to the overall plate surface is as follows:

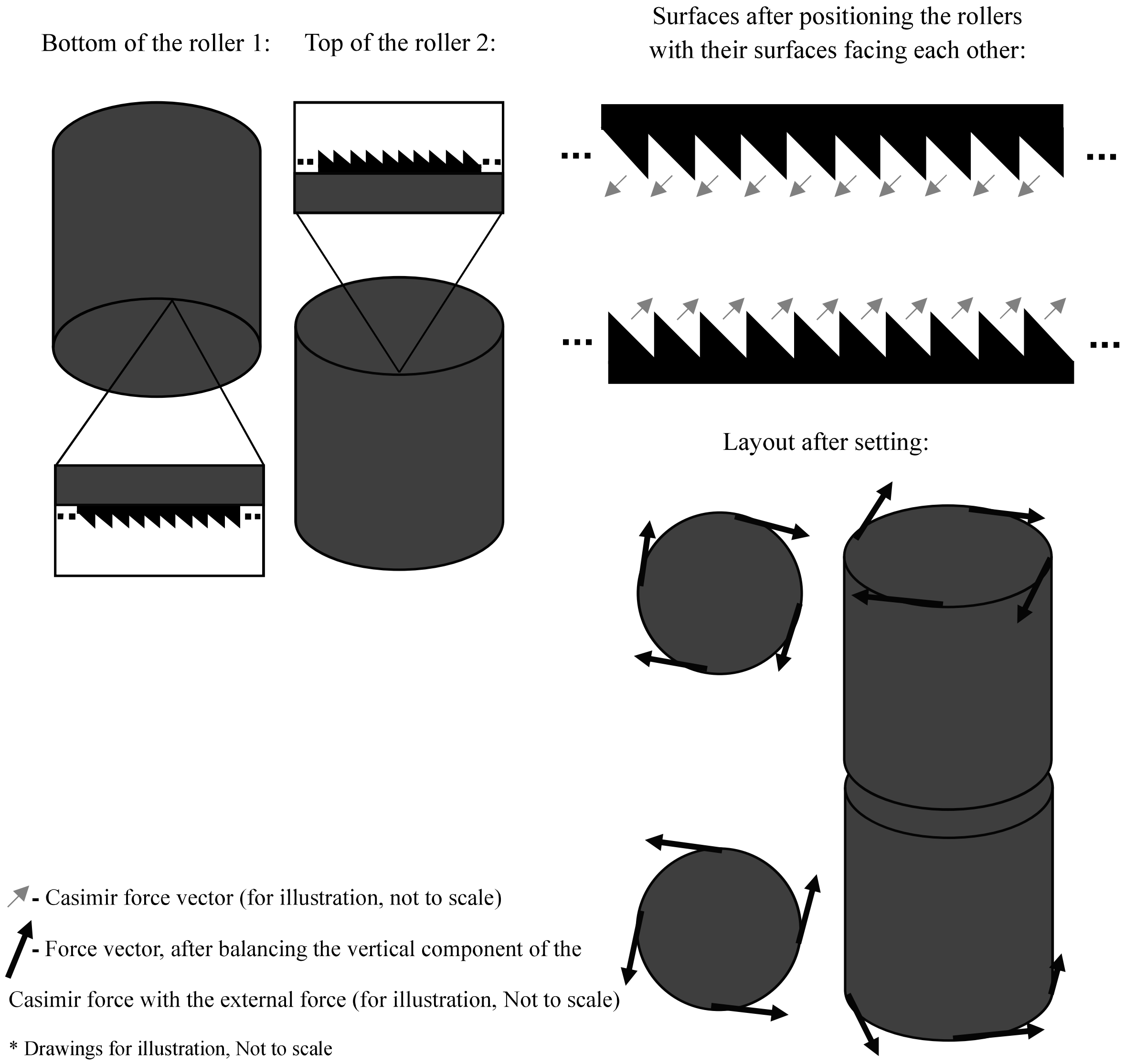
$$F_{v\ and\ h\ for\ all} = \frac{\sqrt{2}}{2}F_{for\ all} = \frac{\sqrt{2}}{2}\frac{\sqrt{2}}{960}\frac{A_{main}\hbar c\pi^2}{a^4} = \frac{A_{main}\hbar c\pi^2}{960a^4}$$

$F_{v\ and\ h\ for\ all}$ – Horizontal and vertical components of the Casimir force acting between all tiles

The tiles at 45 degrees of inclination can come as close as the length of a single tile before colliding, but for smaller angles of inclination of the tiles relative to the general surface of plate, this distance will decrease, potentially allowing for a greater maximum horizontal component at the cost of a significantly greater vertical component, but with proper control, this can be worthwhile. It depends only on the requirements and precise control of a given system, so I will not elaborate on it.

4. Roller arrangement

The system for generating torque from this type of structure requires precise control of the external force and accurate determination of the distance between the surfaces. To convert the horizontal component of the Casimir force into torque, two rollers can be used, where one of them has a geometric structure on the lower base, which is a mirror image of the geometry on the upper base of the other roller. Both surfaces are positioned opposite each other, and their geometric patterns are "looped" around a common axis along the rollers, forming a continuous structure around the perimeter. This configuration allows for the generation of controlled, counter-rotating torque between the rollers. Now I will present a potential surface geometry, which will probably have a slightly different Casimir force vector due to additional fills between the tiles, etc., but for simplicity I will omit them in the example.



The system must operate under high vacuum conditions to eliminate the influence of air resistance forces, prevent surface degradation of components due to chemical reactions, adsorption, etc.

To ensure the controllability of the system, the method of compensating for the vertical component of the Casimir force must be selected appropriately. Only by balancing it is it possible to precisely control the position of the components and ensure stable and correct operation of the entire system.

5. Requirements for obtaining useful amounts of energy

Any system using the presented method of converting vacuum energy into mechanical energy in reasonable quantities must meet the following conditions:

The system must be held by an external force that compensates for any components leading to uncontrolled approach of the surfaces (including mainly the vertical component of the Casimir force, i.e. directed to the space between the surfaces). Operating distances depend only on the application, but for systems aimed at obtaining useful amounts of energy at the macro scale, surfaces must be kept at distances potentially smaller than a dozen nanometres, which requires precise control of the external force.

The surfaces of the structures forming the geometry must be smoothed to a level ranging from several dozen to single atoms, depending on the expected accuracy and scale of the system.

Geometries must obtain complete static and dynamic solutions for forces acting between entire surfaces, individual geometric shapes on the same surface, etc., in order to maintain precise control of the system.

A vacuum should be maintained between and around the system to avoid unnecessary friction and weakening of the effect.

The angle of inclination of the surface components (such as the tiles described above) must be optimized so that the horizontal component of the Casimir force (the component parallel to the overall surface) reaches the expected value at a given distance between the surfaces, with the desired conversion efficiency of the effect, depending on the precision of manufacture and the level of control over the system.

6. Contact

Individuals or teams interested in deepening the topic or developing this and other concepts together can contact via the email address provided. Please note that contact is limited only to e-mail correspondence, I do not offer any other form of cooperation at the moment.

7. Summary

I proposed a potential method for converting vacuum energy into mechanical energy using appropriate surface geometries and their relative positioning. I have also proposed a layout and geometry that is likely to be capable of effectively converting vacuum energy. And although the system and geometries require further research and experimentation, the presented concept indicates a real possibility of converting quantum fluctuations of vacuum into useful mechanical energy.

References

[1] H. B. G. Casimir, *On the attraction between two perfectly conducting plates*, Proc. Kon. Ned. Akad. Wetensch. **51**, 793–795 (1948)

[2] S. K. Lamoreaux, *Demonstration of the Casimir Force in the 0.6 to 6 µm Range*, Phys. Rev. Lett. **78**, 5–8 (1997)

[3] U. Mohideen and A. Roy, *Precision Measurement of the Casimir Force from 0.1 to 0.9 µm*, Phys. Rev. Lett. **81**, 4549–4552 (1998)

[4] R. S. Decca, D. López, E. Fischbach, D. E. Krause, *Precise comparison of theory and experiment in the Casimir force measurements*, Annals of Physics **318**, 37–80 (2005)

[5] G. Bressi, G. Carugno, R. Onofrio, G. Ruoso, *Measurement of the Casimir Force between Parallel Metallic Surfaces*, Phys. Rev. Lett. **88**, 041804 (2002)

[6] D. E. Krause, R. S. Decca, D. López, E. Fischbach, *Casimir force and in-situ surface potential measurements*, Phys. Rev. Lett. **98**, 050403 (2007).