Find a Maxwell's demon that does not consume energy

JiaRun Deng, cmos001@163.com

Abstract

In this paper, we did not propose any new hypothesis, but simply derived from classical electromagnetism theory that the second law of thermodynamics can be violated.

1. Introduction

Maxwell’s demon, as one intelligent device assumed by James Clerk Maxwell, was proposed to indicate the possibility of violating the Second Law of Thermodynamics. But up until now, existing physical experiments have shown that the operation of Maxwell’s demon needs the consumption of energy or the increase of corresponding entropy.

Therefore, it's worth exploring whether there is one device that could play the role of Maxwell’s demon without energy consumption.

2. Methods and Discussion

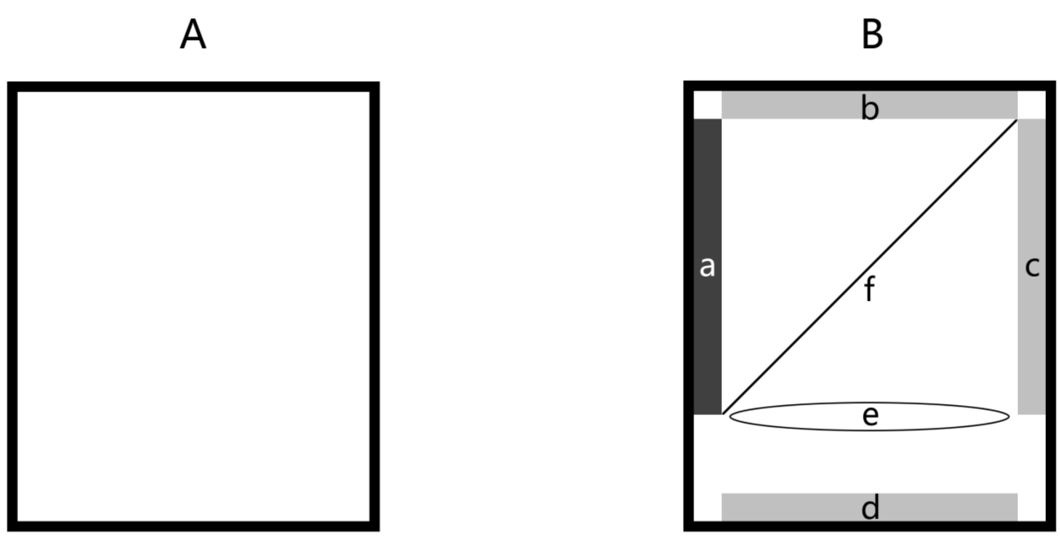

Fig.1(A) A box in thermal equilibrium. (B) Add Michelson interferometer inside the box.

As shown in Fig.1(A), a box in thermal equilibrium, the temperature at any position inside the box is the same, and the radiation inside the box is isotropic.

As shown in Fig.1(B), add Michelson interferometer inside the box[1]. Plane “a” is made of gray material[2], and in this device we use plane “a” as an extended light source. The infrared light radiated by plane“a” is split into two equal-amplitude beams by the spectroscope “f”. These two beams of infrared light are reflected by mirrors “b” and “c” and then reach the lens “e”, where they are focused and ultimately projected onto the plane “d”. When the optical path difference between the two beams approaches zero, interference fringes of alternating brightness can be detected on the plane “d”. This principle is the same as the Michelson white-light interference experiment that has been verified countless times.

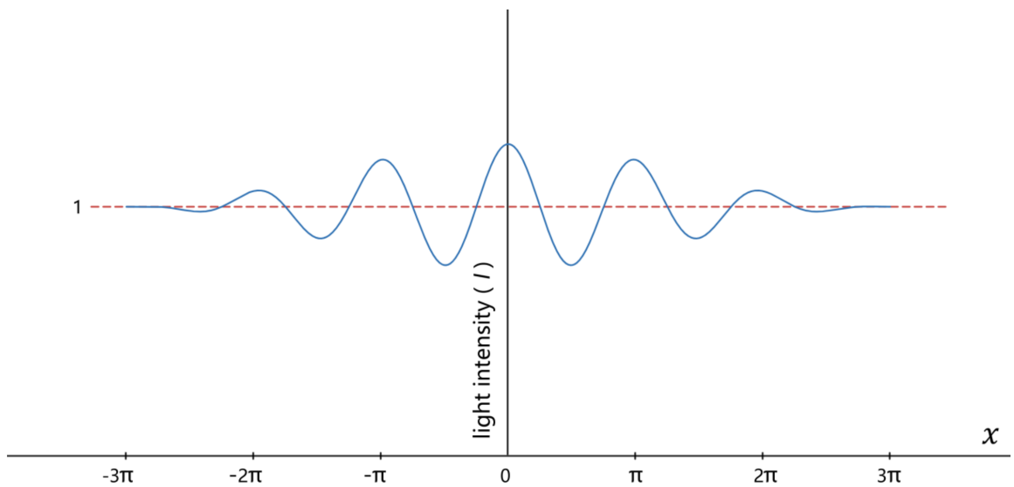

Fig.2 The image corresponding to formula (1), with n=3 and α=0.5.

The energy distribution of interference fringes can be approximated using the following formula:

$$I = \left(1 + \cos\frac{x}{n}\right)\frac{\cos(2x)\alpha}{4} + 1 \qquad (0 < \alpha < 1, \qquad -n\pi < x < n\pi) \qquad (1)$$

In formula (1), the range from -nπ to nπ represents the visibility of the interference fringe. α represents the absorption coefficient of plane “a”. To obtain interference fringes with higher contrast, the value of α should be close to 1.

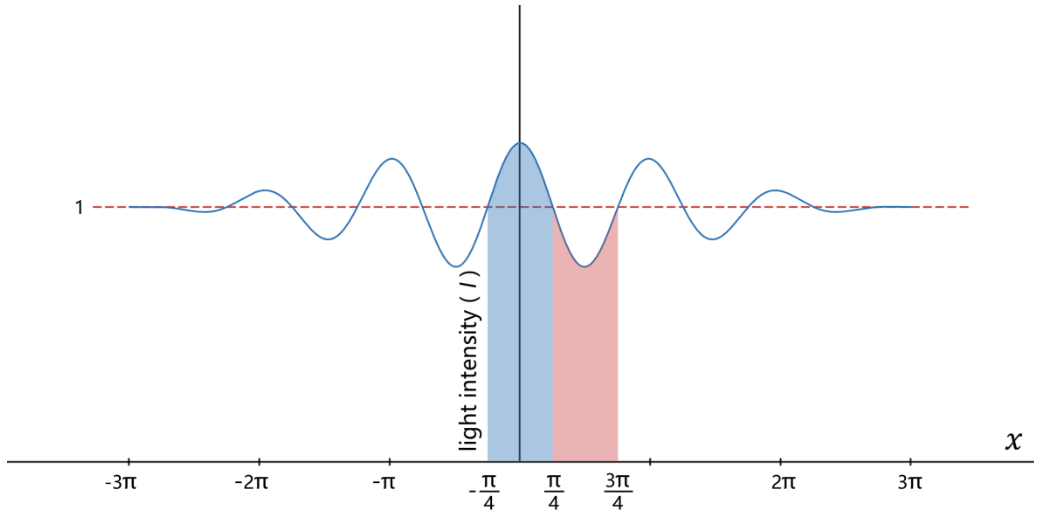

Fig.3 The image corresponding to formula (2).

The existence of interference fringes indicates that the energy distribution is non-uniform. The energy distribution of bright and dark fringes can be described using an inequality:

$$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} I\,dx \;>\; \int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} I\,dx \tag{2}$$

In formula (2), 2 π is the central wavelength of blackbody radiation in the thermal equilibrium state, from - π/4 to π/4 belongs to the area of bright stripes, and from π/4 to 3 π/4 belongs to the area of dark stripes.

Obviously, the light intensity received in the area with bright stripes is greater than that received in the area with dark stripes, which will cause a temperature difference between the two areas. Importantly, the temperature difference generated between the two regions does not require input of energy from the outside to maintain, which clearly violates the second law of thermodynamics.

If we place one end of the thermocouple in the area of bright stripes and the other end of the thermocouple in the area of dark stripes, the thermocouple will generate a constant current, which means we can obtain free energy from the surrounding environment.

Here, the Michelson interferometer is like a Maxwell demon, which transforms the disorderly and uniform radiation into orderly and uneven radiation. It is important that we do not need to provide energy for the Michelson interferometer.

3. Conclusion

In this paper, we did not propose any new hypothesis, but simply derived from classical electromagnetism theory that the second law of thermodynamics can be violated. The beneficial effects of this conclusion include improving the efficiency of converting thermal energy into electrical energy, humans being able to obtain free energy from the surrounding environment (although with a very low power density), and making revisions to the theory of cosmic evolution.

References

[1] Michelson, Albert Abraham, and Edward Williams Morley. "On the relative motion of the earth and the luminiferous ether." *American journal of science* 3.203 (1887): 333-345.

[2] Planck, Max. "On the law of the energy distribution in the normal spectrum." *Ann. Phys* 4.553 (1901): 1-11.