From Nothing: The dynamical Casimir effect

Nicolas Tarantino

April 2, 2013

Abstract

Viewing the world with our classical intuition, we think of the vacuum as being empty, a space with no particles whatsoever. However, quantum mechanics makes a mockery of this, as it is only reasonable to speak of states with certain quantum numbers. The vacuum is thus the state with minimum energy. By relaxing this definition, the vacuum is now filled with a sea of virtual particles which produce observable phenomena known as Casimir effects. The best known is these is the static Casimir effect, where the vacuum exerts an attractive force between two reflecting surfaces.[1] But in 2011, the dynamical Casimir effect (DCE) was confirmed by C.M. Wilson et al. By simulating a rapidly oscillating mirror with a superconducting circuit[2], the team succeeded in exciting pairs of photons out of the vacuum, probing the vacuum structure of electromagnetism directly.[3, 4]

This talk will overview the concepts behind vacuum structure and the two Casimir effects, and then proceed to present the predictions of particle production via the DCE. A survey of C.M. Wilson et al.'s experimental setup will follow, and then will end with the results published in their 2011 article.

References

[1] H. B. G. Casimir, Proc. K. Ned. Akad. Wet. B **51**, 793 (1948).

[2] J. R. Johansson, G. Johansson, C. M. Wilson, and F. Nori, Phys. Rev. Lett. **103**, 147003 (2009).

[3] C. M. Wilson *et al.*, Nature **479**, 376 (2011).

[4] D. A. R. Dalvit, Nature **479**, 303 (2011).