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Optical Chopper Driven by the Casimir Force

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Abstract

© 2018 American Physical Society. We propose an experimental scheme and present detailed theoretical description of the optical chopper in which functionality is based on the balance between the Casimir and light pressures. The proposed device consists of two atomically thin metallic mirrors forming the Fabry-Perot microfilter. One of the mirrors is deposited on a solid cube and another on a thinner wall subjected to bending under the influence of attractive Casimir force and repulsive force due to the pressure of light from a continuous laser amplified in the resonator of a microfilter. The separation distance between the mirrors should only slightly exceed the half wavelength of the laser light. It is shown that in this case the resonance condition in the microfilter alternatively obeys and breaks down resulting in the periodic pulses of the transmitted light. The Casimir pressure is calculated taking into account an anisotropy of the dielectric permittivity of a metal at several first Matsubara frequencies. The reflectivity properties of atomically thin metallic mirrors in the optical spectral range are found using the experimentally consistent phenomenological approach developed earlier in the literature. The specific values of all parameters, found for the microfilter made of quartz glass with Ag mirrors, demonstrate its workability. The proposed optical chopper may find prospective applications in the emerging field of nanotechnology exploiting the effects of quantum fluctuations.

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