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On the torque on birefringent plates induced by quantum fluctuations JEREMY MUNDAY, Harvard University, Department of Physics, Cambridge, MA 02138, DAVIDE IANNUZZI, FEDERICO CAPASSO, Harvard University, Division of Engineering and Applied Sciences, Cambridge, MA 02138, YURI BARASH, Institute of Solid State Physics, Russian Academy of Sciences, Moscow, reg. 142432, Russia — We present detailed numerical calculations of the mechanical torque induced by quantum fluctuations of the electromagnetic field on two parallel birefringent plates with in plane optical anisotropy, separated by either vacuum or a liquid (ethanol). The torque is found to vary as $\sin(2\theta)$, where θ represents the angle between the two optical axes, and its magnitude rapidly increases with decreasing plate separation d. For a 40 μm diameter disk made out of calcite which is kept parallel to a Barium Titanate plate at a distance d=100 nm, the maximum torque (at $\theta = \pi/4$) is on the order of $\sim 10^{-18}$ N·m. We propose an experiment to observe this torque when the Barium Titanate plate is immersed in ethanol and the other birefringent disk is placed on top of it. In this case the retarded van der Waals (or Casimir-Lifshitz) force between the two birefringent slabs is repulsive. The disk would float parallel to the plate at a distance where its net weight is counterbalanced by the retarded van der Waals repulsion, free to rotate in response to very small driving torques.

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