

Green's functions and Zero-point energy in Axion Electro-dynamics

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Abstract— After reviewing the formalism of Axion Electro-dynamics, we work out the axionic modifications to the electromagnetic Green's function with fixed axion background, from which Casimir energies can be evaluated. The theory is related to and extends former treatments in Refs.[1, 2, 3, 4, 5, 6, 7] by considering the case of an oscillating axion field, an axion domain wall alone and finite temperature T . We discuss three cases of interest of axion backgrounds for the QCD axion (or axion-like particles) and the effective axion field in topological insulators: $\dot{a}(t) = \text{constant}$, $a(t) = a_0 \sin(\omega_a t)$ and an axion domain wall, where $a(\vec{x}, t)$ is the axion field. With the first two backgrounds we evaluate the Green's function in order to calculate the modifications to the static Casimir force between two infinite parallel conducting plates, while we evaluate the reflection and transmission coefficients of an axion domain wall and calculate the Casimir pressure acting on an axion domain wall alone. We then briefly suggest and describe possible applications of our results to axion detection and topological insulators.

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