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Quantum calculation of axion-photon transition in electromagnetodynamics for cavity haloscope

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The Witten effect implies the presence of electric charge of magnetic monopole and possible relationship between axion and dyon. The axion-dyon dynamics can be reliably built based on the quantum electromagnetodynamics (QEMD) which was developed by Schwinger and Zwanziger in 1960's. A generic low-energy axion-photon effective field theory can also be realized in the language of "generalized symmetries" with higher-form symmetries and background gauge fields. In this work, we implement the quantum calculation of axion-single photon transition rate inside a homogeneous electromagnetic field in terms of the new axion interaction Hamiltonian in QEMD. This quantum calculation can clearly imply the enhancement of conversion rate through resonant cavity in axion haloscope experiments. We also show the promising potentials on the cavity search of new axion-photon couplings in QEMD.

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