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Probing Virtual ALPs Using Precision Phase Measurement

We propose an experimental scheme for detecting the effects of off-shell axion-like particles (ALPs) through optical cavities. In this proposed experiment, linearly polarized photons are pumped into an optical cavity where an external time-periodic or space-periodic magnetic field is present. The magnetic field mediates an interaction between the cavity photons and ALPs giving rise to a modification in the phase of the cavity photons. The time-dependent nature of the external magnetic field prompts a novel amplification effect which significantly enhances this phase modification. A detection scheme is then proposed to identify such axion-induced phase shifts. We find that the phase modification is considerably sensitive to the photon-ALPs coupling constants for the range of ALPs mass $3e-6$ eV to $44e-6$ eV for time-periodic and $6e-4$ eV to $6e-3$ eV for space-periodic magnetic fields.

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