

Constraints on Axion-Like Particles with the Silicon Detector at a Nuclear Reactor

Axion and axion-like particles (ALPs), predicted in various extensions of the Standard Model, can be abundantly produced in nuclear reactors via the Primakoff process. In this work, we explore the detection of ALPs in silicon detectors through plasmon excitations. Owing to their relativistic nature, reactor-produced ALPs can efficiently excite plasmon resonances, while the accompanying energetic photon typically escapes from the thin detector without depositing an appreciable amount of energy. Utilizing the data from the Connie and Atucha-II experiments, we set the 90% confidence level upper limits on the ALP-photon coupling $g_{a\gamma\gamma}$ over the axion mass range $0.1 - 100$ keV. We further show that, for an exposure of 30 kg·yr, the projected sensitivity of vIOLETA exceeds the current NEON limit by a factor of three in the same mass range. This improvement would expand the explored region of the QCD axion and ALP parameter space.

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