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Broadening Frequency Range of a Ferromagnetic Axion Haloscope with Strongly Coupled Cavity-Magnon Polaritons

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Ferromagnetic axion haloscopes search for axion dark matter by exploiting their coupling to electrons. We present a new theoretical framework by which such devices can be understood with a Hamiltonian approach using strongly coupled cavity photons, and magnons from a spherical ferrimagnet. Particular focus is put of the operation of these devices in the dispersive regime, which allows these experiments to search over a broader frequency range with respect to the axion parameter space. An initial experiment is performed with limits set on axion to electron coupling of $g_{aee} > 3.7 \times 10^{-9}$
in the range 33.79μeV<m_a< 33.94μeV with 95% confidence. The potential range of operation of this experiment is calculated, however, to be in bands: 4.1μeV centred around 34.1μeV and 6.6μeV centred around 41.4μeV. Future improvements to the experiment are also discussed.

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