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Axion Dark Matter Induced Modulation in Ferromagnetic Resonance and Spin Wave Interferometry

We propose a novel asymmetric sensitive spin wave interferometer to detect ultralight axion dark matter, which modulates spin wave properties through a weak effective magnetic field in ferromagnets. By splitting a spin wave source into two paths of different lengths and setting them to interfere destructively, the interferometer converts the axion induced phase shift into a measurable magnetization oscillation, which can radiate electromagnetic waves and also generate electrical signals via Faraday induction. The signal to noise ratios have been evaluated for three detection schemes: the linear amplifier, the single photon detector and the electrical signal detection approach, with both magnetization fluctuation noise and thermal noise taken into account. Limited by the conditions of spin wave propagation distance and the relaxation time, the accessible axion mass range is approximately 10^{−8} eV to 10^{−6} eV.

Primary author(s) : LIU, Jiayi (Beijing Institute of Technology)

Co-author(s) : XIE, Chen-Hui (Beijing Institute of Technology); LEI, Runyu (Beijing Normal University); SUN, Sichun (Beijing Institute of Technology); GAO, Yu (Institute of High Energy Physics, Chinese Academy of Sciences); ZHANG, Jinxing (Beijing Normal University)

Presenter(s) : LIU, Jiayi (Beijing Institute of Technology)