

Axion Detection with Cavity Arrays

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We demonstrate that a cavity built of an array of elementary harmonic oscillators with negative mutual couplings exhibits a dispersion curve with lower order modes corresponding to higher frequencies. Such cavity arrays help to achieve infinitely large mode volumes with high resonant frequencies, where the mode volume for the composed array scales proportional to the number of elements, but the frequency remains constant. This gives an advantage over simultaneous averaging over the same number of independent cavities (giving the same scaling law), as the proposed approach requires only one measurement system. The negatively coupled cavity array may be realised by magnetically coupling coils, where the sign of next-neighbour coupling (set by chirality of adjacent elements) sets the dispersion curve properties of the resonator array medium. The principle is demonstrated by determining the dispersion relation for a one dimensional array of coils, configured as re-entrant cavity resonators.

We will also discuss cavity arrays employing some features of left handed metamaterials and how these features may boost axion sensitivity.

The presentation is based on arXiv:1703.07207

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