

# Ultra-wide frequency tuning with dielectric meta-material for higher mass axion search

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We, Center for Axion and Precision Physics research (CAPP), introduce a noble method of frequency tuning for the higher mass axion searching cavity using dielectric meta-material. When the dielectric slits are arranged periodically, they become a dielectric meta-material that has an effective dielectric constant which is proportional to the ratio of the period to the gap, that is, we can precisely control the electric permittivity of the structure. We have simulated the microwave frequency resonance mode of the rectangular cavity where the dielectric slits are periodically placed, using finite-difference-time-domain (FDTD) method and found that the anisotropic dielectric characteristics along the direction of dielectric slit alignment are consistent with the analytic prediction. We also found that dielectric constants are constantly related to the period and slit gap when the dielectric slits are arranged with an azimuthal period in a cylindrical cavity. By arranging such dielectric meta-material in a cylindrical cavity and by adjusting its spacing, we have the resonant frequencies of  $TM_{0n0}$  modes tuned with respect to effective electric permittivity and the position of DMM. When the cavity diameter is 90mm, we could obtain tuning range of 4GHz  $\sim$  5.5GHz at  $TM_{020}$  mode, 5.2GHz  $\sim$  7.5GHz and 6.9GHz  $\sim$  8.4GHz at  $TM_{030}$  mode with different size of dielectric while form factor is maintained above 0.3.

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