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Application of the Bead-Perturbation Technique to a Study of a Tunable 5 GHz Annular Cavity

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Microwave cavities for a Sikivie-type axion search are subject to several challenging constraints. In the fabrication and operation of such cavities, often used at frequencies where the resonator is highly overmoded, it is important to be able to reliably identify the symmetry of the mode of interest, confirm its form factor, and to determine the frequency ranges where mode crossings with intruder levels have caused unacceptable admixing of the purity of the mode of interest. A simple and powerful diagnostic for mapping out the electric field of a cavity is the bead perturbation technique. While a standard tool in accelerator physics, we have for the first time applied this technique to cavities used in the axion search. In this talk, I will report initial results from an extensive study for the initial cavity used in ADMX-HF. This is an annular resonator of 25.4 cm x 10.2 cm diameter, with an off-center 5.1 cm diameter pivoted copper tuning rod, for which the TM(010) mode could be tuned over the 3.4-5.8 GHz range. Two effects in particular have been investigated, i.e. the role of rod misalignment in mode localization, and mode-mixing at avoided crossings of TM and TE modes. These results are being brought together with precision metrology and high-fidelity simulations.

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