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Demonstration of a High-Volume Tunable Haloscope Above 7 GHz

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We present results from a first experimental demonstration of a tunable thin-shell axion haloscope, as proposed in [JCAP02(2021)018]. This novel geometry decouples the overall volume of the haloscope from its resonant frequency, thereby evading the steep sensitivity degradation in scaled high-frequency haloscopes. An aluminum 4 L pathfinder (designed for 6.8-8.2 GHz) has been fabricated and measured at room temperature. A singly polarized, axion-sensitive, TM_{010}-like mode is clearly identified against a background of spurious resonances. The on-resonance E-field distribution is mapped, verifying results from numerical calculations. With high-precision alignments, we achieve robust tuning over a representative frequency range. Anticipating future cryogenic operations, we demonstrate successful cavity alignments relying only on microwave reflection measurements, achieving a form factor of 0.57 and a room temperature Q of 5,000

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