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High-temperature superconducting cavities: current progress and future plans for axion searches at CAPP

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Superconducting radiofrequency technology has been essential for advancing the performance in particle physics experiments over the past decades. In particular, axion haloscopes require high-quality factor (Q) superconducting cavities working in multi-tesla magnetic fields to enhance scanning speeds, which can be accomplished using high-temperature superconducting (HTS) tapes. Biaxially-textured rare-earth barium copper oxide (ReBCO) tapes, with robust vortex pinning capabilities in high magnetic fields, are ideal materials for creating high Q cavities in a strong magnetic field. The Center for Axion and Precision Physics Research (CAPP) has successfully fabricated cavities utilizing ReBCO tapes, which boast a Q factor up to two orders of magnitude greater than copper. In this presentation, we discuss the first axion dark matter search results using a high-temperature superconducting cavity with a sapphire tuning mechanism. The experiment demonstrated an order-of-magnitude increase in scanning speed compared to previous laboratory setups. Furthermore, we will cover the development and characterization status of HTS cavities for various experiments at CAPP.

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