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The first axion quark nugget experiment using a haloscope at CAPP

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Axions are hypothetical particles arising from the Peccei-Quinn mechanism, which solves the strong charge-parity problem, a significant puzzle in the Standard Model. In this study, we focus on an alternative axion production mechanism compared to conventional dark matter axions, known as the axion quark nugget (AQN) dark matter model. The model suggests that anti-AQNs predominantly constitute the dark matter component, and upon colliding with ordinary matter, they can annihilate to produce broad-band relativistic axions. Although the resulting axion frequency distribution differs from the conventional model, cavity haloscopes can detect axions produced through the interaction of anti-AQNs and the Earth's surface. Based on this concept, the Center for Axion and Precision Physics research initiated an AQN-based experiment utilizing a haloscope, which incorporates a flux-driven Josephson parametric amplifier and a newly developed superconducting cavity. With the cavity resonant frequency fixed at 2.2685 GHz, the experiment aims to explore the 4 μeV – 9 μeV axion rest mass region, seeking the daily modulation of the axion signal predicted by the model. This experiment is currently underway, and the results will be presented during the workshop.

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