Contribution ID: **31** Type: **Presentation**

Status of the ADMX-HF Extreme Axion Experiment

Wednesday 22 June 2016 11:05 (25 minutes)

Axions are a leading dark matter candidate, and may be detected by their resonant conversion to a monochromatic RF signal in a tunable microwave cavity permeated by a strong magnetic field. The Axion Dark Matter eXperiment –High Frequency (ADMX-HF) serves both as an innovation platform for cavity and amplifier technologies for the microwave cavity axion experiment, and as a pathfinder for a first look at data in the 20–100 μeV (~ 4–25 GHz) range. A collaboration of Yale University, where the experiment is sited, the University of California Berkeley, Colorado University, and Lawrence Livermore National Laboratory, ADMX-HF is a small but highly capable platform where advanced concepts can be developed and vetted in an operational environment. The experiment is built on a superconducting solenoid magnet (9 T, 17.5 cm Ø x 40 cm) of high field uniformity, and a dilution refrigerator capable of cooling the cavity and amplifier to 25 mK. In its initial configuration, the microwave cavity is made of high purity electroformed copper, tunable between 3.6 –5.8 GHz. The cavity is coupled to a Josephson Parametric Amplifier; JPAs are ideally suited for the 5 GHz range, being broadly tunable and exhibiting near-quantum-limited noise temperature. Construction and commissioning was completed in 2015, and the experiment embarked on its first data production run in January 2016, which will conclude in late summer. This talk will give an overview of the design and operational experience of the experiment, and a preliminary report on its first data. R&D oriented to significantly increase the sensitivity of the microwave cavity experiment will also be reviewed, including a squeezed-vacuum state receiver, very high-Q cavities, and photonic band-gap resonators. This work was supported under the auspices of the National Science Foundation, under grants PHY-1067242 and PHY-1306729, the Heising-Simons Foundation under grant 2014-182, and the U.S. Department of Energy by Lawrence Livermore National Security, LLC, Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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