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High Field, Large Aperture HTS Solenoid for Axion Dark Matter Search

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The Center for Axion and Precision Physics (CAPP) at the Institute for Basic Science (IBS) is setting up a major facility in Korea to search for Axion dark matter. Axion dark matter is partially converted to a very weak flickering electric field in the presence of a strong magnetic field applied with a resonating cavity. One key component of this proposed state-of-the-art experiment will be the high magnetic field (25 T), large aperture (100 mm) solenoid. In addition to the large stresses associated with such a large aperture high field solenoid, the specific challenges also include the quench protection needed for the reliable operation of such a HTS solenoid in a user facility environment. The basic design of the IBS solenoid will be based on the 25 T, 100 mm HTS solenoid that Brookhaven National Laboratory (BNL) designed and constructed with ReBCO tape as part of a Superconducting Magnetic Energy Storage System (SMES). During the initial tests at 27 K, the SMES solenoid successfully reached the field expected, 12.5 T. Even though the test could not be completed due to electrical problems, the tests established that the basic HTS solenoid design could be used for the overall design of the IBS solenoid. The major difference between the SMES and IBS solenoid, however, will be switching over from the metallic-insulation (stainless steel tape) to no-insulation to provide an extra level of protection against the quench. The no-insulation scheme is particularly attractive in this case since the field quality and ramp rate requirements are rather relaxed. In addition to the overall design of this large aperture, high field no-insulation HTS solenoid, the paper will also present test results of the no-insulation pancake coils built and tested with ~12 mm wide ReBCO tapes.

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