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[Invited] The SPARC Toroidal Field Model Coil

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The SPARC Toroidal Field Model Coil (TFMC) Project seeks to design, build, and test in a two-year time period a first-in-class, high-field, large-scale fusion magnet using Rare Earth Yttrium Barium Copper Oxide (REBCO) superconductor. The principal objective of the project is to retire the operational and manufacturing risks of REBCO toroidal field magnet technology at-scale for the SPARC tokamak, a net-energy fusion device now beginning construction outside of Boston Massachusetts. Weighing 9,270 kg (20,430 lb) and utilizing over 270 km (168 mi) of REBCO superconductor, the TFMC is designed to obtain 20 T peak field-on-coil and demonstrate quench handling with stored magnetic energy up to 110 MJ. The TFMC will operate at a nominal temperature of 20 K and current of 41 kA with the winding pack containing a total of 256 turns distributed across 16 radial plate-style pancakes. The magnet is now completing construction in a dedicated 370 m^2 (4,000 ft^2) facility at the MIT Plasma Science and Fusion Center (PSFC) with REBCO qualification and winding performed at Commonwealth Fusion Systems (CFS). The MIT PSFC has also established a specialized 836 m^2 (9,000 ft^2) magnet test facility, which includes several novel capabilities such as binary 50 kA REBCO current leads. The magnet is on schedule to be completed in June 2021 with the initial test campaign planned for July 2021. This talk will provide a high-level overview of the TFMC Project, including the magnet, initial experimental results, and the manufacturing and test facilities. The SPARC TFMC project is a joint effort between the MIT PSFC and the research sponsor CFS.

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