Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

**Empirical and physics-based predictions of core plasma performance for the SPARC tokamak**[1] P. RODRIGUEZ-FERNANDEZ, N.T. HOWARD, M.J. GREENWALD, J.W. HUGHES, MIT PSFC, A.J. CREELY, Commonwealth Fusion Systems, C. HOLLAND, University of California - San Diego, J.C. WRIGHT, Y. LIN, F. SCIORTINO, MIT PSFC, SPARC TEAM — SPARC is being designed to be a medium-size tokamak (R=1.85m) that will leverage recent advancements in high-temperature superconductor technology to operate with a toroidal magnetic field of B=12.2T on axis. ICRF-heated deuterium-tritium H-mode plasmas in SPARC are expected to reach Q>2 (core mission) and both empirical and physics-based models predict ample margin with respect to this mission. The empirical scaling of energy confinement (H98y2=1.0) and conservative assumptions estimate 140MW of fusion power and a gain of Q=11. Independent high-fidelity integrated modeling simulations with physics-based models for transport and heating are in remarkable agreement with empirical predictions and yield Q=9.0. This work presents predictions of several scenarios expected for the SPARC research program, and comprehensive scans of the parameter space with varying physics assumptions, demonstrating that the SPARC design is robust to uncertainties in plasma physics. The work that is being done in designing SPARC and its future operation will lay the basis for the high-field path and will serve as testbed for predictive burning-plasma physics models to be used in the design of high-field compact fusion power plants.

[1]Research supported by Commonwealth Fusion Systems. C. Holland was supported by DOE award DE-SC0018287.

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Date submitted: 28 Jun 2020

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