The boundary physics program plan for the initial research phase of the National Compact Stellarator Experiment

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The National Compact Stellarator Experiment (NCSX) is a three-field period compact stellarator presently in the construction phase at Princeton, NJ. The design parameters of the device are major radius R=1.4m, average minor radius <a> = 0.32m, 1.2 < toroidal field (B_t) < 1.7 T, and auxiliary heating power up to 12 MW. The NCSX average aspect ratio <R/a> of 4.4 lies well below present stellarator experiments and designs, allowing investigation of high β physics. Also the NCSX design choice for a quasi-axisymmetric configuration introduces the prospect of achieving tokamak-like transport. In this paper, we report on the planned research themes in the boundary physics areas during early NCSX research operations.

Broadly speaking, the present plan is envisioned to consist of two parts: one for scrape-off layer (SOL) characterization in preparation for installation of full plasma-facing components (PFCs), and access to enhanced confinement regimes with edge transport barriers. In the first area, three main topics are envisioned: 1) dependence of heat and particle flux profiles at PFCs on discharge configuration, 2) power accountability studies, and 3) edge and SOL width studies. Data from this set of experiments will be used to compare with field line tracing calculations for preliminary design of the PFCs[1-3]. In the second area, research will be focused around the conditions needed to access enhanced confinement regimes, including implementation of necessary wall conditioning procedures. Execution of the research plan will be enabled with a staged set of boundary diagnostics.

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