DPP13-2013-000230

Abstract for an Invited Paper
for the DPP13 Meeting of
the American Physical Society

Twenty Years of Research on the Alcator C-Mod Tokamak[1]

MARTIN GREENWALD, Massachusetts Institute of Technology

Alcator C-Mod is a compact, high-field tokamak, whose unique design and operating parameters have produced a wealth of new and important results since its start in 1993, contributing data that extended tests of critical physical models into new parameter ranges and into new regimes. Using only RF for heating and current drive with innovative launching structures, C-Mod operates routinely at very high power densities. Research highlights include direct experimental observation of ICRF mode-conversion, ICRF flow drive, demonstration of Lower-Hybrid current drive at ITER-like densities and fields and, using a set of powerful new diagnostics, extensive validation of advanced RF codes. C-Mod spearheaded the development of the vertical-target divertor and has always operated with high-Z metal plasma facing components - an approach adopted for ITER. C-Mod has made ground-breaking discoveries in divertor physics and plasma-material interactions at reactor-like power and particle fluxes and elucidated the critical role of cross-field transport in divertor operation, edge flows and the tokamak density limit. C-Mod developed the I-mode and EDA H-mode regimes which have high performance without large ELMs and with pedestal transport self-regulated by short-wavelength electromagnetic waves. C-Mod has carried out pioneering studies of intrinsic rotation and found that self-generated flow shear can be strong enough to significantly modify transport. C-Mod made the first quantitative link between pedestal temperature and H-mode performance, showing that the observed self-similar temperature profiles were consistent with critical-gradient-length theories and followed up with quantitative tests of nonlinear gyrokinetic models. Disruption studies on C-Mod provided the first observation of non-axisymmetric halo currents and non-axisymmetric radiation in mitigated disruptions.

[1]Work supported by U.S. DoE