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OV/2-3: Overview of Experimental Results and Code Validation Activities at Alcator C-Mod

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Recent research on the Alcator C-Mod tokamak has focused on a broad range of scientific issues with particular emphasis on ITER needs and on detailed comparisons between experimental measurements and predictive models. It was possible for the first time to demonstrate quantitative, simultaneous agreement between nonlinear gyrokinetic calculations (GYRO) of impurity transport fluxes and experimental observations for impurity diffusion, convection and ion heat flux. Experiments into self-generated rotation in torque-free C-Mod discharges, found an unexpected connection between momentum and energy transport in which spontaneous flow reversal was observed at a critical density, identical to the transition density between LOC and SOC regimes. It was shown for the first time that ITBs could be created with the aid of self-generated ExB shear flow. Research on ICRF heating focused on understanding and mitigating production of metallic impurities. 3D finite-element antenna modeling predicts significantly reduced parallel electric fields if the antenna were aligned to the total magnetic field. A novel field-aligned antenna has been recently installed and has demonstrated sharply reduced impurity generation. LHCD experiments have shown efficient current drive and creation of electron internal transports barrier via modification of magnetic shear. At higher densities, experiments and modeling with ray tracing and full-wave codes suggest that excessive wave interaction in outer regions of the plasma combined with low single-pass absorption are responsible for markedly lower efficiency. Experiments with I-mode have increased the operating window for this promising ELM-free regime. Extrapolation to ITER suggests that Q˜10 could be possible in ITER. H-mode studies have measured pedestal widths consistent with KBM-like instabilities, while the pedestal heights quantitatively match the EPED predictions. Investigations into the physics and scaling of the heat-flux footprint showed a scaling proportional to Te3/2. The width was found to be independent of conducted power, BT or q95 and insensitive to the SOL connection length. As at the midplane, IP is the dominant control parameter. At the same time, heat flux can be reduced to about 10% of the total input power via impurity seeding, while maintaining good H-mode energy confinement even with power close to threshold.

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