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EX/P3-23: Quantitative Comparison of Experimental and Gyrokinetic Simulated ICRH and I_p Dependent Impurity Transport

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For the first time, quantitative comparison of nonlinear gyrokinetic simulation and experiment is found to demonstrate simultaneous agreement in the ion heat and impurity transport channels. Linear and nonlinear simulation was used to interpret changes in measured transport as changes in turbulence drive and suppression terms. Extensive sensitivity analysis of the GYRO predicted impurity transport to uncertainty in experimental measurement was performed to assess quantitative agreement or disagreement between simulation and experiment. The modification of measured and gyrokinetic simulated impurity transport in response to changes in plasma current (I_p) and Ion Cyclotron Resonance Heating (ICRH) were also studied for the first time in the core of Alcator C-Mod. Utilization of a novel multi-pulse laser blow-off system coupled with the unique measurements provided by a high resolution x-ray crystal spectrometer allows for precise characterization of the spatial and temporal behavior of the full, time-evolving profile of the He-like calcium charge state. Changes in the experimental impurity transport coefficients have been determined during scans of ICRH (1.0 -3.3 MW) and I_p (0.6-1.2 MA) using a synthetic diagnostic developed around the impurity transport code STRAHL. At fixed values of a/L_{T_e}, a/L_n, and s^, increasing ICRH input power is observed to reduce the drive for Ion Temperature Gradient (ITG) turbulence. Linear stability analysis performed using the gyrokinetic code GYRO suggests that the character of the core plasma turbulence transitions from ITG to Trapped Electron Mode (TEM) dominated during the power scan. Measured changes in the experimental transport coefficients with input power have been compared with qualitative predictions of quasi-linear theory. During the I_p scan, significant modification of the measured impurity confinement time and the parameters a/L_n and s^ is observed. Analysis using high fidelity, global (0.29 < r/a < 0.62), nonlinear GYRO simulations predict a decrease in the inward impurity pinch and diffusion with increasing plasma current which is both quantitatively and qualitatively consistent with experimental observations. Physical interpretation of I_p and ICRH driven changes in turbulent impurity transport as well as critical comparison of code predictions with measured transport will be presented.

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