

Transport of Helium Impurity in Alcator C-Mod*

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Helium-3 and helium-4 impurity density, temperature, and velocity profile measurements have been obtained on Alcator C-Mod in a variety of discharge conditions using the wide view Charge Exchange Recombination Spectroscopy (CXRS) diagnostic. The helium concentrations range from trace ($< 2\%$) to large minority ($\sim 20\%$). L-mode, H-mode, and I-mode results are included, with Ohmic heated, ICRF heated, and LH heated plasmas. Helium is observed to pinch inward with plasma current. There is a slight trend suggesting an outward thermodiffusion pinch. Helium profile shape is approximately $1/q$ but with sometimes increased core peaking and edge outward transport. For a D(H)(³He) plasma, ICRF antenna frequency can be chosen to resonate with H or ³He minority, generating fast ions. With multiple ICRF antennas operating, no change was observed in the ³He profile when changing from ³He heating to H heating while keeping total ICRF power fixed. High time resolution measurements during ⁴He puffing are used to obtain D and v transport parameters in an Ohmic plasma. Linear and nonlinear gyrokinetic simulations were performed using the GENE code. Sensitivity scans are done for magnetic shear, impurity density, and other plasma parameters and transport scalings are compared with experimental results. We are developing a hybrid CXRS/BES system which will reduce the systematic uncertainty in density profiles. H_α beam emission is directly measured, so impurity density profiles do not depend on modeled beam penetration. The BES measurements also have other applications such as spectral MSE.

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