Investigation of Main Chamber and Divertor Recycling in DIII-D Using Tangentially Viewing CID Cameras*

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The spatial distribution of deuterium-alpha emission in the main inboard scrape-off layer in DIII-D in low and medium-dense, low and high-confinement plasmas suggests that core plasma fueling is derived from the divertor plasma. Emission profiles of carbon-II and carbon-III also point to impurity sources concentrated in the divertor region rather the main-walls. These observations are in contrast to results obtained in recent experiments in Alcator C-Mod and DIII-D which claim enhanced plasma recycling at the main chamber walls at levels comparable to the divertor. Since enhanced main chamber recycling in fusion devices has detrimental effects on plasma performance and particle control, and represents serious implications for the design of future reactors, this question was re-addressed in DIII-D with improved edge diagnostics providing a higher degree of poloidal and toroidal coverage than previously.

The spatial distribution of D_α, CII, and CIII in the main SOL was obtained by measurement of the line-integrated emission using a tangentially viewing, intensified CID camera, and tomographic reconstruction of the image data in the poloidal plane. Preliminary analysis of single-null plasmas with the ion ∇B drifts toward the divertor showed the D_α emission highest in the region closest to the divertor and exponentially decreasing poloidally toward the opposite divertor. In balanced double-null plasma, the distribution of the D_α emission was still concentrated in the region closest to the divertor in ion ∇B drift direction, but more uniformly distributed at the midplane and opposite divertor. The dependence of the emission profiles on plasma shape and density, confinement, and divertor geometry will be presented. Simulations of the edge plasma and recycling using the edge fluid code UEDGE will aid the interpretation of the experimental data.

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