INTRINSIC CARBON IMPURITY TRANSPORT STUDIES IN DIII–D USING THE MONTE-CARLO IMPURITY (MCI) CODE

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The MCI code\textsuperscript{1} follows trace impurities through multiple ionization states as they traverse a wide range of divertor and Scrape-Off Layer (SOL) conditions encountered in realistic plasma confinement geometries. The code is presently being used to model and understand impurity transport physics under plasma conditions relevant to the DIII–D radiative divertor concept. Detailed studies of intrinsic carbon impurity ion distributions are being made under varying plasma conditions in order to test the basic MCI physics assumptions and to provide data for benchmarking the code against experimental measurements. For example, good qualitative agreement is found between calculated CIII emissions ($\lambda = 464.7$ nm), based on simulated MCI carbon density distributions, and 2-D carbon emission distributions measured with a tangentially viewing divertor TV system. Spatial distributions of the total radiated power, calculated as an integral across all the charge states of carbon in MCI, also compare favorably to the bolometrically measured power radiated in the divertor and to chord integrated spectroscopic data taken in the visible and XUV. Fully stripped carbon impurity ion concentrations calculated by MCI at the edge of the core plasma ($r/a > 0.95$) are also compared with CER measurements. To achieve good quantitative agreement with experimental measurements accurate carbon source rates and distributions are required in MCI. Specifically, a vertically viewing CCD camera is used to determine the radial distribution of CII emissions/recycling across the divertor. This source function is then used for subsequent MCI simulations of higher charge state transport processes in the divertor plasma.

Specific applications of importance for the control of power exhaust in tokamaks are discussed for the intrinsic carbon impurity studies including: 2-D impurity screening effects in the SOL, calculations of impurity compression ratios in the divertor, and characterizations of divertor geometry effects on impurity retention and radiation rates. These studies have also been done for DIII–D using other intrinsic and non-intrinsic impurity species over a range of divertor and SOL plasma conditions. MCI results which are of particular interest for improving the efficacy of the radiative divertor approach will be emphasized.

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