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6.9 Synthetic Diagnostic for Assessing Spatial Averaging of Charge Exchange Recombination Spectroscopy Measurements

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A synthetic charge exchange recombination spectroscopy diagnostic based on the FIDAsim modeling suite has been created for the DIII-D tokamak. This synthetic diagnostic assumes the ions have Maxwellian distribution functions on each flux surface and generates synthetic emission from charge exchange events between the beam neutrals and a fully ionized impurity. This work was motivated by the observation of non-Gaussian spectra that may be caused by spatial averaging, atomic physics, or non-Maxwellian distribution functions. Measurements of non-Gaussian spectra commonly observed in the H-mode pedestal and in plasmas with very steep core gradients are compared to the synthetic diagnostic. Spatial averaging alone cannot account for the observations, indicating other cause(s) such as non-Maxwellian distribution functions. The synthetic diagnostic has also been used to resolve a long-standing issue: it is shown that vertical view chords near the magnetic axis often measure lower temperatures than the tangential view chords because of a difference in spatial averaging due to the DIII-D neutral beams being twice as tall as they are wide. Work supported by US DOE under DE-FC02-04ER54698, DE-AC02-09CH11466, and the Science Undergraduate Laboratory Internship (SULI) program.

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