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6.1 Relative Intensity Calibration of the DIII-D Charge-Exchange Recombination Spectroscopy System Using Neutral Beam Injection into Gas

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A new calibration method for the DIII-D charge-exchange spectroscopy system produces smoother impurity density profiles compared to previous techniques, improving the accuracy of our impurity density profile reconstruction. Relative intensity calibration between the chords of the DIII-D charge-exchange recombination (CER) spectroscopy system is performed by firing neutral beams into the evacuated vacuum vessel pre-filled with neutral gas. Relative calibration is required to account for uncertainty in the 3D geometry of the neutral beam. Previous methods using helium gas have been improved by using xenon, which emits an emission line close to the commonly used carbon wavelength 5290.5A, as well as improved timing of the gas injection, inclusion of variation in the vessel pressure, and timing of neutral beam injection. Photoemission recorded by 108 sightlines viewing 6 neutral beams are compared and used to form a relative calibration factor for each sightline. This relative calibration is used to refine the absolute intensity calibration procedure that utilizes an integrating sphere. Results of the relative calibration are compared to an ideal diverging beam calculation that uses a Monte-Carlo 3D model and exposes discrepancies in the assumptions about the neutral beam divergence.

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