Active and Passive Spectroscopic Imaging in the DIII-D Tokamak

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Abstract.

Wide angle, 2D imaging of Doppler-shifted, Balmer alpha (D_α) emission from high energy injected neutrals, charge exchange recombination (CER) emission from neutral beam interaction with thermal ions and fully stripped impurity ions, and visible Bremsstrahlung from the core of DIII-D plasmas has been carried out. Narrowband interference filters were used to isolate the specific wavelength ranges of visible radiation for detection by a tangentially viewing, fast-framing camera. Measurements of the D_α emission from fast neutrals injected into the plasma from the low field side reveal the vertical distribution of the beam, its divergence, and the variation in its radial penetration with density. Modeling of this emission using both a full Monte Carlo collisional radiative code, as well as a simple beam attenuation code coupled to Atomic Data and Analysis Structure (ADAS) emissivity lookup tables, yields qualitative agreement, however the absolute magnitudes of the emissivities in the predicted distribution are larger than those measured. Active measurements of carbon CER brightness are in agreement with those made independently along the beam midplane using DIII-D's multichordal, CER spectrometer system, confirming the potential of this technique for obtaining 2D profiles of impurity density. Passive imaging of visible Bremsstrahlung (VB), which can be inverted to obtain local emissivity profiles, is compared with measurements from both a calibrated filter/photomultiplier array and the standard multichordal CER spectrometer system.