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MEASUREMENT OF NEUTRAL BEAM PROFILES AT DIII–D*

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The neutral beam systems at DIII–D are used both for heating the plasma, and as tools for plasma diagnostics. The profile (spatial distribution) of the beam is used in the absolute calibration of both the CER and MSE diagnostics. The CER (Charge Exchange Recombination) diagnostic is used to make spatially and temporally resolved measurements of ion temperature and poloidal and toriodal rotational velocities. These measurements are made by visible spectroscopy of the Doppler shifted He II (468.6 nm), C VI (529.1 nm) and B V (494.5 nm) spectral lines, excited by the charge exchange recombination events between the plasma ions and the beam neutrals. Thus, the spatial distribution of the beam is needed for an absolute calibration of the CER diagnostic. The MSE (Motion Stark Effect) diagnostic measures the internal poloidal field profile in a neutral beam heated plasma. The diagnostic measures the polarization angle of the Stark broadened neutral beam D-α emission due to the $\boldsymbol{v}_{\mathrm{beam}} \times \boldsymbol{B}$ motional electric field. Again, the spatial profile of the neutral beam is needed for the absolute calibration of the MSE diagnostic.

In the past, the beam profile used in these calibrations was derived from beam divergence calculations and IR camera observations on the centerpost target tiles. Two experimental methods are now available to determine the beam profile. In one method, the Doppler shifted D-α light from the accelerated neutrals is measured, and the full-width at half-maximum (FWHM) of the beam can be inferred from the measured divergence of the D-α light intensity. The other method for determining the beam profile uses the temperature gradients measured by the thermocouples mounted on the calorimeter. A new iterative fitting routine for the measured thermocouple data has been developed to fit theoretical models on the dispersion of the beam. The results of both methods are compared, and used to provide an experimental determination of the beam profile.

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