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Core Measurements of the Thermal Deuterium Ion Temperature and Toroidal Rotation in DIII-D*

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New advances in characterizing wavelength-resolved D-alpha charge-exchange emission for main-ion properties are used to directly measure the thermal deuterium ion temperature and rotation in the core of DIII-D discharges. An advanced spectral fitting technique incorporating passive emission from the plasma edge, and active emission from thermal charge-exchange, Stark-split beam emission and fast ion emission (FIDA) permits an accurate determination of the temperature, velocity and photoemission intensity of the thermal deuterium. Viewchord sightlines of both co-I_p and counter-I_p neutral beam injection at matched radii allow a direct determination of the true plasma toroidal rotation velocity based on geometrical factors without relying on atomic databases. A sophisticated forward modeling code is used to quantify the atomic cross-section and halo emission effects based on collisional-radiative modeling. Measurements of core deuterium temperature, toroidal rotation, density, fast-ion emission intensity and magnetic field magnitude |B| will be presented. A profile diagnostic from core to edge is currently being installed for the upcoming experimental campaign, providing measurements of the bulk ion properties to compare to impurity measurements. Prospects on thermal, momentum and particle transport studies will be presented.

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