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Comparison of poloidal velocity measurements to neoclassical theory on NSTX[1]

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Knowledge of poloidal velocity is required for the determination of the radial electric field, which along with its gradient, is linked to turbulence suppression and transport barrier formation. Pitch-angle measurements from the motional Stark effect require knowledge of the radial electric field to obtain accurate current profiles. Measurements of impurity poloidal flow on conventional tokamaks, that differ an order of magnitude from expected neoclassical values, challenge neoclassical theory as presently formulated. In contrast, recent poloidal velocity measurements from a new diagnostic on NSTX are much more similar to neoclassical predictions from the code NCLASS. The novel NSTX charge exchange recombination spectroscopy diagnostic addresses many atomics physics issues that complicate poloidal velocity measurements, e.g. the collisonal energy dependence of the charge exchange cross section and effects due to ion gyro motion, which lead to pseudo velocities not associated with plasma flow. Uncertainties in atomic physics cross sections that can dominant the relatively small impurity poloidal velocity to be measured are virtually eliminated with a novel viewing geometry. Unique active and passive sets of up/down symmetric views are used to isolate charge exchange emission in the beam volume. Each up/down viewing pair yields an independent line-integrated measurement of poloidal velocity that does not rely on any atomic physics, since gyro orbit effects are small due to low magnetic fields on NSTX. Local profiles can be obtained with an inversion of line-integrated measurements in the beam volume. Comparisons between the measured poloidal velocity and neoclassical predictions and the potential implications will be described.

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