

A Method for Determining Poloidal Rotation from Poloidal Asymmetry in Toroidal Rotation*

C. Chrystal¹, K. H. Burrell², and B. A. Grierson³

¹University of California-San Diego, La Jolla, CA 92093 USA

²General Atomics, San Diego, CA 92121, USA

³Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543, USA

chrystal@physics.ucsd.edu

Abstract. A new impurity poloidal rotation diagnostic has been developed on DIII-D that significantly expanded the measurement capability by determining the poloidal rotation from the poloidal asymmetry in the toroidal angular rotation velocity. This asymmetry is measured with recently added tangential charge exchange viewchords on the high field side of the plasma midplane. The addition of these viewchords is enabled by a novel technique for doubling the number of viewchords that can be imaged by existing CCD detectors. Toroidal rotation measurements are made on co- and counter-current neutral beams, which allow the charge exchange cross section effect to be measured, eliminating the need for atomic physics calculations. The measurement range is restricted to the core of DIII-D ($r/a < 0.6$) where, relative to measurements made with the vertical charge exchange system, the spatial resolution is significantly improved. The measurement technique leverages the fact that asymmetries in toroidal rotation are larger than the poloidal rotation by a factor of $B_\phi/B_\theta \sim 10$ to more precisely determine the poloidal rotation. Significant physics results have been obtained with the new system; for example, poloidal flows disagreeing with neoclassical predictions have been observed in a variety of plasmas. The new charge exchange views have also been used to investigate poloidal asymmetries in impurity density.

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