Experimental test of the neoclassical theory of impurity poloidal rotation in tokamaks

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Abstract

Despite the importance of rotation in fusion plasmas, our present understanding of momentum transport is inadequate. The lack of understanding is in part related to the difficulty of performing accurate rotation measurements, especially for poloidal rotation. Recently, measurements of poloidal rotation for impurity ions ($Z > 1$) have been obtained in the core of DIII-D [J.L. Luxon, Nucl. Fusion **42**, 6114 (2002)] plasmas using charge exchange recombination spectroscopy. The inferred poloidal rotation is based on careful consideration of the effective energy-dependent cross-section and of the gyro motion of the ions. The rotation measurements are found to be consistent with the radial electric field determined independently from multiple impurity species as well as from motional Stark effect spectroscopic measurements. The poloidal rotation measurements have been compared with predictions based on the neoclassical theory of poloidal rotation from the code NCLASS [W.A. Houlberg *et al.*, Phys. Plasmas **4**, 3230 (1997)]. The comparison shows that the neoclassically predicted poloidal rotation is in general significantly smaller than the actual measurements.

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