Toroidal rotation in DIII-D in ECH and Ohmic H-mode discharges

J.S. deGrassie,[1] K.H. Burrell, [1] L.R. Baylor,[2] W. Houlberg,[2] and J. Lohr[1]

[1]*General Atomics, P.O. Box 85608, San Diego, California 92186-5608*

[2]*Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831*

Abstract. Spatially and temporally resolved toroidal rotation measurements have been made in DIII–D [J.L. Luxon, Nucl. Fusion **42**, 614 (2002)] discharges with no externally applied torque. The velocity measurements are made using the charge exchange recombination (CER) technique viewing emission from the intrinsic carbon impurity in deuterium discharges. Three cases have been studied: L–mode and H–mode with Ohmic heating and H–mode with electron cyclotron heating (ECH). The ECH H–mode has carbon counter-rotation in the center of the plasma, and co-rotation outside, where co- and counter- are relative to the direction of the toroidal plasma current. The Ohmic H–mode has carbon rotation everywhere in the co-direction. Neoclassical theory is applied to compute the deuterium toroidal velocity and it is found that the counter rotation measured for carbon in the core of the ECH H–mode is also thus predicted for the bulk deuterium species. Short blips of neutral beams (NB) must be used for the CER technique and these blips do apply a toroidal torque. Care is taken to verify that a nonperturbative measurement is made; data from the first 2 ms of NB injection in each discharge are used for this measurement.