Ion Acceleration in the Vicinity of Magnetic Islands in DIII-D

C.M. Samuell[1], J.D. Lore[2], M.W. Shafer[2], S.L Allen[1], W.H. Meyer[1], J. Howard[3]

[1] *Lawrence Livermore National Laboratory, Livermore, CA 94550, USA*

[2] *Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831, USA*

[3] *Australian National University, Canberra, ACT 0200, Australia*

Three dimensional flows in the vicinity of magnetic islands have been imaged in the scrape off layer (SOL) for the first time in a tokamak. 3D flow measurements are essential to validate the numerical models used for developing island divertors for advanced stellarators like W7-X and to explain the resonant magnetic field (RMP) supression of ELMs in future devices like ITER. In these cases a complex interplay between parallel pressure gradients, local ionization sources, and separtrix perturbation are predicted to produce localized changes in the ion momentum balance. In turn this affects our ability to predict core density, divertor impurity screening and detachment onset in future devices.

In DIII-D these 3D structures were observed in L-mode plasmas limited on the inner wall where an RMP was used generate n=1 island chains. An example of CIII line-of-sight velocity referenced to axisymmetric steady-state conditions is shown in Figure 1. Velocity measurements were made using a Doppler Coherence Imaging Spectroscopy (CIS) camera system. The emergence of large coherent island chains in the edge measured with Thompson scattering was correlated with the onset of localized changes in impurity ions velocity ($< \pm 10$ km/s). This pattern displayed a poloidal length scale of 30-40 cm along the inboard mid-plane and extended to the far-SOL ($\Psi_n > 1.1$). Once established, changes in the RMP phase resulted in a localized velocity response that was faster than the camera's frame rate (50 Hz). These structures are investigated using EMC3-Eirene with a synthetic CIS diagnostic to separate competing contributions from ionization at the target plate, parallel pressure gradients, and the altered magnetic field line topology.

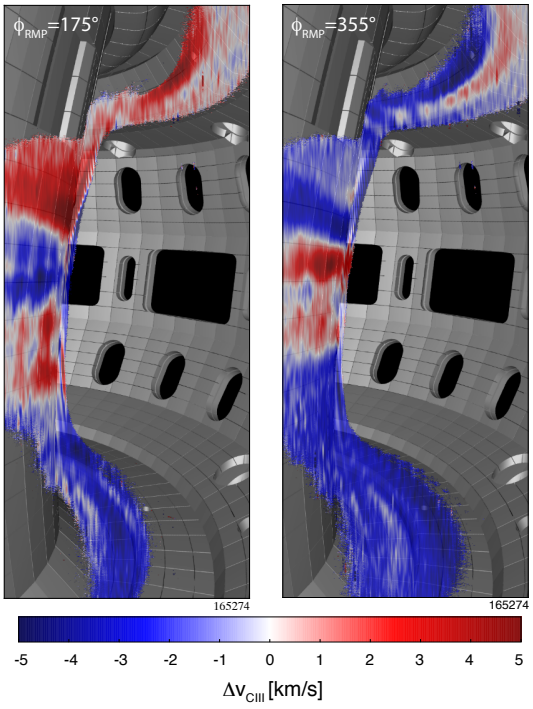

Figure 1: *Change in CIII velocity near magnetic islands produced at two different applied RMP phases.*

Work supported by the US Department of Energy under DE-FC02-04ER54698 and DE-AC52-07NA27344.