Measurements of the Perturbed Rotation in Slowly Rotating Tearing Mode Islands in DIII-D*

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A helically modified ion flow by a rotating island can lead to helical ion polarization currents which can affect tearing mode stability. This issue is of particular importance to ITER where large inertia and relatively low torque will likely result in low rotation. Measurement of rotation near a slowly rotating tearing mode island shows that the perturbed rotation is toroidally in phase with the island O-point and has an extremum at the island rational surface with oppositely oriented extrema located just outside the island (Fig 1). The magnitude of the helical current density inferred from the measured perturbed ion flow is a fraction (~1/3) of the total island helical current density and is stabilizing in the case where the island is freely rotating. In DIII-D cases either (1) coupled m=1,2,3 n=1 modes are slowed down to ~1 kHz (faster than the inverse wall time) by near balanced neutral beams or (2) a resonant, predominantly m/n=2/1 island is entrained by applied rotating n=1 magnetic field at 10 Hz (slower than the inverse wall time). The n=1 island structure is measured with electron cyclotron emission (ECE) radiometry. The ion rotation and temperature are measured by fast resolution (274 ms) charge exchange recombination (CER) spectroscopy in the 1 kHz freely rotating case and by standard CER (5 ms) in the 10 Hz entrainment. In both cases the measured perturbed rotation qualitatively agrees with the theoretical picture [1,2]. A comparison of the measured nonlinear island structures with that from the linear resistive stability code M3D-C1 will be presented noting that extrapolating measurements to small initial islands is a key issue for destabilization of neoclassical tearing modes in ITER [3].

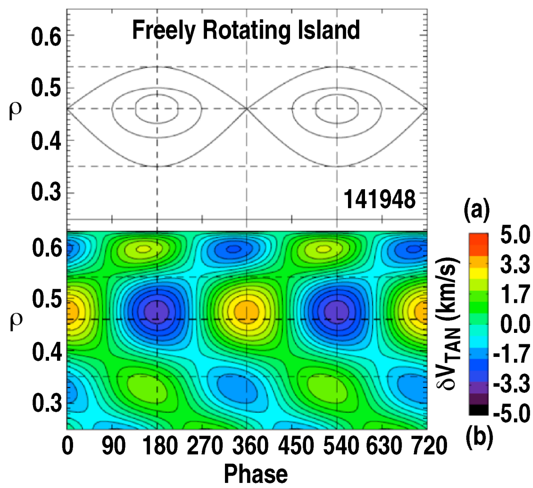

Fig. 1. (a) Island structure from fit to radial ECE measurements, (b) perturbed tangential rotation fit from CER data for a DIII-D case with a freely rotating island.

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*Work supported in part by the US Department of Energy under DE-FC02-04ER54698 and DE-AC05-06OR23100.