Magnetic Island Evolution Due to ELM-NTM Coupling in DIII-D*

J.D. King[1,2], R.J. La Haye[3], C.C. Petty[3], T.H. Osborne[3], C.J. Lasnier[1], M.J. Lanctot[1], M.A. Makowski[1], C.T. Holcomb[1], S.L. Allen[1], and E.C. Morse[2]

[1]*Lawrence Livermore National Laboratory, Livermore, California 94550, USA*
[2]*University of California-Berkeley, Berkeley, California 94720, USA*
[3]*General Atomics, PO Box 85608, San Diego, California 92168-5608, USA*

Previous work shows that coupling between edge localized modes (ELM) and m/n=3/2 neoclassical tearing modes (NTM) pumps poloidal flux from the core to the edge in hybrid discharges allowing q_{min} to be maintained above 1 for the avoidance of sawteeth [1]. Similar flux-pumping is now observed for m/n=2/1 mode cases farther from the magnetic axis but closer to the edge. This suggests comparable physics is at work.

Intermediate n ELMs are observed to couple to saturated m/n=2/1 NTMs causing significant transient drops in magnetic island width. These changes in the NTM are measured using external Mirnov probes, as well as internal electron cyclotron emission (ECE) and motional Stark effect (MSE) diagnostics. The fast island width drop occurs on an Alfvénic timescale and is followed by a slow recovery, consistent with resistive diffusion, to the original saturated width. Inclusion of a negative impulse term in the modified Rutherford equation (MRE) allows the NTM recovery phase to be described analytically.

For 2/1 NTMs an upward trend has been identified between the "size" of the ELM and the depth of the island drop. Specifically, the fractional change in the island width has been found to increase with the ELM fractional stored energy loss measured by both in-vessel diamagnetic loops and divertor tile IRTV camera heat flux measurements. This finding suggests larger ELMs with lower order dominant modes [2] are at a closer proximity to the $q=2$ rational surface and have greater mode number matching, resulting in stronger coupling. Experimental comparison with NIMROD simulations will be presented.

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