Characterization of Low-Frequency MHD Activity in Local Helicity Injection

C.E. Schaefer, M.W. Bongard, R.J. Fonck, J.A. Reusch, and N.J. Richner

Department of Engineering Physics, University of Wisconsin-Madison, Madison, WI 53706

Strong, low-frequency (~20–40 kHz) $n = 1$ activity is generally observed on the low field side (LFS) during Local Helicity Injection (LHI) non-solenoidal tokamak startup. NIMROD simulations of LHI suggest this $n = 1$ mode is associated with reconnection of the edge current streams via island coalescence instabilities. Prior work has characterized the LHI $n = 1$ mode in Pegasus as a singly line-tied kink instability of the injected current streams. A new operational regime was found at low B_T above a threshold I_p where this $n = 1$ mode is abruptly stabilized, leading to improved performance. However, access to this regime is restricted at higher B_T with $I_{p,crit} \propto I_p/I_{TF} \sim 1$, contrary to expectations from kink stability theory. A new 3D Hall sensor probe is used to measure internal $\boldsymbol{B}(R,t)$ on equilibrium timescales (< 50 kHz). Initial measurements during LHI indicate the probe can directly locate the plasma boundary and, in conjunction with external magnetics, give insight into the spatial structure of LFS MHD. Planned experiments will measure the $n = 1$ activity and edge $\boldsymbol{B}(R,t)$ using the 3D probe in discharges that feature the MHD transition.

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