**Reconstructions of Global Plasma Oscillations on C-2W**

**via 300-channel Bolometry System**

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In TAE Technologies’ current experimental device, C-2W (also called “Norman”) [1], record breaking, advanced beam-driven field reversed configuration (FRC) plasmas are produced and sustained in steady state utilizing variable energy neutral beams (15 – 40 keV, total power up to 20 MW), expander divertors, end bias electrodes, and an active plasma control system. FRC plasmas in C-2W are stable to MHD modes due to a combination of end biasing and neutral beam injection [2] and can even remain stable to the tilt mode past the traditional empirical stability boundary of S\*/E < 3 [3]. There is an ongoing effort to study the stabilization mechanisms as well as low-amplitude MHD modes which remain in stable plasmas. A 300-channel bolometer system installed on C-2W utilizes photodiode arrays to collect broadband radiation (SXR to NIR) along 180 unique lines of sight that intersect a toroidal plane of the FRC near the mid-plane, providing a diagnostic for bulk plasma motion and MHD activity [4]. Automated scripts process the raw photo-signals after each plasma discharge, yielding time-resolved tomographic reconstructions and centroid trajectories of the near-midplane emissivity profile. Both 1D and 2D tomographic reconstructions are achieved via pixel-based methods with Phillips-Tikhonov regularization, while the centroids are derived via a custom view chord intersection algorithm. The reconstructions reveal stable, annular emission profiles with low-amplitude MHD mode structure. Application of singular value decomposition (SVD) to the reconstructed profiles successfully resolves toroidal mode numbers n=0, n=1, and n=2. Both the tomographic reconstructions and the centroid trajectories indicate that the n=1 toroidal mode reverses from the electron diamagnetic direction to the ion diamagnetic direction and grows in amplitude immediately after termination of end biasing, qualitatively consistent with the expected stabilizing effect of the electrodes. Diagnostic considerations for improving signal-to-noise and accounting for photodiode sensitivity degradation are also addressed.

[1] H. Gota et al, “Formation of hot, stable, long-lived field-reversed configuration plasmas on the C-2W device,” Nuclear Fusion **59**, 112009 (2019).

[2] M. Tuszewski et al, "Field Reversed Configuration Confinement Enhancement through Edge Biasing and Neutral Beam Injection," Physical Review Letters **108**, 255008 (2012).

[3] T. DeHaas et al, “Magnetic Field-Shaping Effects on Tilt Stability in C-2W Field Reversed Configuration.” Poster presented at: 64th Annual Meeting of the APS Division of Plasma Physics; October 20th, 2022; Spokane, WA.

[4] A. S. Bondarenko et al, "Tomographic and centroid reconstructions of plasma emission on C-2W via enhanced 300-channel bolometry system," Review of Scientific Instruments **93**, 103517 (2022).