

P2.1006 Equilibrium and stability calculations of MAST spherical torus plasmas in preparation for MAST-U

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See full abstract here

<http://ocs.ciemat.es/EPS2019ABS/pdf/P2.1006.pdf>

Disruption prediction and avoidance is necessary in future MAST-U spherical tokamak discharges to enable long-pulse plasma operation. Research examining the stability of plasmas in the MAST database utilizing new kinetic equilibrium reconstructions and comparisons to present models in the Disruption Event Characterization and Forecasting code (DECAF) [1] will illuminate relevant physics and enable subsequent analysis and control for MAST-U. A parametrized forecasting model for Nno-wall implemented in the DECAF code and tested for NSTX is compared to MAST using input from magnetics-only reconstructions. Initial ideal MHD stability analysis has also begun using the DCON code with unstable modes found above about $N = 5$ for the magnetics-only reconstructions. The DECAF model for Nno-wall was about 4.3 for similar plasma conditions. The continuing work is now examining improvements to the accuracy of global MHD stability analysis gained when using equilibrium reconstructions including kinetic plasma profiles and motional Stark effect data on MAST plasmas. It is also important for spherical tokamak plasmas to include currents in the device conducting structure, as they can comprise a significant component of the toroidal current during the discharge. An axisymmetric wall model of MAST created for EFIT analysis is also used in VALEN time-domain calculations using experimental currents in coils with and without plasma current for verification. The DECAF code consists of many separate physical event modules that provide warnings and declare occurrences of certain events leading to disruption and has been applied to the MAST database to examine density and vertical stability limits. Disruptivity diagrams indicate where disruptions occur in various parameter spaces, and examination of vertical displacement events show that they occur less often than in NSTX, but when they do occur it is in close time proximity to the disruption current quench. MAST operation was bound by the Greenwald density limit, and this limit was often reached in the current ramp-down which lowered the limit below the level of the experimental plasma density.

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Presenter: BERKERY, J.W. (EPS 2019)

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