Stability Research for Disruption Prediction and Avoidance in MAST-U Spherical Tokamak Plasmas

S.A. Sabbagh, J.W. Berkery, J.M. Bialek, Y.S. Park (Columbia University)

- Motivation: Expand ST Disruption Prediction Research
  - In response to DOE DE-FOA-0001784: “Collaborative Research on International and Domestic Spherical Tokamaks”
- Major Elements:
  1. Generate kinetic equilibrium reconstructions of MAST/-U plasmas to support stability and disruption prediction calculations. Distribute to MAST-U Team.
  2. Apply and expand disruption event characterization and forecasting (DECAF) using MAST database, and for MAST-U
  3. Actively assess plasma stability for disruption prediction and avoidance (DPA)

Stability, disruption prediction/avoidance elements aim at key needs for both MAST-U and US collaboration

- Symbiotic collaboration
  - Highly desired by MAST-U program/US collaboration making closer connection to ITER, brings new capabilities, expands DPA research
  - MAST/-U provides unique lab: ST geom with *no* conducting wall, high β with adv. divertor, 3D field capable, world class diagnostic set
- Significant new capabilities in main research elements
  - Routine kinetic equilibrium reconstructions of MAST/-U (including MSE, flux-isotherm constraint, plasma rotation desired by program)
  - Stability analysis including ideal and resistive MHD, kinetic effects, non-linear resistive MHD; connection to TRANSP analysis (S. Kaye)
  - Application of expanding DECAF code: multi-machine data essential
  - Active MHD spectroscopy for measurement of plasma stability
  - Evaluation of plasma response through state-space mode observer
- A coordinated experimental program is part of this research