DPP11-2011-001505

Abstract for an Invited Paper
for the DPP11 Meeting of
the American Physical Society

High Resolution Detection and Excitation of Resonant Magnetic Perturbations in a Wall-Stabilized Tokamak[1]

DAVID MAURER, Columbia University

We report the first high-resolution detection of the 3D magnetic response of wall- stabilized tokamak discharges in the High Beta Tokamak-Extended Pulse (HBT- EP) device. A new adjustable conducting wall has been installed on HBT-EP made up of 20 independent, movable, wall segments instrumented with three distinct sets of 40 modular coils that can be independently driven to generate a wide variety of magnetic perturbations [1]. High-resolution detection of the plasma response is made with 216 poloidal and radial magnetic sensors that have been located and calibrated with high-accuracy. Static and dynamic plasma responses to resonant and non-resonant magnetic perturbations are observed through measurement of the step-response following a rapid change in the toroidal phase of the applied perturbations. Biorthogonal decomposition of the full set of magnetic sensors clearly defines the structures of multiple modes without the need to fit either a Fourier or a model-based basis. We have observed the plasma response to be strongly dependent on the edge safety factor, q_a, and the helicity of the control coil currents. As the amplitude of the applied perturbations increase, the initially linear plasma response becomes nonlinear. We observe the plasma response to saturate and, at the highest levels of applied fields, a major disruption is induced when the applied perturbation is rapidly switched off and the plasma attempts to relax back from the induced asymmetry. Modeling of the response with ideal MHD indicates the strongest multimode response occurs with $q_a \sim 3$ with the excitation of both n=1 and 2 modes. These predictions are compared with measurements of the plasma response as a function of q_a and plasma rotation.

[1] D A Maurer, et al., 2011 Plasma Phys. Control. Fusion 53 074016

[1]Work supported by U.S. DOE Grant DE-FG-02-86ER53222.