Contribution ID: **3442** Type: **not specified**

P4.1066 Studies of RWM feedback control in EXTRAP T2R

Thursday, 11 July 2019 14:00 (2 hours)

See full abstract here
http://ocs.ciemat.es/EPS2019ABS/pdf/P4.1066.pdf

The RWM instability, relevant for the advanced tokamak operation scenario, grows on the time scale of magnetic field diffusion through the conducting structures surrounding the plasma. Substantial progress has been made in the understanding and stabilization of the RWM [1]. In this work, models of resistive wall mode (RWM) instability are studied and validated in dedicated plasma experiments. The aim is to contribute to the development of high-performance, model-based active magnetic feedback algorithms for RWM control. Statespace, model based feedback control algorithms have potential advantages compared to conventional controllers such as proportional-integral-derivate (PID) control [2]. However, in order to benefit from these advantages, it is a necessary prerequisite to have a realistic model of the RWM instability including both plasma and the conducting structures. There are in principle two main methods to obtain such a model; 1) through first-principles physics, leading to "white box" models of the controlled plant, and 2) through empirical modeling experiments, often referred to as "system identification" leading to "black box" models [3]. In this work, first principles RWM instability models are experimentally validated in the EXTRAP T2 reversed-field pinch (RFP) device [4]. Due to the low toroidal magnetic field of the RFP equilibrium, current-driven RWMs are robustly unstable at all values of beta. The easy access to the RWM instability makes the RFP configuration suitable for studies of RWM control. The unstable RWM spectrum of the RFP consists of a wide range of modes. For a high aspect ratio, circular cross-section RFP device, the circular cylinder MHD model is approximately valid, and the RWMs are in this model Fourier modes with poloidal mode number m= 1 and a range of toroidal mode number n. The unstable range depends on the aspect ratio of the device. For EXTRAP T2R with aspect ratio R/a = 1.24 m/ 0.183 m = 6.8, the unstable spectrum consists of toroidal mode numbers in the range from around n=-11 to n=+6 for a typical equilibrium. The sign of the mode number indicates here the handedness of the mode helicity. Since the mode spectrum consists of modes with variation of spatial structure in the toroidal direction, different modes can easily by separated experimentally using toroidal array of sensors. The aim of the present work is to validate the model spectrum over a wide range of n-modes, also including stable modes at higher n values.

[1] Chu M.S and Okabayashi M., Plasma Phys. Control. Fusion 52 (2010) 123001. [2] Clement M., et al, Nucl. Fusion 58 (2018) 046017. [3] Olofsson K.E.J., et al, Plasma Phys. Control. Fusion 53 (2011) 084003. [4] Brunsell P R, Plasma Phys. Control Fusion 43 (2001) 1457-1470.

Presenter: SAAD, E. (EPS 2019)

Session Classification: Poster P4

Track Classification: MCF