Resistive Wall Mode Observation and Control

J. P. Levesque
APPH 4990: ITER Seminar Project Proposal
Columbia University

An important instability that limits plasma performance in tokamaks is the resistive wall mode (RWM). This mode is a form of the ideal external kink whose growth rate has been slowed from an Alfvénic time scale to the resistive time scale of a nearby conducting wall. Pressure and current gradients at the plasma edge drive the RWM, thus high-pressure machines such as ITER are inevitably susceptible to the instability.

This project will review RWMs as they relate to ITER-relevant plasmas. A basic cylindrical RWM model will be introduced. Stability theory will briefly be extended to rotation and kinetic effects such as resonances with collision, drift, and bounce frequencies. Methods for predicting and observing RWMs will be described. Measured characteristics of RWMs will be shown for several tokamaks. Stabilization mechanisms will be described, including passive wall stabilization, active feedback, plasma rotation, and fast particle populations. The impact of RWMs on ITER operating scenarios will be discussed, as well as the suppression of RWMs in ITER and future burning plasmas.

References

1. R. Fitzpatrick and A.Y. Aydemir, "Stabilization of the resistive shell mode in tokamaks." *Nuclear Fusion* **36**, 11 (1996)
2. T. C. Hender et al., "Chapter 3: MHD stability, operational limits and disruptions." *Nuclear Fusion* **47**, S128 (2007)
3. J. W. Berkery et al., "The role of kinetic effects, including plasma rotation and energetic particles, in resistive wall mode stability." *Physics of Plasmas* **17**, 082504 (2010)
4. L. Delgado-Aparicio et al., "Soft x-ray measurements of resistive wall mode behavior in NSTX." *Plasma Phys. Control. Fusion* **53** 035005 (2011)
5. S. A. Sabbagh et al., "Advances in global MHD mode stabilization research on NSTX." *Nuclear Fusion* **50**, 025020 (2010)
6. M. Okabayashi et al., "Comprehensive control of resistive wall modes in DIII-D advanced tokamak plasmas." *Nuclear Fusion* **49**, 125003 (2009)
7. T. S. Pedersen et al., "Experiments and modeling of external kink mode control using modular internal feedback coils." *Nuclear Fusion* **47**, 1293 (2007)