Model based feedback control of resistive wall modes using external coils*

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A promising avenue toward achieving stable tokamak operation above the no wall beta limit for the resistive wall mode (RWM) involves the use of magnetic feedback to detect and stabilize the mode, and feedback stabilization experiments using classical control algorithms have met with some success. Simulations of RWM feedback in ITER indicate that plasma pressures up to 84% of the ideal wall beta limit can be attained using an advanced control algorithm that incorporates a three-dimensional VALEN [1] model for the control and sensor coils, vacuum vessel wall, and plasma stability [2]. Furthermore, using the advanced controller is predicted to result in a ten-fold reduction in control power, compared with classical, proportional-derivative gain feedback. A VALEN model for the DIII-D vacuum vessel wall and coil sets has been validated using frequency-dependent vacuum vessel eddy current measurements and serves as the basis for an advanced controller design. The DIII-D experiment makes an ideal test bed for ITER-relevant RWM control strategies because DIII-D's external, non-axisymmetric control coil set closely resembles the one that is planned for ITER. A reproducible target discharge exhibiting current-driven RWM activity has been established for feedback experiments on DIII-D. Comparative simulations of advanced and classical controller-based RWM feedback for DIII-D and progress in implementing an advanced control algorithm for experiments will be reported.

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*Work supported by the US Department of Energy under DE-FG02-04ER54761, DE-AC05-06OR23100, DE-FG02-06ER84442, DE-AC02-09CH11466, and DE-FC02-04ER54698.