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Vessel Forces from a Vertical Displacement Event in ITER[1]
STEPHEN JARDIN, CESAR CLAUSER, Princeton Plasma Physics Laboratory
— Disruptions are one of the major concerns in ITER and other future tokamaks. A particularly troublesome type of disruption is a vertical displacement event (VDE) where control of the vertical position of the plasma column is lost. In addition to heat, particle flux, and energetic electrons impacting the first wall, significant electromagnetic loads will arise. For realistic modelling of a VDE disruption, an accurate 3D model of the disrupting plasma and the surrounding conducting structures is required. The structure affects the plasma evolution itself and the plasma acts as a source of currents and fields which produce the electromagnetic loads. Most of the VDE modeling work to date has used the axisymmetric evolving equilibrium codes TSC, DINA, and CarMa0N to describe the disrupting plasma. This paper describes more recent efforts to extend this analysis by using the fully 3D MHD code M3D-C1. We have performed several long-time simulations of VDEs in a model of ITER with realistic structure time-constants. We find that the horizontal (sideways) force depends strongly on the vessel time-constant, and on the ability of the disrupting plasma to reach a state where the edge safety factor, q(a) <1. This depends on the current-quench time, on the amount of halo current present, and on the rate at which the vertical displacement changes during the current quench.

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Stephen Jardin
Princeton Plasma Physics Laboratory

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