Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Axisymmetric Stability in Ferromagnetic Tokamaks OLIVER BARDSLEY, TIM HENDER, UK Atomic Energy Authority — In the first generation of fusion power plants, ferritic steels are attractive candidate materials for structural elements of first wall and breeding regions. These materials, however, are ferromagnetic and uncertainties remain as to the magnitude of the negative effects this may have on plasma confinement, particularly with the significant quantities of steel required. Vertical stability and control in tokamaks is an important design concern, particularly so at high plasma elongation. We present an analytical model of vertical displacement events in tokamaks with resistive walls, which assesses the modification to their passively stabilising influence when ferromagnetic effects are included. A dichotomy is found in the dependence of the instability growth rate upon the materials magnetic permeability. For rapid instabilities, the induced currents penetrate only part way through the wall and its passive stabilising force is depleted. For slower instabilities, the wall is magnetically thin and the ferromagnetic field evolves in a quasi-steady manner, providing an additional destabilising influence. In either case, the growth rate is increased by a factor on the order of the effective relative magnetic permeability (~ 2).

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Date submitted: 29 Jun 2020 Electronic form version 1.4