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Formation and evolution of localized pressure gradients from force-free magnetic fields ADELLE WRIGHT, Australian Natl Univ, NATE FERRARO, STUART HUDSON, Princeton Plasma Physics Laboratory — We develop a theoretical framework that quantifies the conditions under which the evolution of a tokamak-relevant plasma can be approximated by a sequence of instantaneous equilibria and, as an illustrative example, apply this principle to model the onset of a 3D helical core in tokamak-like equilibria. We then consider the evolution of a 1D cylindrical initial state which resembles a (possibly nonlinear) force-free magnetic field seeded with localized pressure gradients. Using the M3D-C1 extended MHD code we explore the validity of the proposed framework and identify circumstances in which pressure gradients diffuse via ohmic dissipation, persist or accumulate. Gradual accumulation, followed by rapid collapse, of localized pressure gradients is commonly associated with phenomena which play an important role in magnetically confined fusion devices, including internal transport barriers, edge-localized modes and sawtooth cycles. Modelling temporally extended phases of relatively slow (e.g. quasi-steady state) plasma evolution as a sequence of equilibria would circumvent the need to evolve the full set of extended or resistive MHD equations over large time domains, yielding clear benefits for time and computational resources, particularly in complex, 3D geometries.

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