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Model Improvement for Transonic Flows[1] LUCA GUAZZOTTO, RICCARDO BETTI, University of Rochester, STEVE JARDIN, Princeton Plasma Physics Laboratory — Finite toroidal and poloidal flows are routinely observed in the edge plasma region of tokamaks. MHD theory predicts that when the poloidal velocity becomes transonic with respect to the poloidal sound speed ($c_{sp} \equiv c_s B_p/B$, where B_p is the poloidal field) transient shocks will develop in the transonic region. The shocks will move in the poloidal direction and disappear once they reach the location of the minimum transverse flow cross section. After the transient, a steady-state pedestal in plasma density and pressure is left, with the height of the pedestal depending on the poloidal location. Time-dependent and equilibrium calculations confirm the theoretical picture. Here we present several improvements to the existing numerical and theoretical results. Derivation and implementation of an equilibrium numerical solution explicitly enforcing the correct jump condition across the transonic discontinuity are shown. This has an effect on equilibrium profiles only if the discontinuity is located in a high-beta region. We also show that the transonic discontinuity is removed and replaced by a boundary layer through a two-fluid treatment of the plasma. The implementation of an expression for neoclassical poloidal viscosity in time-dependent simulations is also discussed.

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