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Numerical Study of Two-Fluid Transonic Equilibria[1] LUCA GUAZZOTTO, Auburn University, RICCARDO BETTI, University of Rochester — In axisymmetric plasmas "transonic" equilibria are equilibria, in which the poloidal macroscopic velocity of the plasma is larger than a characteristic velocity ($\sim C_{sp} = C_s B_p/B$) in the edge region of the plasma and smaller than C_{sp} in the central region. Theoretical ideal MHD analysis proved that the two regions are separated by a contact discontinuity on a critical magnetic surface. Except for one point in the poloidal cross section, plasma density, pressure and velocity have finite jumps between the two sides of the discontinuity. Since there is no macroscopic flow perpendicular to the discontinuity due to the frozen-in law, the discontinuity can exist at steady state without energy dissipation or increase of entropy. Numerical solutions of the equilibrium equations confirmed the theoretical results. It is unknown whether the transonic discontinuity still exists in a two-fluid model of the plasma or is replaced by a narrow boundary layer, since in this model magnetic field and plasma velocity do not reside on the same family of surfaces. We explore for the first time the properties of transonic equilibria in a two-fluid model with numerical tools adapted to include dedicated routines based on the ones designed for the solution of the MHD transonic problem.

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