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Two-Fluid Equilibrium Calculation and Applications[1] LUCA GUAZZOTTO, RICCARDO BETTI, University of Rochester — Poloidal and toroidal flows are routinely found in tokamak equilibria. In ideal MHD, the axisymmetric equilibrium problem reduces to the solution of a PDE for the magnetic poloidal flux ψ coupled with an algebraic equation for the plasma density. Plasma velocity is within magnetic surfaces. This picture is modified when two-fluid effects are considered. Neglecting electron inertia, plasma flow is found to lie on stream surfaces labeled by the stream function $\Psi \neq \psi$. Assuming quasi-neutrality, the equilibrium problem requires the solution of two coupled PDEs and an algebraic equation for the density. In this work, we present the status of the development of FLOW2, designed to solve the two-fluid equilibrium axisymmetric problem in arbitrary geometry. Applications, limiting cases and reduction to MHD are presented. In particular, we focus on transonic equilibria, that is equilibria in which the poloidal velocity in faster than the poloidal sound speed ($C_{sP} = C_s B_p/B$) at the plasma edge, and slower in the center. The discontinuous MHD solution is modified by two-fluid effects. Comparison with theory and MHD solution are presented.

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