Certain developments on the equilibrium of magnetized plasmas

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Recent results will be presented on steady states of magnetically confined plasmas obtained by conventional and Hamiltonian methods. The presentation consists of three parts. The first one concerns the derivation of a generalized Grad-Shafranov equation describing helically symmetric equilibria with pressure anisotropy and incompressible plasma flow of arbitrary direction with application to straight-stellarator configurations [1]. The impact of pressure anisotropy and flow on the equilibrium characteristics is also examined. In the second part the axisymmetric equilibrium code HELENA is extended for pressure anisotropy and flow parallel to the magnetic field and ITER-pertinent equilibria are constructed. In the third part the Hamiltonian formulation of helically symmetric plasmas is established within the framework of extended MHD, a simplified two-fluid model including Hall-ion and electron-inertia contributions [2,3]. Four families of Casimir invariants are obtained and they are used to construct Energy-Casimir variational principles for deriving generalized extended MHD equilibrium equations with arbitrary flow. The system is then cast into the form of Grad-Shafranov-Bernoulli equations. In addition, an example of an incompressible double-Beltrami equilibrium will be presented in connection with a straight-stellarator configuration.

References:

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