Bootstrap current in optimized stellarators

A.S. WARE, University of Montana, D.A. SPONG, L.A. BERRY, S.P. HIRSHMAN, J.F. LYON, Oak Ridge National Laboratory — This work examines bootstrap current and its impact on the equilibrium properties in optimized stellarators. Two independent methods are used to calculate the bootstrap current: a fast code based on a calculation in an asymptotically collisionless limit [K. C. Shaing, et al., Phys. Fluids B 1, 148 (1989)] and a fluid moments approach that self-consistently calculates the neoclassical transport coefficients, including the bootstrap current [D. A. Spong, Phys. Plasmas 12, 056114 (2005)]. The bootstrap current calculations from the two codes were done for low density, ECH-heated and high density, ICH-heated plasmas. In the configurations examined here, namely, the Quasi-Poloidal Stellarator (QPS), the National Compact Stellarator Experiment, the Helically Symmetric Experiment (HSX), the Large Helical Device, and the Wendelstein-7X Stellarator (W7-X), the bootstrap currents predicted from the two codes agree qualitatively for both ICH and ECH profiles. A self-consistent bootstrap current results in a negligible increase in the rotational transform for W7-X, an increase in the rotational transform for QPS, and a larger decrease in the rotational transform for HSX.

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