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Gyrokinetic-neoclassical study of the bootstrap current in the H-mode pedestal[1] ROBERT HAGER, C. S. CHANG, S. KU, PPPL, E. S. YOON, RPI, E. F. D'AZEVEDO, P. H. WORLEY, ORNL — Since existing bootstrap current formulas are based on assumptions that are valid only under core plasma conditions, we developed an improved bootstrap current formula for the steep H-mode pedestal based on simulations with the gyrokinetic-neoclassical particle-in-cell code XGCa [R. Hager, C.S. Chang, Phys. Plasmas 23, 042503 (2016)] using a fully nonlinear, multi-species Fokker-Planck-Landau collision operator. The new formula is much more accurate than the widely used formula by Sauter et al. [O. Sauter et al., Phys. Plasmas 6, 2834 (1999)], which deviates by about 24.8 percent from XGCa results. The new bootstrap current formula is applied to electromagnetic stability calculations with a version of gyrokinetic code XGC1 that uses gyrokinetic ions and fluid electrons. Two significant findings from this XGCa study of the bootstrap current are the significant contribution of trapped electrons to the total current and the finite orbit width effects that generally decrease the bootstrap current compared to the prediction from conventional neoclassical theories and simulations. We also present the numerical implementation and results of verification studies of our nonlinear collision operator.

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Robert Hager
PPPL

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