TGLF transport modeling of DIII-D hybrid discharges

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Abstract

Previous work has summarized the physics and first results of benchmarking the Trapped Gyro-Landau-fluid (TGLF) model for turbulent transport driven by trapped ion and electron modes, ion and electron temperature gradient (ETG) modes and electromagnetic kinetic ballooning modes including the effects of shaped geometry. Recently, an improved collision model was implemented which provides a more accurate fit to a transport database of nonlinear collisional GYRO [J. Candy and R.E. Waltz, J. Comput. Phys. **186**, 545 (2003)] simulations of long wavelength driftwave turbulence. The impact of the new collision model on TGLF modeling results was unknown. Using the improved TGLF model we obtain excellent agreement with the ion and electron temperature profiles from 30 DIII-D [A. Mahdavi and J.L. Luxon, Fusion Sci. Technol. **48**, 2 (2005)] hybrid discharges. The transport results show that the electron energy transport tends to be dominated by short wavelength ETG modes in cases where the ion energy transport approaches neoclassical levels. The hybrid regime has significant energy confinement improvement from $E \times B$ velocity shear which is well predicted by TGLF. Weak magnetic shear and low safety factor are also shown to enhance the hybrid regime energy confinement. In high normalized β hybrids we find that finite β effects noticably reduce the predicted electron energy transport and improve agreement with the measured electron temperature profiles.

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