Development and Validation of the Next Generation Trapped Gyro-Landau-Fluid Transport Model*

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The next generation trapped gyro-Landau fluid (TGLF) transport model [1-3] includes several advances that remove the limitations of its predecessor, GLF23. In particular, the trapped electron model is greatly improved and both trapped and passing particles are included in a single system of moment equations valid for all wavenumbers. The model solves for the linear eigenmodes of trapped ion and electron modes (TIM, TEM), ion and electron temperature gradient (ITG, ETG) modes and finite beta kinetic ballooning (KB) modes in either shifted circle or shaped geometry [2]. In the first phase of developing TGLF, the linear eigenmodes from the model were successfully benchmarked against a database of 1800 linear stability calculations [3] using the GKS gyrokinetic code. The next phase focused on finding a saturation rule that used the quasilinear (QL) weights from TGLF and accurately fit the fluxes from nonlinear simulations. In the process, a database of over 400 nonlinear gyrokinetic simulations using the GYRO code was created [4]. A subset of 140 kinetic electron simulations with Miller shaped geometry was used to fit a model for the saturation fluctuation intensity in TGLF. The resulting TGLF transport model yields remarkable agreement with the GYRO energy and particle fluxes. Employing this QL saturation rule and a new ExB shear quench rule for shaped geometry, the next step was to validate TGLF using experimental data. Recently, the TGLF predictions of the density and temperature profiles were compared against experimental data from a database of 96 L- and H-mode discharges from the DIII-D, JET, and TFTR tokamaks [1]. The benchmarking of the model using gyrokinetic simulations and validation of the model using experimental profile data will be summarized. Included are the results obtained examining the sensitivity of the predictions to geometry, ExB shear, and the fraction of ETG transport. Examples of successes and discrepancies for the energy and particle transport are given. The validation metrics employed and future upgrades to TGLF (e.g. momentum transport) will also be discussed.

[1] J.E. Kinsey, G.M. Staebler, and R.E. Waltz, to appear in Phys. Plasmas, May (2008).
[2] G.M. Staebler, J.E. Kinsey, and R.E. Waltz, Phys. Plasmas **14**, 055909 (2007).
[3] G.M. Staebler, J.E. Kinsey, and R.E. Waltz, Phys. Plasmas **12**, 102508 (2005).
[4] The GYRO database is documented at fusion.gat.com/theory/gyro.

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