Status of GLF23 model for AT Transport

- GLF23 is a quasilinear theory based model with a comprehensive spectrum of linear drift-ballooning modes used to compute transport: ITG, TEM, ETG
- GLF23 is not a non-linear turbulence simulation code. It is a model approximation to the transport predicted by simulation codes.
- The GLF23 model has been extensively tested against L-mode and H-mode core data and is found to be a good predictor of core temperature profiles.
- The L-mode and H-mode database mostly tests the ITG sector of the model including the impact of ExB shear on the critical ion temperature gradient.
- Modeling of AT regimes with GLF23 can accurately predict the location of an ExB shear induced transport barrier and the ion thermal transport (which is neoclassical) within the barrier. The ETG driven electron thermal transport is about right for barriers which are toroidal rotation dominated and have weak magnetic shear.
- GLF23 should be adequate for predicting the increase in the ITG threshold temperature gradient caused by ExB shear including toroidal rotation.
- Particle transport in GLF23 is caused by ITG and TEM modes but has not been extensively tested by experiment.

Outstanding issues for GLF23 and AT Transport

- Experiments show that toroidal momentum transport is of the order of ion neoclassical thermal transport within an ITB. GLF23 would predict neoclassical toroidal momentum transport once the ITG/TEM modes are turned off. This can be two orders of magnitude too small.
- Experiments show that for weak magnetic shear particle transport within an ITB is not strongly reduced but can be reduced for strongly negative shear. GLF23 always has neoclassical particle transport if the ITG/TEM modes are turned off by ExB shear.
- Experiments show that the electron temperature profile has a steep region in the strongly negative magnetic shear region but that there is profound flattening of the electron temperature profile near the center. GLF23 does not accurately fit the gyrokinetic growth rates for ETG modes for strongly negative shear which have been shown to be consistent with the data. The flat region in the center is not a drift-ballooning mode.
- Thus, GLF23 and basic drift-wave transport theory have to resolve the above issues before AT plasmas transport can be predicted.

Theoretical Candidates for AT transport

- The problem with the poor fit in GLF23 to negative magnetic shear growth rates has been identified and is being fixed. (sorry about that)
- Trapped electron modes may not be quenched by ExB shear in the way ITG modes are. This would resolve most issues since the ion thermal transport could drop to neoclassical levels while particle, momentum and electron thermal transport remain above neoclassical values. Linear theory predicts a higher ExB shear is required for stability of TE modes.
- ETG modes could produce a non-adiabatic ion response. This is more speculative but could also resolve all the above issues in principle.
- At present the only information we have about the strong flattening in the center of negative central shear plasmas is that it correlates well with resistive interchange instability, it has a beta dependence and it stops about where $q<2$.