GLF2003: a Theory Based Transport Model for the Edge and Core*

G.M. Staebler,[1] J.E. Kinsey,[2] R.E. Waltz[1]
[1]General Atomics, P.O. Box 85608, San Diego, California 92186-5608
[2]Lehigh University, Bethlehem, Pennsylvania 18015

The theory based transport model GLF23, published in 1997, has proven to be an accurate predictor of the core energy confinement in L-mode and H-mode tokamak plasmas. The strength of the model is that it closely approximates the linear growth rates of the dominant drift-wave instabilities. Since the temperature profiles are often close to the marginal linearly stable profiles for these modes, the quasilinear GLF23 model can succeed with only a crude model for the saturated amplitude of the turbulence. The original GLF23 model was valid for only a limited range of magnetic shear and Shafranov shift and used a shifted circle magnetic geometry. Hence, it could not be used for modeling the plasma edge. It has also been observed that experimental plasma condition in the outer part of the plasma can have very strongly unstable electron temperature gradient modes (ETG). These modes normally are not unstable in the same range of poloidal wavenumber as the ion temperature gradient mode (ITG). However, in the outer 20% of the plasma, kinetic linear stability analysis has found the unstable wavenumber range of ETG and ITG modes can overlap. This situation violates the assumption of a stable gap between ETG and ITG wavenumber ranges used in GLF23. It also opens up the possibility that ETG modes can produce significant particle and ion heat transport in addition to the electron thermal transport in the overlapping region. In order to address these limitations of GLF23, and with the aim of making a transport model which is valid close to the separatrix , we have begun development of a new model GLF2003. The new model treats electrons and ions together on the same footing, so both ETG and ITG modes can co-exist. A more accurate solution of the gyrofluid linear eigenmodes is made using a new solution method. This removes the limitations on magnetic shear and Shafranov shift. An improved set of gyrofluid equations that includes both trapped and circulating particles has also been developed. The last step will be to include shaped magnetic geometry in order to obtain an accurate kinetic ballooning mode threshold. Details of the construction of GLF2003 will be presented.

*Work supported by U.S. Department of Energy under Grant Nos. DE-FG03-95ER54309 and DE-FG02-92ER54141.