Ion Transport From Electron Driftwave Instabilities*

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If electron temperature gradient (ETG) modes produce some ion transport it could solve an important puzzle arising in transport barrier regimes. When the E×B velocity shear exceeds the linear growth rates of the ion temperature gradient (ITG) and trapped electron modes these modes are theoretically stabilized and do not produce transport. Experimentally it is observed that the electron thermal transport remains well above its neoclassical value within a transport barrier. This may be explained as due to ETG modes which have too high a growth rate to be stabilized by E×B velocity shear. The particle and ion momentum transport is also observed to remain above neoclassical levels. It is possible that this transport could result from the ETG modes non-linearly coupling to the stable ITG modes. A fully non-linear simulation with both ETG and ITG modes is not possible with today's computers. Even quasilinearly, ETG modes can produce ion transport, especially if the ITG and ETG modes are unstable at the same wavenumber. The implications of this on transport will be explored at the quasilinear level with a new model. Gryo-Landau-Fluid (GLF) models have been shown to give an accurate approximation to the kinetic linear growth rates of drift-ballooning modes in tokamaks [1-4]. Even though the GLF model GLF23 has ETG modes, they are assumed to be decoupled from the ions. A new set of GLF equations is needed in order to treat coupling between ETG modes and ions. The new model presented here has three moments for trapped particles and six moments for passing particles. The closure of the highest moments yields coefficients which are functions of the trapped particle fraction. A model for the boundary between those trapped particles which can bounce average a given wave and those which can have a Landau resonance with the wave is developed. Using this bounce averaging fraction in place of the trapped fraction gives a model which is valid over the full spectrum of drift-wave eigenmodes and is not restricted to modes with frequency below the bounce frequency. The GLF model gives a much faster calculation of the linear eigenmodes than a gyrokinetic initial value code.

[1] G.W. Hammett and F.W. Perkins, Phys. Rev. Lett. **64**, 3019 (1990).
[2] R.E. Waltz, R.R. Dominguez and G.W. Hammett, Phys. Fluids **B4**, 3138 (1992).
[3] M.A. Beer and G.W. Hammett, Phys. Plasmas **3**, 4046 (1996).
[4] R.E. Waltz, *et al.,* Phys. Plasmas **4**, 2482 (1997).

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