Time Dependent Plasma Viscosity and Relation between Neoclassical Transport and Turbulent Transport*

K. C. Shaing
Engineering Physics Department
University of Wisconsin
Madison, WI 53706

Time dependent plasma viscosities for asymmetric toroidal plasmas in various collisionality regimes are calculated. It is known that in the symmetric limit the time dependent plasma viscosities accurately describe plasma flow damping rate. Thus, time dependent plasma viscosities are important in modeling the radial electric field of the zonal flow. From the momentum balance equation, it is shown that, at the steady state, the balance of the viscosity force and the momentum source determines the radial electric field of the zonal flow. Thus, for a fixed source, the smaller the viscous force is, the larger the value of the radial electric field is, which in turn suppresses the turbulence fluctuations more and improves turbulence transport. However, the smaller the viscous force also implies the smaller the neoclassical transport fluxes based on the neoclassical flux-force relationship. We thus show that when neoclassical transport fluxes are improved so are the turbulent fluxes in toroidal plasmas.

* This work was supported by US Department of Energy under Grant No. DE-FG02-01ER54619 with the University of Wisconsin.