Contribution ID: **159** Type: **Poster**

TH/P4-04: Transport Theory for Error Fields and in the Pedestal Region for Tokamaks

Wednesday, 10 October 2012 14:00 (4h 45m)

Real tokamaks have error fields that break toroidal symmetry and lead to enhanced particle, energy and momentum transport. The comprehensive theory for the error field induced transport fluxes consists of several collisionality regimes resulting from the asymptotic analysis of the drift kinetic equation. An analytic theory for the superbanana plateau resonance at the phase space boundary has been developed to show that the strength of the resonance is weakened when the resonance occurs at the phase space boundary. Fusion born alpha particles are extremely sensitive to error fields. Only resonant transport mechanisms, such as superbanana plateau resonance, are important for error field induced energetic alpha particle transport. The energy loss limits the magnitude of the error fields in International Thermonuclear Experimental Reactor (ITER). Neoclassical transport theory in the pedestal region of the high confinement mode (H-mode) is also presented to show that effects of orbit squeezing and the sonic poloidal E × B velocity reduce the ion heat conductivity. Here, E is the electric field and B is the magnetic field. Other transport quantities, including bootstrap current, are also obtained.

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

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Session Classification: Poster: P4

Track Classification: THC - Magnetic Confinement Theory and Modelling: Confinement