How micro-turbulence breaks magnetic surfaces*

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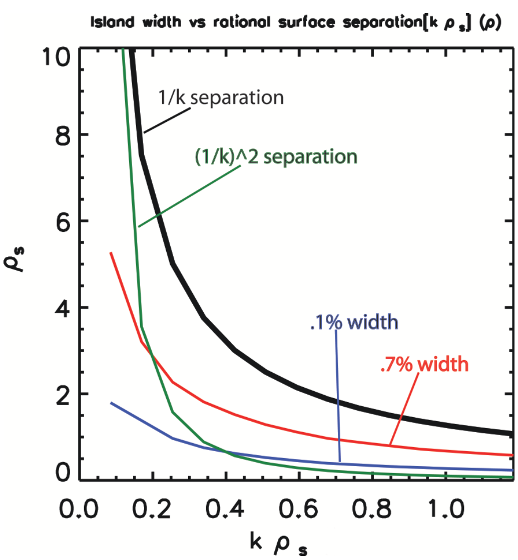
It has recently been demonstrated that plasma microturbulence breaks magnetic surfaces to produce a stochastic magnetic field at very low values of β, ($\beta_e \geq 10^{-3}$).[1] In this presentation we investigate mechanisms responsible for producing magnetic stochasticity. This require the presence of a resonant component of $A_{//}$ at rational surfaces to break the magnetic surfaces; and sufficient amplitude in $A_{//}$ to produce resonant overlap and magnetic stochasticity. The resonant component of $A_{//}$ can be produced by non-adiabatic electron currents from electrostatic perturbations with odd parity about the outboard midplane,[2] or the resonant excitation of (damped) collisionless tearing modes. Simulation data will be used to determine the dominate mechanism for generating the resonant component of $A_{//}$. Simulation data shows that intensity of the resonant component of $A_{//}$ falls of with bi-normal wavenumber as $k_\perp^{-4}$. In this situation, magnetic island overlap first occurs about rational surfaces associated with the two highest bi-normal wavenumbers retained in the simulation, as this results in a rational surface separation scaling as $1/k_\perp^2$, which drops off with increasing $k_\perp$ faster than the island width. The associated magnetic diffusion coefficient is small so that the resulting stochastic electron heat transport is not catastrophic.



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[1]W.M. Nevins, E. Wang, and J. Candy, "Magnetic stochasticity in gyrokinetic simulations of plasma microturbulence", PRL **106**, 065003 (2011).

[2]D.R. Hatch, P.W. Terry, W. M. Nevins and W. Dorland, "Role of stable eigenmodes in gyrokinetic models of ion temperature gradient turbulence", Phys. Plasmas **16**, 022311 (2009).