Quasilinear model for energetic particle diffusion in radial and velocity space

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Abstract

A *quasilinear model* for passive energetic particle (EP) turbulent diffusion in radial and velocity space is fitted and tested against nonlinear gyrokinetic tokamak simulations with the GYRO code [J. Candy and R.E. Waltz, Phys. Rev. Lett. **91**, 045001 (2003)]. Off diagonal elements of a symmetric positive definite 2×2 EP diffusion matrix account for fluxes up radial (energy) gradients driven by energy (radial) gradients of the EP velocity space distribution function. The *quasilinear ratio kernel* of the model is provided by a simple analytic formula for the EP radial and velocity space EP diffusivity relative to radial thermal ion energy diffusivity at each linear mode of the turbulence driven by the thermal plasma. The TGLF [G.M. Staebler, J.E. Kinsey and R.E. Waltz, Phys. Plasmas **14**, 0055909 (2007), ibid. **15**, 0055908 (2008)] tokamak transport model provides the linear mode frequency and growth rates to the *kernel* as well as the *nonlinear spectral weight* for each mode.

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