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Gyrokinetic turbulence under near-separatrix or non-axisymmetric conditions

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The comprehensive gyrokinetic turbulence code GENE can use geometric information extracted from MHD equilibria, including the near-separatrix regions of tokamaks and non-axisymmetric equilibria of stellarators. This allows comparisons between simulations of microturbulence in the core versus the edge and in tokamaks versus stellarators. The GENE simulations can include the interactions among ion temperature gradient (ITG), trapped electron mode (TEM), and electron temperature gradient (ETG) turbulence. Simulations of the tokamak core show a strong nonlinear interaction among these modes, which modifies the transport. Moreover, multiscale simulations show that for realistic ion heat (and particle) flux levels, sub-ion scales generally have to be included in comprehensive transport models. In the very edge region of a tokamak, the turbulence also tends to acquire a multi-scale nature, being driven, e.g., by ETG modes peaking near the X-point and by microtearing modes. Nonlinear simulations will be presented which help characterize the residual anomalous transport in the H-mode edge. Large differences are seen in the criteria for marginal stability, the rapidity of the increase in the level of transport above marginality, and the importance of zonal flows when GENE is used to study ITG microturbulence in several tokamaks and in various optimized stellarators. This allows an assessment of the potential for modifying and optimizing mictroturbulence by non-axisymmetric shaping.