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Gyrokinetic Simulations of Solar Wind Turbulence

Although turbulence in the solar wind has been studied for more than four decades, only recently has the "dissipation range" of solar wind turbulence become a focus of the heliospheric physics community. To explore the physical mechanisms responsible for the dissipation of the turbulent fluctuations in the nearly collisionless solar wind, one must abandon fluid approaches to modeling the turbulence and adopt a kinetic description. For some time, there has been significant effort focused on employing a gyrokinetic formalism to study the dissipation of turbulence in the solar wind, taking advantage of sophisticated numerical techniques developed for use in the fusion community. Here I will report on some of the most recent successes of this effort, in particular the first three-dimensional, nonlinear gyrokinetic simulation of plasma turbulence resolving scales from the ion to electron gyroradius with a realistic mass ratio, where all damping is provided by resolved physical mechanisms. The resulting energy spectra are quantitatively consistent with a magnetic power spectrum scaling of $k^{-2.8}$ as observed using *in situ* spacecraft measurements of the dissipation range. The collisional ion heating is measured at sub-ion-Larmor radius scales, which provides the first evidence of the ion entropy cascade in an electromagnetic turbulence simulation.