Kinetic range plasma turbulence, reconnection and particle energization: what we can learn from large scale kinetic simulations and observations within our heliosphere

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Satellite observations of plasma parameters in-situ suitable for the study of turbulence and reconnection in the solar wind cover timescales from below ion kinetic scales up to days, providing a 'laboratory' to explore the fundamental physics. High resolution imaging of line of sight emissions from the solar corona also provide the first opportunity to study the spatio-temporal dynamics of turbulence and reconnection. Recent large scale self-consistent fully kinetic simulations in three dimensions are able to begin to capture both dynamic reconnection and self-generation of turbulence. Central to the idea of using these natural systems as physics laboratories, are methods that allow direct quantitative comparison between the predictions of theory and simulation, and the observations. Critically, theoretical predictions, and data analysis methods, must come together in a manner in which uncertainties can be well understood, and thus different theoretical scenarios can be distinguished unambiguously. In this talk I will present methods and recent results that quantify turbulence in these kinetic simulations of reconnection, in quiescent solar prominences, and in the solar wind, and how the statistical scaling of the turbulence relates to particle acceleration.