Kinetic Scale Turbulence in the Solar Wind: A review of current challenges

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The solar wind has been observed to be a turbulent plasma for many decades. It provides a unique environment in which spacecraft can directly measure the turbulent fluctuations at the small scales on which the turbulence is dissipated, providing the detail necessary to identify the nature of these small-scale fluctuations, information critical for unraveling the physical mechanisms by which the turbulence is dissipated. The underlying question of the nature of the fluctuations is still under debate. Indeed, the steepening of the observed power spectra, although originally attributed to ion cyclotron damping, is now believed to be due to the dispersive nature of the fluctuations, with two leading interpretations in terms of Kinetic Alfven Wave Turbulence and/or Whistler Wave Turbulence. Several recent studies have focused on developing various tests to distinguish between both wave modes. Other possible contributions to the spectrum at these scales include current sheets and/or kinetic instabilities, although their effect remains to be fully investigated.

We present here a review of the recent ground-breaking observations in the dissipation range of solar wind turbulence. We discuss the different available interpretations and their impact on the heating of the solar wind plasma. We will also discuss the recent "Turbulent Dissipation Challenge", a community driven effort to address these issues via coordinated numerical simulations, in close connection to observations.