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Kinetic Alfvén Turbulence in Space Plasmas

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In recent years, evidence has been accumulating in support of the existence of kinetic Alfvén turbulence, i.e., the extension of Alfvénic turbulence to small perpendicular scales, in a wide variety of plasmas in the solar system. I will present here an overview of this work, the observational spacecraft techniques through which it is detected, theoretical models for both its linear and nonlinear properties, and will discuss some of the implications for how it fits into the macroscopic behavior of plasmas such as the solar wind, e.g., through its dissipation and plasma heating. In particular, I will discuss the detection of kinetic Alfvén turbulence in the solar wind[1], discovery of a new type of inertial kinetic Alfvén wave based turbulence in the magnetosheath[2], a novel analysis to probe the turbulence dissipation mechanisms[3], and recent results from the Parker Solar Probe mission that reveal new ways in which kinetic Alfvén turbulence operates up close to the Sun, and how it may be involved in the origin of the solar wind[4,5].

References

[1] Chen et al. (2013) Phys Rev Lett **110** 225002 "Nature of Subproton Scale Turbulence in the Solar Wind"
[2] Chen & Boldyrev (2017) Astrophys J **842** 112 "Nature of Kinetic Scale Turbulence in the Earth's Magnetosheath"
[3] Chen et al. (2019) Nat Comm **10** 740 "Evidence for electron Landau damping in space plasma turbulence"
[4] Chen et al. (2020) Astrophys J Supp **246** 53 "The Evolution and Role of Solar Wind Turbulence in the Inner Heliosphere"
[5] Chen et al. (2021) Astron Astrophys **650** L3 "The near-Sun streamer belt solar wind: turbulence and solar wind acceleration"