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Energy cascades and dissipation in kinetic plasma turbulence

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Solar wind plasma may be described by magnetohydrodynamics (MHD) at large scales, with existence of an energy cascade where energy is transferred from large to smaller scales. This also requires kinetic description at kinetic scales to include dissipative processes that terminate the cascade. In this talk I will report some of our recent works on the study of energy cascades and dissipation in solar wind plasmas with high resolution kinetic plasma simulations. We show the development of turbulence characterized by sheet-like current density structures spanning a range of scales down to electron scales. We present evidence that these structures are sites for heating and dissipation, and that stronger current structures signify higher dissipation rates. We also introduced several energy transfer functions in plasma turbulence using filtering approaches to analyze their statistical properties. We found that these energy transfer channels, to some extent, are correlated with coherent structures. In particular, we find that different energy dissipation proxies, although not pointwise correlated, are concentrated in proximity to each other, for which they decorrelate in a few ion inertial scales. However, the energy dissipation proxies dominate at different scales.

References

1. M. Wan, W. H. Matthaeus, H. Karimabadi, V. Roytershteyn, M. Shay, P. Wu, W. Daughton, B. Loring, and S. C. Chapman, Intermittent dissipation at kinetic scales in collisionless plasma turbulence, PRL, 109, 195001 (2012),
2. M. Wan, W. H. Matthaeus, V. Roytershteyn, H. Karimabadi, T. Parashar, P. Wu, and M. Shay, Intermittent Dissipation and Heating in 3D Kinetic Plasma Turbulence, PRL, 114, 175002 (2015),
3. M. Wan, W. H. Matthaeus, V. Roytershteyn, T. N. Parashar, P. Wu, and H. Karimabadi, “Intermittency, coherent structures and dissipation in plasma turbulence”, Phys. Plasmas, 23, 042307 (2016).
4. Y. Yang, W. H. Matthaeus, T. N. Parashar, P. Wu, M. Wan, Y. Shi, S. Chen, V. Roytershteyn, and W. Daughton, “Energy transfer channels and turbulence cascade in Vlasov-Maxwell turbulence”, Phys. Rev E, 95, 061201 (2017).
5. Y. Yang, M. Wan, W. H. Matthaeus, L. Sorriso-Valvo, T. N. Parashar, Q. Lu, Y. Shi and S. Chen, “Scale dependence of energy transfer in turbulent plasma”, Monthly Notices of the Royal Astonomical Society, 482, 4933 (2019).