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Intermittency and dissipation in turbulent solar wind: Cluster observations

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A puzzling aspect of solar-wind dynamics consists in the empirical evidence that it is hotter than expected for an adiabatic expanding gas. Understanding the mechanisms of energy dissipation into heat from the Sun in such a collision-free system represents a key challenge not only in space plasma physics but also for thermodynamics in general.

Here, the nature of the turbulent fluctuations close to the ion scales, in both slow and fast solar wind streams, is investigated by using high-time resolution magnetic field data of multi-point measurements of Cluster spacecraft. The ion scales are characterized by the presence of coherent structures responsible for solar wind intermittency. We find that, in fast solar wind, intermittency is mostly due to Alfvén vortex-like structures, also several current sheets are observed. In slow solar wind, we observe as well compressive structures like magnetic solitons, holes and shocks. Moreover, all structures, both in fast and slow solar wind, are characterized by a strong wave-vector anisotropy in the perpendicular direction with respect to the local magnetic field. Some of them propagate in the plasma rest frame. Finally, particle velocity distribution shows a high variability: close to coherent structures particle velocity distributions appear strongly deformed. Possible interpretations of the observed structures and their role in the heating process of the plasma are also discussed.