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Intermittent structures at ion scales in the turbulent solar wind

Denise Perrone (1), Olga Alexandrova (2), Sonny Lion (2), Owen W. Roberts (3), Milan Maksimovic (2), Philippe C. Escoubet (3), and Yannis Zouganelis (1)

(1) European Space Agency / ESAC, Madrid, Spain (denise.perrone@esa.in), (2) LESIA, Observatoire de Paris, Meudon, France, (3) European Space Agency / ESTEC, Noordwijk, Netherlands

Understanding the physical mechanisms of dissipation, and the related heating, in turbulent collisionless plasmas (such as the solar wind) represents nowadays one of the key issues of plasma physics. Although the complex behavior of the solar wind has been matter of investigation of many years, some of the primary problems still remain a puzzle for the scientific community.

Here, we study coherent structures responsible for solar wind intermittency around ion characteristic scales. We find that, in fast solar wind, intermittency is due to current sheets and Alfvén vortex-like structures. In slow solar wind, we observe as well compressive structures like magnetic solitons, holes and shocks. By using high-time resolution magnetic field data of multi-point measurements of Cluster spacecraft, we characterize the observed coherent structures in terms of topology and propagation speed. We show that 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 and typical scales around ion characteristic scales. Moreover, some of them propagate in the plasma rest frame. Moreover, a further analysis on the ion velocity distribution shows a high variability; in particular, close to coherent structures the proton distribution function appears strongly deformed and far from the thermodynamic equilibrium. We discuss possible interpretation of the observed structures and their role in the heating process of the plasma.