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Multifractal analysis of magnetic field fluctuations inferred Cluster and solar wind measurements: Evidence for intermittent turbulence in the plasma sheet and solar wind

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Solar wind magnetometer and plasma data and magnetometer data acquired by Cluster in the magnetospheric plasmasheet are employed to construct probability distribution functions (PDFs) of velocity fluctuations and magnetic field fluctuations over various temporal and spatial scales. This technique, often used in analysis of laboratory plasmas, is used to look for intermittent plasma turbulence. We examined the distribution of the magnetic field and plasma fluctuations for a single spacecraft, and between pairs of highly correlated spacecraft time series data in both the plasma sheet and the solar wind (fast and slow speed streams). We demonstrate that the plasma sheet fluctuations are multi-fractal and do not rescale to a single master curve. The plasma and magnetic field PDFs are fit with the Castaing et al. [1990] energy cascade model. This model is able to capture the non-Gaussian behavior at small temporal and spatial separations in the wings of the distribution and non-self similar scaling behavior over a range of temporal and spatial separations. The model results provide an experimental test for the Castaing et al. model and allow for a quantitative comparison between different systems and events.