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Statistical Intermittency of Solar Wind Turbulence-Measurement and Modelling.

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The solar wind provides a natural laboratory for observations of MHD turbulence over extended temporal scales. We consider two complimentary approaches for capturing the scaling properties of the Probability Density Functions (PDF) of fluctuations (differenced quantities): scaling collapse of the PDF, and generalized structure function analysis. Extended Self Similarity (ESS)- essentially normalizing one structure function by another- is also used to extend the scaling range. Although one generally finds multifractal scaling, certain solar wind in- situ bulk plasma parameters such as fluctuations in the ion density, field and particle energy densities and MHD-approximated Poynting flux are under certain conditions approximately self-similar on timescales up to tens of hours. The intermittency of the system is then expressed in these parameters through the non-Gaussian nature of the single curve that describes the fluctuations PDF up to this timescale.
Self- similarity implies that a simple Fokker-Planck model exists for the timeseries and we derive this here along with the associated Langevin equationa stochastic dynamical equation for the fluctuations in the timeseries. This is an example of a generic approach to turbulence, with connections with our understanding of the statistical mechanics of correlated systems generally. In that context the (non-Gaussian) statistics of the integrated quantities will also be discussed.

Keywords: solar wind; turbulence; intermittency