Mutual information exchange in solar wind density fluctuations

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The fluctuations of proton density in the slow solar wind are analyzed by means of joint Empirical Mode Decomposition (EMD) and Mutual Information (MI) analysis. The analysis reveal that, within the turbulent inertial range, the EMD modes associated with nearby scales have their phases correlated, as shown by the large information exchange. This is a quantitative measure of the information flow occurring in the turbulent cascade. On the other hand, at scales smaller than the ion gyroscale, the information flow is lost, and the mutual information is low, suggesting that in the kinetic range the nonlinear interactions are no longer sustaining a turbulent energy cascade.