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Turbulence as seen from the point pattern of space plasma electrons

T. D. Carozzi (1), A. M. Buckley (1), E. C. Chambers (1), M. P. Gough (1), N. Beloff (1)

(1) Space Science Centre, University of Sussex, UK

Turbulence is one of the least understood aspects of fluids dynamics despite its ubiquitousness and importance in space plasmas. Homogeneous turbulence is usually thought of in terms of random fluctuations of a continuous field such as magnetic field strength or plasma density. An entirely different perspective on plasma turbulence, presented in this work, is to consider the instantaneous spatial distribution or point pattern of the individual particles involved in the turbulence. The point pattern of plasma particles cannot be described as fluctuations of a field but rather as a countable set of stochastic positions which as a whole may have a structure or pattern. We introduce a measure of the structure in the particle point pattern called the index of dispersion. This parameter can de derived directly from the DWP electron correlator instrument onboard the CLUSTER-II space mission. While turbulence in field observables manifests itself as spectra of the Kolmogorov type, we show that the index of dispersion of the particle point pattern is strictly greater than one. The physical interpretation of this, and our main conclusion, is that plasma particles tend to cluster together in the presence of turbulence which may indicate mixing of particle populations.