COMPLEXITY-ENTROPY ANALYSIS OF INTERPLANETARY PLASMAS

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Abstract:

Magnetic reconnection is a complex process in which magnetic energy is converted to particle kinetic and thermal energy in space plasmas and astrophysical plasmas. We apply the Jensen-Shannon (J-S) complexity-entropy index to magnetic field data of four reconnection exhausts detected in the solar wind at 1 AU. Three events are related to the passage of an interplanetary coronal mass ejection, and one event is related to a rope-rope magnetic reconnection event. The interplanetary magnetic field is projected into the LMN coordinates by applying the hybrid minimum variance analysis. The inertial subrange of the magnetic field components in the LMN coordinates is identified by computing the compensated power spectral density. The J-S index indicates that the three components of the magnetic field display entropy and complexity values similar to stochastic fluctuations. However, we show that a high degree of intermittency is related to a lower degree of entropy and a higher degree of complexity. We also show that, for all four events, the L component of the magnetic field displays lower entropy and higher complexity than the M and N components. These results show that coherent structures can be responsible for decreasing entropy and increasing complexity within reconnection exhausts in the interplanetary magnetic-field turbulence.

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References: Miranda et al., submitted to The Astrophysical Journal (http://arxiv.org/abs/2109.10987); Miranda et al., Annales Geophysicae (2018).

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