Intermittent turbulence and complexity within reconnection exhausts in the solar wind

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Magnetic reconnection and turbulence in plasmas are related in a complex manner that is not well understood. The conversion of magnetic energy into particle kinetic energy during the reconnection process leads to the formation of magnetic exhausts, which usually have a short duration in the solar wind at 1 AU. The Jensen-Shannon (J-S) complexity-entropy index is a statistical tool that allows to distinguish noise from chaos in time series. We apply the J-S index to interplanetary magnetic field data within four magnetic exhausts detected in the solar wind at 1 AU [1]. 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 [2]. The magnetic field is projected into the LMN coordinates by applying the hybrid minimum variance analysis. The L magnetic field component is related to the exhaust outflow direction, the M direction is related to the reconnection guide field direction, and the N component is related to the normal of the current sheet. The J-S index indicates that the three components of the magnetic field display entropy and complexity values similar to stochastic fluctuations. For the first event we show that a higher degree of intermittency in the inertial subrange is related to a lower degree of entropy and a higher degree of complexity. For the four events, the L component displays lower entropy and higher complexity than the M and N components. Our results show that coherent structures can be responsible for decreasing entropy and increasing complexity of the turbulence within reconnection exhausts in the solar wind.

References

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