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Study of compressible coherent structures, close to ion scales, in solar wind turbulence using Cluster data

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The interplanetary medium, a weakly collisional and fully turbulent medium, can be considered the best natural laboratory to study the dynamical behavior of turbulent plasmas. A fundamental question in solar wind plasma physics is whether, space plasma turbulence can be considered as a mixture of quasi-linear waves or if the turbulence is strong with formation of coherent structures responsible for the dissipation.
Here we present an automatic method to identify compressible coherent structures using Morlet wavelet decomposition of magnetic signal from Cluster spacecraft and reconstruction of magnetic fluctuations in a selected scale range (0.033-0.2 Hz). Different kind of coherent structures have been detected: from soliton-like compressible structures to current sheet- or vortex-like alfvenic structures. A multi-satellite analysis, in order to characterize 3D geometry and propagation in plasma rest frame, reveals that these structures propagate quasi-perpendicular to the mean magnetic field, with finite velocity. Moreover, the spatial scales of coherent structures have been estimated: for the selected frequency range, the distribution of spatial scales is picked around $\sim$30 ion Larmor radius or ion inertial length ($\sim$1200 km).
Our observations in the solar wind can provide constraints on theoretical modeling of small-scale turbulence and dissipation in collisionless magnetized plasmas.