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Numerical analysis of plasma flow vortices in the magneto-tail

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Ulf electromagnetic planetary waves can self-organize into vortex structures (monopole, dipole or into vortex chains). They are often detected in the plasma media, for instance in the magneto-sheath, in the magneto-tail and in the ionosphere. Large scale vortices may correspond to the injection scale of turbulence, so that understanding their origin is important for understanding the energy transfer processes in the geo-space environment. In a recent work, the THEMIS mission has detected vortices in the magneto-tail in association with the strong velocity shear of a sub-storm plasma flow which have conjugate vortices in the ionosphere. By analysing the THEMIS data for that event, we find that several vortices can be detected together with the main one, and that the vortices indeed constitute a vortex chain. The study was carried out by analysing both the velocity and the magnetic field measurements for spacecraft C and D, and by obtaining the corresponding hodograms. It is found that both monopolar and bipolar vortices may be present in the magneto-tail. The comparison of observations with numerical simulations of vortex formation in sheared flows is also discussed.

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