Geophysical Research Abstracts
Vol. 21, EGU2019-9068, 2019
EGU General Assembly 2019

Magnetospheric Multiscale Observation of Kinetic Effects in an Alfvén Vortex

Tieyan Wang (1), Olga Alexandrova (2), Denise Perrone (3), Malcolm Dunlop (1,4), Xiangcheng Dong (4), and Robert Bingham (1)

(1) RAL Space, Rutherford Appleton Laboratory, Harwell Oxford, Didcot OX11 0QX, UK (tieyan.wang@gmail.com), (2) LESIA, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université, Univ. Paris Diderot, Sorbonne Paris Cité, 5 place Jules Janssen, 92195 Meudon, France, (3) Department of Physics, Imperial College London, London SW7 2AZ, UK, (4) School of Space and Environment, Beihang University, Beijing 100191, China

Alfvén vortex is a multi-scale nonlinear structure which contributes to the intermittency of turbulence. Despite previous explorations mostly on the spatial properties of the Alfvén vortex, the plasma characteristics within such coherent structure is unknown. Moreover, the connection between the plasma energization and the Alfvén vortex still remains unclear. Based on high-resolution in-situ measurement from the Magnetospheric Multiscale (MMS) mission, we report for the first time, distinctive plasma features within an Alfvén vortex. This Alfvén vortex is identified to be two-dimensional quasi-monopole with a radius of $\sim$10 proton gyroscales. Its perpendicular magnetic fluctuations are in anti-correlation with perpendicular velocity fluctuations, thus the parallel current density and flow vorticity are anti-aligned. In different parts of the vortex (i.e. edge, middle, center), the ion and electron temperatures are found to be quite different and they behave in an opposite manner: the ion temperature variations are correlated with the parallel current, while the electron temperature variations are correlated with the parallel vorticity. Furthermore, the temperature anisotropies, together with the non-Maxwellian kinetic effects, exhibit strong enhancement at peaks of the vorticity/current within the vortex. Comparison between observations and numerical/theoretical results are made. In addition, the energy-conversion channels and the compressibility associated with the Alfvén vortex are discussed. These results may help to understand the link between coherent vortex structures and the kinetic processes, which determines how the turbulence energy dissipate in the weakly-collisional space plasmas.