Geophysical Research Abstracts
Vol. 18, EGU2016-12588, 2016
EGU General Assembly 2016

Propagation properties of magnetic holes - MMS and Cluster observations

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Magnetic holes (MHs) are structures showing a significant decrease in the magnetic field magnitude. Previous investigations suggest that MHs can be excited by the mirror instability, hence implying that they are "frozen" into the plasma flow. Another possible candidate for explaining the observations of LMDs is the soliton wave, which can propagate with respect to the plasma flow. In this study we use multi-spacecraft MMS and Cluster data to investigate MHs in the solar wind, magnetosheath and magnetospheric plasma. Various methods are used to obtain propagation properties of the MHs. Our results are compared with predictions from mirror mode and soliton wave theories. We find that 8 of 10 MH events detected by Cluster in the plasma sheet are propagating in the plasma flow, and they are considered to be generated by soliton waves.