Geophysical Research Abstracts
Vol. 21, EGU2019-3954, 2019
EGU General Assembly 2019
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Alfvén ion cyclotron waves in sheath regions driven by interplanetary coronal mass ejections

Matti Ala-Lahti (1), Emilia Kilpua (1), Jan Souček (2), Tuija Pulkkinen (3,4), and Andrew Dimmock (5)

(1) University of Helsinki, Department of Physics, Helsinki, Finland (matti.ala-lahti@helsinki.fi), (2) Institute of Atmospheric Physics, Czech Academy of Sciences, Prague, Czech Republic, (3) Department of Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, MI, USA, (4) Department of Electronics and Nanoengineering, Aalto University, Espoo, Finland, (5) Swedish Institute of Space Physics, Uppsala, Sweden

We report a statistical analysis of the occurrence and properties of Alfvén ion cyclotron (AIC) waves in sheath regions driven by interplanetary coronal mass ejections (ICMEs). In the Earth's magnetosphere, ICME sheaths are significant drivers of geomagnetic activity and a considerable fraction of ICME-driven storms are pure-sheath induced storms or the sheath makes a significant contribution. Together with mirror mode (MM) waves, AIC waves are important for the global dynamics by regulating the heating of plasma in the Earth's magnetosheath. We have developed an automated algorithm to identify AIC wave events from magnetic field data and we apply it to investigate 91 ICME sheath regions observed by the Wind spacecraft. We compare the occurrence of AIC waves to the one of mirror mode (MM) waves reported by Ala-Lahti et al., 2018 in terms of plasma conditions surrounding these different wave types. We report AIC waves to be frequent structures in ICME-driven sheaths, and their occurrence is the highest in the vicinity of the shock. Thus, similarly to Ala-Lahti et al., 2018, our results imply that the shock compression has a crucial role in generating wave activity in ICME sheaths. In addition, AIC waves tend to have their frequency below the ion cyclotron frequency. They, in general, occur in plasma that is stable in respect to the ion cyclotron instability and has lower plasma beta than mirror modes. The results suggest that the plasma beta anisotropy > 1 appearing in ICME-sheaths is regulated by both ion cyclotron and mirror instabilities.