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Statistical analysis of mirror mode waves in interplanetary coronal mass ejection-driven sheath regions

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We have performed a comprehensive statistical analysis of mirror mode waves and their surrounding plasma properties within interplanetary coronal mass ejection (ICME)-driven sheath regions. 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.

In the Earth's magnetosheath, mirror modes regulate the plasma, and thus drive its local and global properties. To investigate mirror modes in ICME sheaths, we implemented a semi-automated method to identify mirror modes using only the magnetic field data. Our statistical analysis includes 91 ICME-driven sheath regions which took place between January 1997 and April 2015.

We present our mirror mode identification procedure and the main results from the study. Our statistical data suggest: 1) mirror modes are observed throughout the sheath, but are more frequently detected near the shock, 2) mirror modes observed at 1 AU occur almost exclusively as dip-like structures in mirror stable plasma, and could be remnants of mirror modes generated during earlier phases of the sheath evolution, 3) the shock strength is the most important parameter in controlling the occurrence of mirror modes, 4) ICME sheath conditions may facilitate the growth of Alfvén ion cyclotron waves.