

Cessation of Pc3 activity: Investigate the correlation between LDA events and the occurrence of ion beam instabilities near the bow shock

Introduction

Geomagnetic pulsations are small fluctuations of the near-Earth magnetic field typically falling within the ultra-low frequency (ULF) range between about 1 mHz to 1 Hz and reflect dynamic processes within Earth's magnetosphere influenced by solar wind conditions. One of the most commonly observed types of continuous pulsations at low to middle latitudes during local daytime are Pc3 pulsations (22-100 mHz). Studies (e.g., Kovner et al., 1976) have suggested a correlation between Pc3 occurrence and IMF direction relative to the sun-earth line (through the cone angle between the IMF direction and the sun-earth line), alongside solar wind plasma speed. Interestingly, during periods of exceptionally low solar wind density, Pc3 activity ceases despite other favorable conditions. The underlying mechanism for this cessation remains unclear.

Goal

This project aims to analyze data from satellites at L1 (e.g., ACE), ground-based pulsation magnetometers, and MMS spacecraft to investigate beam instabilities near the bow shock and sheath region during Low Density Anomalies (LDAs) and the accompanying cessation of Pc3 activity.

Research Hypothesis: During low-density anomalies ($N_p < \sim 0.3 \text{ #/cc}$) observed at L1, the beam instabilities responsible for generating upstream waves cease to exist, leading to a pause in Pc3 wave activity observed on the ground.

Methodology:

1. **Identification of LDA Events:** Utilize data from L1 satellites (e.g., ACE) to identify low-density anomalous events between 2015 and 2022.
2. **Analysis of Ion Beam Instabilities:** Analyze MMS spacecraft data to identify ion beam instabilities during LDA events, focusing on regions near the bow shock and sheath.
3. **Evaluation of Pc3 Wave Activity:** Determine Pc3 wave activity during the same period using ground-based magnetometer data (e.g., HER).
4. **Correlation Analysis:** Investigate the correlation between LDAs and the occurrence of ion beam instabilities, relating these to the cessation of Pc3 activity.