Solar wind discontinuities

FINESST23 Proposal

Zijin Zhang Anton V. Artemyev Vassilis Angelopoulos
Xiaofei Shi Ivan Vasko

2024-01-22

Scientific/Technical/Management

Summary

Rapid variations in interplanetary magnetic fields, commonly recognized as solar wind magnetic discontinuities, embody important localized transient rotations or jumps of the magnetic field. Considered responsible for effective plasma heating, they carry the most intense currents found in the solar wind. Theoretical models suggest that the formation and destruction of discontinuities are closely related to the nonlinear dynamics of Alfvén waves. These nonlinear processes can create significant isolated disturbances to the otherwise adiabatic evolution of the solar wind flow with a frozen interplanetary magnetic field. As such, a comprehensive study of these discontinuities will considerably enhance our understanding of the solar wind heating phenomenon.

Research into discontinuities in the solar wind begin with the onset of the spacecraft era in the 1960s. This field of study has recently seen a significant intensification, thanks to the launch of the Parker Solar Probe (PSP), which enables magnetic field measurements at closer radial distances to the Sun. Though discontinuities are found nearly everywhere in the heliosphere (as shown by Voyager and Ulysses observations), the most in-depth investigations have focused on the inner heliosphere, around 1 astronomical unit (AU). **The primary aim of this project is to utilize two novel datasets procured from PSP and Juno magnetic field measurements, examining the evolution of discontinuity properties within and far beyond 1 AU, up to Jupiter's orbit**. In particular, we will generate and scrutinize two significant datasets: **the first dataset** will collate 1 AU measurements from STEREO, near-Earth WIND, and ARTEMIS missions with measurements beyond 1 AU by Juno; **the second dataset** will amalgamate 1 AU measurements with those made by PSP within 1 AU. The scientific objective of this project is to answer the following three queries: