Project Details

ROSES ID: NNH19ZDA001N
Selection Year: 2019
Program Element: Focused Science Topic

Topic: Fast Reconnection Onset

Project Title:
In-situ investigations of the controlling factors for the onset of magnetic reconnection in solar wind, magnetosheath, and magnetospheric current sheets

PI Name: Tai D Phan
PI Email: phan@ssl.berkeley.edu
Affiliation: University of California, Berkeley
Project Member(s):
- Vasko, Ivan;Co-I;University of California, Berkeley
- Oieroset, Marit;Co-I;University of California, Berkeley

Summary:
Science Goals and Objectives:
Magnetic reconnection in current sheets is a universal plasma process that converts magnetic energy into plasma jetting and heating, and is important in many laboratory, space, solar, and astrophysical contexts. While past in-situ observations in the magnetosphere and solar wind have provided convincing evidence for the occurrence of reconnection, the conditions necessary for the onset of reconnection have not been firmly established. In-situ observations reveal that reconnection occurs in only a fraction of current sheets detected in the Earth s magnetosphere and in the solar wind. For example, the occurrence rate of reconnection in the near-Earth magnetotail is less than 10%, while reconnection signatures are seen in a smaller fraction of solar wind current sheets at 1AU. Observations in the magnetotail have revealed that the onset of reconnection occurs only when the thickness of the magnetotail current sheet is of the order of an ion skin depth or smaller. However, Earth s dayside magnetopause is usually a thin current sheet due to the constant compression of the solar wind against the magnetosphere, but the reconnection occurrence rate there is no more than 50% even when the magnetic shear across the magnetopause is large. This indicates that a thin current sheet is a necessary but not sufficient condition for reconnection. In order words, other conditions need to be satisfied for reconnection to occur, but what are they?

Using in-situ observation in the solar wind, Earth s magnetopause and magnetosheath, we propose to address the following key question about reconnection onset:

What are the controlling factors for the onset and suppression of reconnection in solar wind, magnetosheath, and magnetospheric current sheets?

Methodology:
We propose to use publicly available data from the Parker Solar Probe and Magnetospheric Multiscale missions, collected in the near-Sun solar wind, in the solar wind at 1 AU, and in the Earth s magnetopause and magnetosheath regions. We will examine a large number (hundreds) of current sheets in each of these regions to (a) determine whether reconnection occurs or not in the current sheets, and (b) determine the properties, plasma regime, and boundary conditions of the current sheets. This investigation will reveal the key controlling factors for the onset and suppression of reconnection over a wide range of plasma parameter space.

Relevance of the proposed work to the objectives of the solicitation and to NASA:
The proposed work directly addresses FST #2 Fast Reconnection Onset and is therefore relevant to the objectives of the LWS solicitation. As stated in the AO this proposal is therefore relevant to several LWS Strategic Science Areas (SSAs): SSA-0: Physics-based Understanding to Enable Forecasting of Solar Electromagnetic, Energetic Particle, and Plasma Outputs Driving the Solar System Environment and Inputs to Earth s Atmosphere; SSA-1: Physics-based Geomagnetic Forecasting Capability; SSA-3: Physics-based Solar Energetic Particle Forecasting Capability; and SSA-6: Physics-based Radiation Environment Forecasting Capability. Also, due to the inherent cross-disciplinary nature of this Focused Science Topic and its direct correspondence with space weather as a driver of energy release, this topic is ultimately relevant to all LWS SSAs 0-6.

The proposed study will be relevant to key aspects of the Decadal Survey questions: What is the role of magnetic reconnection in energy release in coronal mass ejections and flares? What are the interactions and feedbacks that connect the magnetosphere, solar wind, and ionosphere? and How does the Sun s magnetic field shape the dynamic heliosphere?

Publication References:

no references