

Topic Proposal for Physics 799H

Student Name

Advisor Name

Topic: *The Effect of Heavy Ions of Ionospheric Origin (O⁺) on Magnetopause Reconnection*

[*Student starts with an overview of the physical situation and motivation for their study.*]

Magnetic reconnection is a process whereby magnetic field lines with antiparallel (or semi-antiparallel) geometry split and reconnect, reconfiguring the magnetic field topology and converting magnetic field energy into particle kinetic energy. At the Earth's magnetopause (the outermost boundary of the terrestrial magnetic field) the magnetic field carried by the solar wind plasma couples with the Earth's field, weakening the terrestrial magnetic field structure and allowing for mass and energy flux to take place across the previously closed boundary. The process is thought to be a common occurrence along the Earth's. The transfer of plasma and magnetic energy into the Earth's magnetic cavity is part of a chain of events that can cause disturbances to near-Earth satellites, and the process is thought to be a driving force for auroral events. Understanding the dynamics of this process is key to understanding the dynamics of our own near-Earth magnetic environment.

[*By describing what is already known, they give further motivation for their work.*]

Reconnection is currently a topic of great interest in space plasma research; although much is known about this process there is still a great amount that remains unknown. Recent theoretical work has proposed a variety of ways that different species (namely O⁺ of ionospheric origin) affect the acceleration of the plasma jets present in reconnection, as well as how the presence of heavy ions affects the structure and rate of the reconnection process.

[*Specifically, what will the student do.*] For my work, I will perform in depth analyses of several reconnection events using data from the Cluster Ion Spectrometer (CODIF) instrument, one of UNH's contributions to ESA's Cluster II mission. By analyzing reconnection rates and structure of these events, I will be able to directly compare events with high oxygen content to events where the plasma consists mainly of ionized hydrogen with the goal of answering the following three questions:

- 1) How does the overall structure of the reconnection region change in the presence of oxygen?
- 2) How are the reconnection jets modified by the presence of oxygen, and how are the different species heated / accelerated?
- 3) Does oxygen affect the rate of reconnection?

Not only will this study provide the much-needed experimental data for validation of current theoretical work, but it will also provide valuable information directly related to NASA's upcoming Magnetospheric Multiscale (MMS) Mission, in which UNH will also be participating.

Work on this project has begun this semester, and will culminate in a detailed study of one reconnection event to be presented by Dr. M at the American Geophysical Union (AGU) Conference this December.

Next semester work will consist of a variable schedule centered around 20 work hours per week. By the first two months, I will have a well-defined set of tests that I will use to

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define the structure and the rate of reconnection, in the next month I will find a set of events useful for my study, and in the remaining time I will summarize my results and prepare them for presentation at the Undergraduate Research Conference and/or a colloquium for peer review.