



Experimental Studies to Unlock Fundamental Plasma Physics Processes: Magnetic Reconnection and Non-linear Alfvén interactions

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The key to progress in many unsolved mysteries in both space and fusion plasmas lies in improving our understanding of fundamental plasma physics processes. I will discuss two examples: magnetic reconnection and non-linear physics of Alfvén waves.

From an arcade of magnetic flux loops on the surface of the sun to tokamak sawteeth, magnetic reconnection is not only fast, but also impulsive -- a slow buildup of magnetic energy is followed by a fast release. But the physics responsible for this is still an open question. Impulsive events observed in recent laboratory experiments [1-2] required 3-D physics to explain and exhibited features in common with events observed in the magnetosphere. Future work will include 1) Satellite observations aimed at investigating events comparable to the experiment, and 2) Laboratory experiments on the new FLARE user facility at Princeton aimed at exploring a multi-X-line regime comparable to the magnetosphere.

Alfvén waves, a fundamental mode of magnetized plasmas, are ubiquitous in lab and space. The non-linear behavior of these modes is thought to play a key role in important problems such as the heating of the solar corona, solar wind turbulence, and Alfvén eigenmodes in tokamaks. In particular, theoretical predictions show that these Alfvén waves may be unstable to various decay instabilities, even at very low amplitudes ($\delta B/B < 10^{-3}$), but this key physics has only recently been demonstrated for the first time in the laboratory [3-5]. My ongoing and future work aims to compare laboratory observations and satellite measurements in order to determine the regions of the heliosphere where Alfvén wave decay instabilities may play an important role. Proposed new projects include investigations of fundamental non-linear interaction physics using Alfvén eigenmodes in tokamak plasmas and whistler waves in a basic laboratory device.

Friday, February 19th @ 10am

CIPS Stern Conference Room, Gamow Tower F931

Refreshments 9:45 Room F935