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ALUMNI SPOTLIGHT

A Last Minute Decision Leads to a Ph.D. in Physics

Alumnus Robert Perry obtained his BA in Liberal Arts from St. John's College in Annapolis, MD; not the typical undergraduate degree from a Professor of Physics at Ohio State University. In fact, throughout his undergraduate education, Perry's intentions were to attend law school.

"At the last minute in my senior year at St. John's, I decided to first obtain a Master's Degree in physics," said Perry. "A good friend from St. John's, Richard Smith, was attending the University of Maryland, so in February of my senior year, I applied there. I ended up in physics almost by accident."

Perry started the program having never solved a differential equation and without ever studying physics at an advanced undergraduate level. This was quickly discovered after being interviewed by faculty and students, who advised Perry to start a remedial course of study. Instead, he took advice from Smith, and enrolled in advanced undergraduate courses on electromagnetism and modern physics. Two semesters later, he took the graduate sequence and joined the nuclear theory group.

"I did not know what area I wished to enter, but my graduate quantum mechanics course was taught by one of the best teachers I have ever had, Joe Redish," said Perry. "Joe is a nuclear theorist, I wanted to work with him so I entered nuclear theory. I had no thought of ever getting a faculty position, I simply wanted to survive graduate school."

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RESEARCH SPOTLIGHT

Observing How Magnetic Fields Reconnect

By: James Drake and T. D. Phan (From ESA Science & Technology)

Magnetic reconnection is a universal process able to drive explosive phenomena such as solar flares. At the he zone called the electron diffusion region, where reconnection is thought to be triggered. In a recent articl observational evidence for the overall size of this region and find that it is 300 times larger than previously tho missions will have a much better chance of detecting and resolving this region than previously estimated, profoun and scientific operations.

Space is filled with plasma (an ionized gas composed of ions and electrons, globally neutral) and threaded by ma fields store energy, which can be explosively released in a process called magnetic reconnection. This physica numerous astrophysical phenomena: star formation, solar flares and intense auror,a to name a few. On Earth disrupt the efficient production of electricity in controlled fusion reactors.

During reconnection, magnetic field lines of opposite polarity annihilate, converting magnetic energy into particle in a small electron diffusion region where a kink in the newly reconnected lines produces large-scale high-ve outward.

"Understanding the structure of the diffusion region and its role in controlling the rate at which magnetic ener energy remains a key scientific challenge," says Dr. Michael Shay, of the University of Delaware.

Theoreticians until very recently thought that the electron diffusion region in the Earth's magnetosphere was a 'tir length ~10 km. This meant that, in the vastness of space, the chance of a spacecraft encountering this region though already crossed and studied (e.g. Scudder et al., 2002; Mozer et al., 2003, 2005a, 2005b, Xiao et al., 200

But as computer power has increased, theorists made their two dimensional (2-D) simulation domains la unexpectedly that the electron diffusion region is much more elongated than seen in earlier simulations, a bit like : et al., 2007; Karimabadi et al., 2007]. However, the theorists still can't tell how long this layer truly is because it simulation box is made bigger and bigger. Is this new simulation finding real? Is such an elongated layer even sta world?

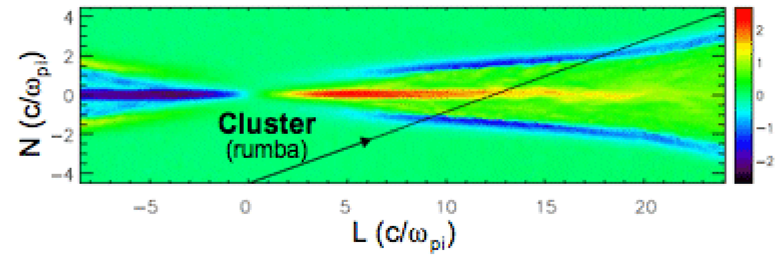

Image 1. Trajectory of Rumba (Cluster-1) overlaid on a numerical simulation of an electron diffusion region in the magnetosheath. The simulated electron flow speed in the diffusion region exceeds the magnetic field line speed, consistent with Cluster observations. Credits: Dr. Tai Phan, SSL, Berkeley University, USA

On 14 January 2003, the four ESA/NASA Cluster satellites were crossing the magnetosheath, a turbulent plasm the Earth's magnetosphere, when they encountered an electron diffusion region. Not only did Cluster confirm th electron diffusion region (Image 1), but the length observed by Cluster is 3000 km, or 300 times longer than the e and even four times longer than seen in recent simulations. The observations are in excellent qualitative agreer 2).

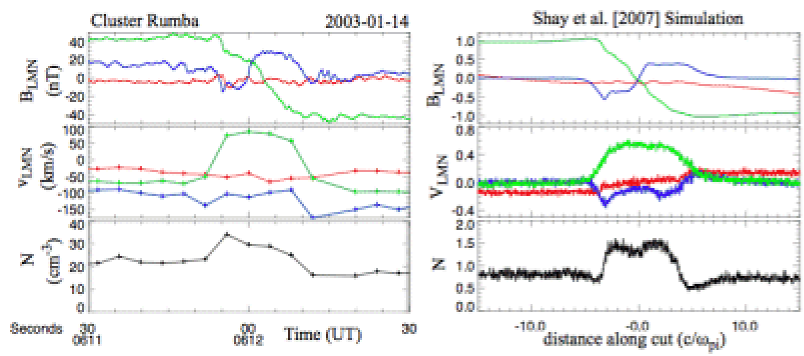

Image 2. Comparison between the observed (left panel) and simulated (right panel) plasma and field profiles of Rumba (Cluster-1) crossing the reconnection electron jet close to a reconnection site. Credits: Dr. Tai Phan, SSL, Berkeley University, USA

These Cluster observations are very significant since they are the first measurements of the length of the electror environment. The finding drastically changes the way we understand the physics of reconnection.

This discovery of an electron diffusion region 300 times longer than previously thought means future space miss probability of detecting and resolving the electron diffusion region than previously estimated.

Cluster was able to detect the electron diffusion region based on its high-resolution magnetic field, electric field a finally understand the fundamental physics of the electron diffusion region (which is ultimately responsible for perform electron measurements with higher time resolution, capable of resolving this thin but long layer. The Magnetospheric Multi-Scale mission (MMS) are being designed to make such measurements. This mission is Following MMS is a mission called Cross-Scale, which comprises 12 spacecraft to simultaneously watch the diffu global consequences of energy released by reconnection. Cross-Scale is currently under study at ESA in cc agencies as part of a competitive selection process for the mid-2017 launch slot in ESA's science programme "Cc

"With a much higher probability of encountering the electron diffusion region, we can be confident that these fu grasp a full understanding of the magnetic reconnection phenomenon," says Philippe Escoubet, Cluster and Do ESA.

References

T. D. Phan, J. F. Drake, M. A. Shay, F. S. Mozer and J. P. Eastwood, Evidence for an elongated (> 60 ion sk region during fast magnetic reconnection, *Phys. Rev. Let.*, 99, 255002, doi:10.1103/PhysRevLett.99.255002, 21 D

James Drake is a Professor of Physics at the University of Maryland. For a more complete description of his rese http://www.physics.umd.edu/people/faculty/drake.html.

However, with the help of his advisors, Joe Redish and Manoj Bannerjee, and several other excellent mentors, Perry became one of a new generation of nuclear theorists with training in relativistic field theories and launched on a program of research that continues to this day.

“Working in the nuclear theory group at Maryland was a fantastic experience,” said Perry. “Joe Redish allowed me to pursue research that interested me, whether it was directly related to his work or not.”

Now, Perry teaches, continues research in nuclear theory and spends an inordinate amount of time on university services. (He is currently chair of Ohio State’s Faculty Council). There seems to be less and less freedom in academia every year, with an ever increasing focus on external funding, but teaching has always been rewarding for Perry, who was recently awarded the 2008 OSU Distinguished Teaching Award.

”Do what you love,” he advises current students. “You can’t predict opportunity.”