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Phase of Four Spacecraft Mission



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International Team of Scientists Gather at UNH Sept. 27 to Chart Next Phase of Four-Spacecraft Mission

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DURHAM, N.H. – When four identical satellites were launched from the Baikonur Cosmodrome in Kazakhstan in the summer of 2000 aboard two Soyuz rockets, each carried 11 identical instruments – two of which contained major components designed and built by scientists and engineers from the University of New Hampshire (UNH). The Electron Drift Instrument or EDI and the Cluster Ion Spectrometer or CIS were designed as part of a suite of instrumentation to study Earth’s magnetic field or “magnetosphere.”

For four years, the Cluster-II spacecraft have been plying the magnetosphere, and this marks the very first time three-dimensional measurements of this critical region of space, which shields us from cosmic rays and is the site of the Northern Lights, have been made.

Because of UNH’s involvement in this joint European Space Agency (ESA)- National Aerospace and Space Administration (NASA) mission, the 8th annual Cluster workshop will take place on the UNH Durham campus beginning next Monday, Sept. 27 and run through Oct. 1. One hundred and thirty space scientists from around the globe will gather to discuss the mission’s scientific achievements and goals and chart out the next phase of the five-year mission, which could be extended through 2009.

This is the first meeting held in the U.S. for the European-led mission. (The Cluster I mission was lost when, in June 1996, the Arian-5 rocket carrying the spacecraft exploded over Kourou, French Guiana. The mission quickly recovered by using flight spares to rebuild instruments.)

Says Eberhard Möbius, a Cluster co-investigator and professor at the UNH Institute for the Study of Earth, Oceans, and Space (EOS) and Department of Physics, “Cluster is the first mission that attempts to understand the physical processes of the magnetosphere with a new tool for measuring the same parameters simultaneously in several locations” and, therefore, provides a true picture of processes as they occur in both space and time.

Scientists Roy Torbert, Jack Quinn, Lynn Kistler, Harald Kucharek, and others are among many on the UNH Cluster team.

The Cluster II mission is part of an international project to find out more about how the Sun and Earth interact. Upon launch, the four Cluster satellites joined an armada of spacecraft from many countries already studying the high-speed wind of charged particles – mostly electrons and

protons – that the Sun continually blasts into space. (The armada included ESA’s Solar and Heliospheric Observatory or SOHO satellite and NASA’s Advanced Composition Explorer or ACE, both of which involved UNH participation.)

The high-energy “plasma” from the Sun is responsible for the “space weather” that can be harmful to satellites and Earth-based power supplies – disrupting telecommunication and electrical power grids. In 1989, for example, a solar storm brought the Hydro-Quebec (Canada) power grid down for over nine hours.

Möbius and Kucharek, note that the SOHO and Cluster satellites are adding significantly to the knowledge of that will allow scientists to some day accurately predict the impact of solar flares on the Earth’s magnetosphere and allow safeguards to be taken. Having predictive capabilities for space weather has become increasingly important as people become more and more dependent upon satellite-based telecommunication and electronic gadgetry. But, says Möbius, this will take time. “I’d say we are in a position similar to 100 years ago for predicting meteorological conditions.”

Kucharek points out that the work the Cluster spacecraft are doing is also important from the standpoint of understanding fundamental processes like particle acceleration and magnetic reconnection. Particle acceleration is a process that occurs in many astrophysical settings, such as supernovae. Magnetic reconnection is the process that drives the solar energy streaming off the Sun, and it also occurs within Earth’s magnetosphere, which looks something like an elongated, egg-shaped, cavity with a long, streaming tail created by the solar wind.

The front edge of Earth’s magnetosphere or “bow shock,” says Kucharek, “Reduces the speed of the solar wind, accelerates solar wind particles, and diverts the flow to the tail, which is an area where magnetic reconnection occurs.”

Using the Cluster spacecraft, which can be realigned from, for example, a widely spaced tetrahedral shape to a simple string of pearls, these areas of magnetic reconnection can be studied directly – something that can’t be done near the 11,000 $\frac{3}{4}$ F surface of the Sun.

Says Möbius, “We have learned more and more using Cluster data with this issue (of reconnection) and, as a result, have been able to rule our old models (of how the process works). And you really need four spacecraft to be able to get that understanding.”

UNH Cluster website: <http://www-ssg.sr.unh.edu/tof/Missions/Cluster/clustermain.html>

Workshop: <http://atlas.sr.unh.edu/cluster8/>

Website for “Rock Around the Bow Shock”:
<http://www.ssg.sr.unh.edu/tof/Outreach/music/cluster/index.html>