



NASA Spacecraft Make New Discoveries About Northern Lights

GREENBELT, Md., Dec. 11 /PRNewswire-USNewswire/ -- A fleet of NASA spacecraft, launched less than eight months ago, has made three important discoveries about spectacular eruptions of Northern Lights called "substorms" and the source of their power.

NASA's Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission observed the dynamics of a rapidly developing substorm, confirmed the existence of giant magnetic ropes and witnessed small explosions in the outskirts of Earth's magnetic field. The findings will be presented at the annual meeting of the American Geophysical Union in San Francisco in December.

The discoveries began on March 23, when a substorm erupted over Alaska and Canada, producing vivid auroras for more than two hours. A network of ground cameras organized to support THEMIS photographed the display from below while the satellites measured particles and fields from above.

"The substorm behaved quite unexpectedly," says Vassilis Angelopoulos, the mission's principal investigator at the University of California, Los Angeles. "The auroras surged westward twice as fast as anyone thought possible, crossing 15 degrees of longitude in less than one minute. The storm traversed an entire polar time zone, or 400 miles, in 60 seconds flat."

Photographs taken by ground cameras and NASA's Polar satellite (also supporting the THEMIS mission) revealed a series of staccato outbursts each lasting about 10 minutes. Angelopoulos said that some of the bursts died out while others reinforced each other and went on to become major onsets.

Angelopoulos was quite impressed with the substorm's power and he estimated the total energy of the two-hour event at five hundred thousand billion Joules. That's equivalent to the energy of one magnitude 5.5 earthquake. Where does all that energy come from? THEMIS may have found the answer.

"The satellites have found evidence of magnetic ropes connecting Earth's upper atmosphere directly to the sun," said David Sibeck, project scientist for the mission at NASA's Goddard Space Flight Center, Greenbelt, Md. "We believe that solar wind particles flow in along these ropes, providing energy for geomagnetic storms and auroras."

A magnetic rope is a twisted bundle of magnetic fields organized much like the twisted hemp of a mariner's rope. Spacecraft have detected hints of these ropes before, but a single spacecraft was insufficient to map their 3D structure. THEMIS' five identical micro-satellites were able to perform the feat.

"THEMIS encountered its first magnetic rope on May 20," said Sibeck. "It was very large, about as wide as Earth, and located approximately 40,000 miles (70,000 km) above Earth's surface in a region called the magnetopause." The magnetopause is where the solar wind and Earth's magnetic field meet and push against one another like sumo wrestlers locked in combat. There, the rope formed and unraveled in just a few minutes, providing a brief but significant conduit for solar wind energy.

THEMIS also has observed a number of small explosions in Earth's magnetic bow shock. "The bow shock is like the bow wave in front of a boat," explained Sibeck. "It is where the solar wind first feels the effects of Earth's magnetic field. Sometimes a burst of electrical current within the solar wind will hit the bow shock and Bang! We get an explosion."

The THEMIS satellites are equipped with instruments that measure ions, electrons and electromagnetic radiation in space. The satellites will line up along the sun-Earth line next February to perform their key measurements. Researchers expect to observe, for the first time, the origin of substorm onsets in space and learn more about their evolution. Scientists from the US, Canada, Western Europe, Russia and Japan are contributing to the scientific investigation over the next two years.

THEMIS is the fifth medium-class mission under NASA's Explorer Program, which provides frequent flight opportunities for world-class scientific investigations within the heliophysics and astrophysics science areas.

The Explorer Program Office at Goddard manages the NASA-funded THEMIS mission. The University of California, Berkeley's Space Sciences Laboratory is responsible for project management, science and ground-based instruments, mission integration and post launch operations. ATK (formerly Swales Aerospace), Beltsville, Md., built the THEMIS probes.

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