Saturday, May 9, 2009



# Aurora "Power Surges" Triggered by Magnetic Explosions

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One theory suggests that the substorms are sparked relatively close to Earth, when large currents of solar wind are disrupted and send even more particles shooting toward the planet.

The second theory says that substorms are triggered much farther out in space, when two of the magnetic field lines in the tail get stretched so far that they snap back like a rubber band and reconnect into a new shape.

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This reconnection releases massive amounts of energy and sends lots of charged particles hurtling toward Earth, which boosts auroral displays.

"It's not unlike an explosion that results from a slingshot acceleration," Angelopoulos said.

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So far, technological hurdles have made it hard for scientists to precisely connect a substorm with its most probable cause.

But using NASA's recently launched Time History of Events and Macroscale Interactions during Substorms (THEMIS) set of satellites, Angelopoulos and colleagues were able to observe a February 2008 substorm that pumped up the aurora borealis.

The five identical THEMIS spacecraft, each about the size of a washing machine, line up once every four days to create a series of observation posts between Earth and the moon. About 20 ground observatories in Canada and Alaska are also part of the array.

THEMIS data revealed that the February substorm was sparked by an explosion along field lines in Earth's magnetic tail at a distance some 10 to 15 times greater than the planet's diameter.

The powerful effect pumped extra energy into the northern lights less than two minutes after the explosion occurred. This suggests that reconnection is the trigger behind the auroral power surges.

But the finding still doesn't tell scientists what triggers the trigger.

"This is just an important piece of the puzzle," Angelopoulos said. "We still don't know what causes [magnetic field lines] to become unstable" and then reconnect.

His team published their findings today in the online edition of the journal *Science.*

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Damien Chua, a geophysicist at the Naval Research Laboratory in Washington, D.C., said that auroral substorms are among the great remaining mysteries in space physics.

"I think the THEMIS experiment is really starting to knock down some of the obstacles to narrowing in on a fairly definite picture as to why substorms occur," Chua said.

"There are still a number of open questions in this process, and the difficulty is we're dealing with such a vast volume of space, it's tough to instrument that volume with enough measurements to be able to tell with data what's going on," Chua continued.

"[But] I think the configuration of spacecraft and instruments they presented here was pretty convincing."

Howard Singer, of NOAA's Space Weather Prediction Center in Boulder, Colorado, said decoding auroras is just one part of the THEMIS mission.

"I think THEMIS is specially designed to help answer some of those compelling science questions. But those questions have a lot of societal relevance," said Singer, who works with THEMIS but was not involved in the new study.

"In the auroral region we have precipitation of energetic particles, currents in the upper atmosphere and ionosphere, and fluctuating magnetic fields.

"These sorts of space weather impact technologies such as radio communications, navigation systems, power grids, and satellites," he noted.

(Read "Stronger Solar Storms Predicted; Blackouts May Result" [March 7, 2006].)

"I think by better understanding where and when and for how long these substorms are going to occur, we're going to be able to translate that into better predictions for [people] that rely on these technologies."

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