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Five New Satellites With a Mission of Finding a Source of Color in Space

By WARREN E. LEARY

WASHINGTON, Jan. 22 — NASA will soon launch a fleet of five spacecraft in hopes of solving the mystery of how the greenish auroras above the Earth's poles suddenly burst into shimmering multicolor lights.

The quintet of identical satellites, NASA's first attempt to launch so many satellites on a single rocket, will be positioned in orbits inside the magnetic field surrounding Earth to look for the origin of sudden energy outbursts that enliven the northern and southern lights.

The space probes are part of a mission called Themis, short for Time History of Events and Macroscale Interactions during Substorms, which is designed to find the trigger point of geomagnetic substorms that can spring up within minutes to brighten auroras and release bursts of potentially damaging radiation.

The Sun constantly fills space with charged particles and other radiation through solar flares or large eruptions called coronal mass ejections. The Earth's magnetic field shields the planet from most of this solar wind by capturing these high-energy particles and channeling them around the planet, forming a tear-shaped protective bubble called the magnetosphere.

Some of these particles leak through the magnetosphere and pour through the atmosphere toward the poles, colliding with air molecules and causing the atmosphere to glow in a greenish-white light. From space, these auroras glow like oval haloes encircling the north and south magnetic poles. At times, however, energy builds up within the magnetic field until it suddenly breaks loose into what is called a substorm, releasing a burst of electrical current that turns the auroras into pulsing red, purple and white colors.

Built by the Space Sciences Laboratory at the University of California, Berkeley, and Swales Aerospace of Beltsville, Md., the satellites aim to establish once and for all where in the magnetosphere substorms originate and what triggers them, said Dr. Vassilis Angelopoulos, a research physicist at the university and the chief scientist for the mission.

“For over 30 years, the source location of these explosive energy releases has been sought after with great fervor,” Dr. Angelopoulos said. “A substorm starts from a single point in space and progresses past the Moon’s orbit within minutes, so a single satellite cannot identify the substorm origin.”

Substorms are a recurring phenomenon that can pop up at any time, even during periods of low solar activity, he said. They appear as well during major storms caused by regular solar eruptions, adding to their destructive power, and a series of substorms happening by themselves can produce enough accumulated energy to cause damage, he said.

Solar storms can damage or disrupt communications and GPS navigation satellites, overload and knock out electric power grids, and pose a radiation danger to astronauts in space, experts said. “Themis is a stepping stone to explain space weather phenomenon that affects our lives,” Dr. Angelopoulos said.

Peter Harvey, project manager for the mission at the university, said the five-satellite constellation is scheduled to be launched aboard a Delta II rocket from Cape Canaveral, Fla., on Feb. 15. Observations from four of the satellites are needed to complete the $200 million mission, and the fifth spacecraft will serve as an in-orbit spare.

The dishwasher-sized satellites are to coast in Earth orbit for 10 months until they line up within Earth’s shadow like a string of beads, with two of the spacecraft positioned about one-sixth of the way to the Moon and the other two about halfway. By February 2008, they will begin collecting coordinated measurements every four days to pinpoint where and when substorms begin.

To get an added dimension to the life cycles of these substorms, the satellite measurements will be coordinated with ground-based readings from 20 observatories spread over Alaska and Canada. These northern observatories are equipped with all-sky cameras and magnetometer sensors that measure currents in near-Earth space.

Dr. Angelopoulos said he expected the satellites to observe more than 30 substorms during the mission’s lifespan and make a major contribution to understanding space physics.

“Themis is so important because the same fundamental physical process is seen around all planets, it happens on the Sun in solar flares, and in astrophysical systems such as black holes,” he said. “It’s amazing that being so close to us, here at Earth, it is not understood yet.”