Lockheed Martin Instruments Study Dynamic Solar Activity On New Sun Missions

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Fresh insights into long-standing solar mysteries and the first 3-D views of the Sun have been made possible by Lockheed Martin space instruments on two new Sun-watching space missions. Hinode, an international cooperative mission, and NASA's Solar Terrestrial Relations Observatory (STEREO) are providing solar physicists a treasure trove of new data on the roiling turbulent nuclear furnace at the center of our solar system.

The primary scientific goal of the Hinode mission, launched on Sept. 23, 2006, is to observe how changes in the magnetic field at the Sun's surface propagate through the different higher layers of the solar atmosphere. A torrent of new images show the Sun's magnetic field to be far more chaotic and energetic than previously believed.

"Hinode images are revealing irrefutable evidence for the presence of turbulence driven processes that are bringing magnetic fields, on all scales, to the Sun's surface, resulting in an extremely dynamic chromosphere or gaseous envelope around the Sun," said Dr. Alan Title, solar physicist at the Lockheed Martin Advanced Technology Center (ATC) in Palo Alto, Calif. "We've known for some time that the solar interior is constantly ringing like a bell. We're now learning that the enormous cacophony is leaking out through the magnetic fields and the acoustic waves are causing tremendous heating in the Sun's atmosphere."

A suite of instruments on Hinode, called the Focal Plane Package (FPP) -- designed and built at the Solar and Astrophysics Laboratory of the ATC -- is providing the high-resolution optical measurements that show connections between changes in the Sun's magnetic field and features of the solar atmosphere, both steady state -- like coronal heating -- or transient -- like flares and coronal mass ejections. The FPP resides on Hinode's Solar Optical Telescope, the largest solar optical telescope ever to be flown in space. It can to resolve features on the surface of the Sun just 90 mi. across.

Hinode, Japanese for "sunrise," is a Japanese mission, developed and launched by Institute of Space and Astronautical Science and the Japanese Aerospace Exploration Agency, in collaboration with the National Astronomy Observatory of Japan. International partners include NASA, the Science and Technology Facilities Council of the UK and the European Space Agency. It is the second mission in the Solar Terrestrial Probes Program within the Heliophysics Division of NASA's Science Mission Directorate, and follow-on to the successful Japanese Yohkoh mission.

NASA's STEREO mission focused a new pair of eyes on the Sun, as two spacecraft with identical instruments were launched on October 25, 2006. The two spacecraft are on different trajectories, to study the most energetic events on the surface and in the lower atmosphere of the Sun, and their travel through interplanetary space.

Data from spacecraft instruments are allowing scientists to construct the first ever three-dimensional views of the Sun, providing a new perspective on Coronal Mass Ejections (CMEs). CMEs are violent explosions on the surface of the Sun that can propel up to 10 billion tons of the Sun's atmosphere -- at a million miles an hour -- out through the corona and into space.

The ATC-built Extreme Ultraviolet Imager (EUVI) instrument is one element of an instrument suite on each STEREO spacecraft called SECCHI -- the Sun-Earth Connection Coronal and Heliospheric Investigation. SECCHI comprises a suite of telescopes, including three white light coronagraphs and EUVI.

"These first 3-D images are magnificent, and just a taste of wonderful things to come! There is enormous satisfaction in seeing our years of effort bear fruit. We've been studying CMEs for a long time, but SECCHI is offering us new insight into the structure and evolution of the solar corona in three dimensions, while EUVI focuses specifically on the initiation and early evolution of CMEs," said Dr. James Lemen, Lockheed Martin co-investigator on SECCHI. "EUVI and the other instruments on SECCHI are allowing us for the first time to follow the propagation of these events through the

corona, out into interplanetary space and all the way to Earth, giving us a comprehensive view of these enormous phenomena."

Coronal mass ejections, which are often associated with solar flares, can take several days to reach the Earth. Fast, powerful ejections give rise to geomagnetic storms, which can disrupt radio transmissions and induce large currents in power transmission lines and oil pipelines. They have resulted in large-scale failures of the North American power grid and greatly increased pipeline erosion. CMEs also can generate spectacular auroras in Earth's polar skies, but can disrupt spacecraft and be extremely hazardous to astronauts. Seeing CMEs in 3-D will allow scientists to discern the cloud front of these enormous detonations and improve predicted arrival times at Earth by an order of magnitude or more.

The complex physics of the solar atmosphere will also be more easily understood as scientists can now view stereoscopic images of solar features and structures and determine which are in front and which behind. The precise flow of matter and energy as it propagates outward from the solar surface will be much clearer.

NASA Goddard Space Flight Center in Greenbelt, Md. manages the STEREO mission. The Johns Hopkins University Applied Physics Laboratory in Laurel, Md. designed and built the spacecraft. The laboratory maintains command and control of the observatories throughout the mission, while NASA tracks and receives the data, determines the orbit of the satellites, and coordinates science results.

The Solar and Astrophysics Laboratory at the ATC has a 43-year-long heritage of spaceborne solar instruments including the Soft X-ray Telescope on the Japanese Yohkoh satellite, the Michelson Doppler Imager on the ESA/NASA Solar and Heliospheric Observatory, the solar telescope on NASA's Transition Region and Coronal Explorer and the Solar X-ray Imager on the GOES-N environmental satellite. The laboratory also conducts basic research into understanding and predicting space weather and the behavior of the Sun including its impacts on Earth and climate. The ATC is also designing and building two instruments for NASA's next Sun mission, the Solar Dynamics Observatory, slated for launch in 2008.

The ATC is the research and development organization of Lockheed Martin Space Systems Company (LMSSC). LMSSC is a major operating unit of Lockheed Martin Corporation, and designs, develops, tests, manufactures and operates a full spectrum of advanced-technology systems for national security, civil and commercial customers. Chief products include human space flight systems; a full range of remote sensing, navigation, meteorological and communications satellites and instruments; space observatories and interplanetary spacecraft; laser radar; fleet ballistic missiles; and missile defense systems.

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