

# *Studying Our Nearest Star*

## **NASA's Role in Japan's Solar-B Mission**

To learn more about our nearest star, NASA is providing instrumental scientific and engineering support to Solar-B — an international mission to study the sun.

The heart of the mission is a large solar optical telescope developed by Solar-B's sponsoring organization, the Japan Aerospace Exploration Agency (JAXA), based in the Tokyo suburb of Sagami-hara. Images gleaned by its telescope will enable scientists to study the sun at specific wavelengths in the visible spectrum. Additional instruments developed with international partners will increase Solar-B's observational powers, enabling scientists to record data from beyond the optical plane — the portion of the electromagnetic spectrum visible to the human eye.

Collectively, these Solar-B instruments — the Solar Optical Telescope Focal Plane Package, X-ray Telescope and Extreme Ultraviolet Spectrometer — will record how the energy stored in and released by the magnetic field spreads through the sun's outer atmosphere. These measurements, along with images captured by the solar optical telescope, will help scientists better understand the origin of the violent power of the sun.

JAXA's international partners include NASA, the Particle Physics and Astronomy Research Council based in Swindon, United Kingdom and the European Space Agency. With its international partners, NASA is designing and building major elements for the three supporting Solar-B instruments. NASA's Marshall Space Flight Center in Huntsville, Alabama, is managing the development of instrument components provided by NASA, with additional engineering, manufacturing and scientific support provided by academia and industry.

Collectively, this team has developed the advanced suite of Solar-B instruments — satellite-based tools that will help scientists better understand our sun and how its explosive energy impacts Earth. The instruments were specifically designed to provide a set of complementary observations that are needed to understand the physical processes that are associated with the propagation and dissipation of the sun's magnetic free energy in the solar atmosphere.

### **Solar-B Instruments**

#### **Solar Optical Telescope Focal Plane**

**Package:** An integral part of Solar-B's Solar Optical Telescope, the Focal Plane Package is a suite of three separate instruments. These include a high-resolution imager to generate optical images of the sun, an imaging vector magnetograph that will make rapid observations of the sun's magnetic and velocity fields, and a spectropolarimeter that will make the most precise observations of the sun's magnetic field.

Together these instruments will, for the first time from space, measure small changes in the strength and direction of the sun's magnetic field. They also will show how these changes evolve and coincide with dynamic events seen in the sun's corona — the sun's "atmosphere," which extends millions of miles into space.

Once Solar-B is operating in space, one key product of this instrument suite will be vector magnetograms — pictorial representations that illustrate variations in the strength of the sun's magnetic field. These magnetograms will have a spatial resolution 5-10-times better than those obtainable from the ground, enabling scientists to better understand how the

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magnetic fields generated in the sun influence the space surrounding our nearest star and extending to the Earth's orbit and beyond.

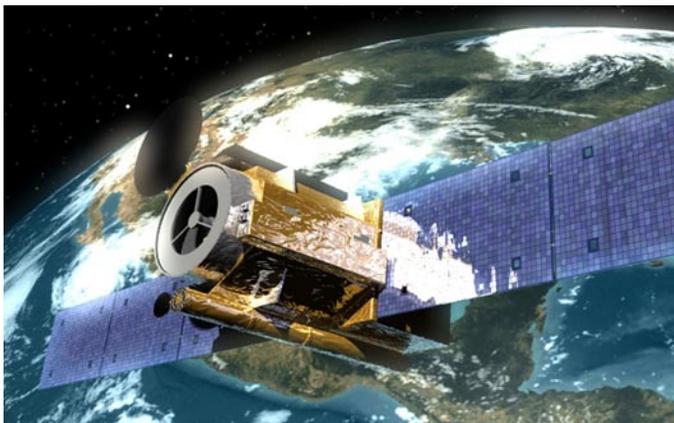
To help ensure clear, focused images and highly accurate readings, an image motion stabilization system also is part of the instrument suite. A joint JAXA/NASA development, the system will compensate for residual motions in the spacecraft by stabilizing images recorded by the Japanese-developed 19.7-inch (50-centimeter) Solar Optical Telescope. Using this suite of instruments, scientists also will record movies of the photosphere and chromosphere — the sun's visible, gaseous surface layers.

NASA is responsible for the design and development of the Focal Plane Package, and Dr. Ted Tarbell of the Lockheed Martin Advanced Technology Center in Palo Alto, Calif., is the NASA principal investigator.

It is important to note that because of the collaborative nature of the mission that encompasses the development of the instruments, all the instruments have Japanese principal investigators in addition to the NASA principal investigators.

**X-ray Telescope:** The X-ray Telescope will generate X-ray movies of the sun's corona — the hot, million-degree, outer atmosphere. The corona is the spawning ground for the solar flares and coronal mass ejections that dominate the space between the sun and Earth. These phenomena are powered by the sun's magnetic field. By combining observations by Solar-B's optical and X-ray telescopes, scientists will be able to study how changes in the sun's magnetic field trigger these explosive solar events.

This instrument is an advanced version of the Solar-A Soft X-ray Telescope launched by the Japanese space agency in 1991. Managed by the Marshall Center, the ten-year Solar-A mission studied high-energy phenomena in solar flares.



**Artist concept of Solar-B operating in space, (NASA/GSFC/Chris Meaney)**

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The Smithsonian Astrophysical Observatory in Cambridge, Mass., is providing the telescope optics, filters and structure, while JAXA provides the charge-coupled-device, or CCD, camera. Dr. Ed Deluca of the Smithsonian is the NASA principal investigator for the X-ray Telescope.

**Extreme Ultraviolet Imaging Spectrometer:** Although capable of generating images, the primary function of Extreme Ultraviolet Imaging Spectrometer is to measure the flow velocity, or speed of solar particles, and diagnose the temperature and density of solar plasma — the ionized gas that surrounds the sun, its corona and beyond. The Extreme Ultraviolet Imaging Spectrometer provides a crucial link between the other two instruments because it can measure the layers that separate the photosphere from the corona — an area known as the chromosphere and the chromosphere-corona transition.

The optical elements of the instrument were provided by NASA to the Mullard Space Sciences Laboratory of the United Kingdom, which is responsible for the development of the instrument and the scientific investigation through a grant provided by the Particle Physics and Astronomy Research Council of the United Kingdom. NASA, at the council's invitation, will participate in the science investigation in addition to providing the optical elements of the spectrometer. Professor Leonard Culhane of the Mullard Space Sciences Laboratory — a department of the University College of London — is the principal investigator. Supporting Culhane in the development of the instrument's optical systems is the NASA principal investigator, Dr. George Doschek of the Naval Research Laboratory in Washington.

## **Mission Summary**

Launched from Kagoshima, Japan, in September 2006, the Solar-B spacecraft will spend at least three years circling Earth in a sun-synchronous orbit. This is a polar, rather than equatorial, orbit and will allow the instruments to remain in continuous sunlight for nine months of each year.

Once the spacecraft is in orbit, NASA and the science teams will support instrument operations and data collection from the operations center located at JAXA's facility in Sagami-hara, Japan.

The NASA contribution to Solar-B is part of the Solar Terrestrial Probes Program within the Heliophysics Division of NASA's Science Mission Directorate in Washington. This program is managed at NASA's Goddard Space Flight Center in Greenbelt, Maryland, which assigned the project management to the Science and Mission Systems Directorate of the Marshall Space Flight Center. Lawrence Hill is the project manager, and Dr. John M. Davis is the Solar-B project scientist.

More information about Solar-B is available at:

[http://www.nasa.gov/mission\\_pages/solar-b/](http://www.nasa.gov/mission_pages/solar-b/)  
and  
<http://solarb.msfc.nasa.gov>