MOSES-2 sounding rocket to investigate coronal heating

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Engineers work on the final steps of integrating the MOSES-2 sounding rocket payload. The rocket, which will launch from White Sands Missile Range in New Mexico August 25, is carrying an instrument called the Multi-Order Solar EUV Spectrograph, or MOSES-2. This instrument will be used to take images of the sun in extreme ultraviolet light on its 15-minute flight into space. Taking these kinds of images is impossible from the ground, since Earth's atmosphere blocks all extreme ultraviolet light. Credit: NASA

A NASA-funded sounding rocket is getting ready to launch to give insight into one of the biggest mysteries in solar physics—the fact the sun's atmosphere is some 1,000 times hotter than its surface. The mission, developed by scientists and students at Montana State University in Bozeman, Montana, will make a 15-minute journey into space on a Black Brant IX suborbital sounding rocket. During its trip, it will take images of the sun in the extreme ultraviolet, or EUV, which can't be seen from the ground due to Earth's EUV-blocking atmosphere.

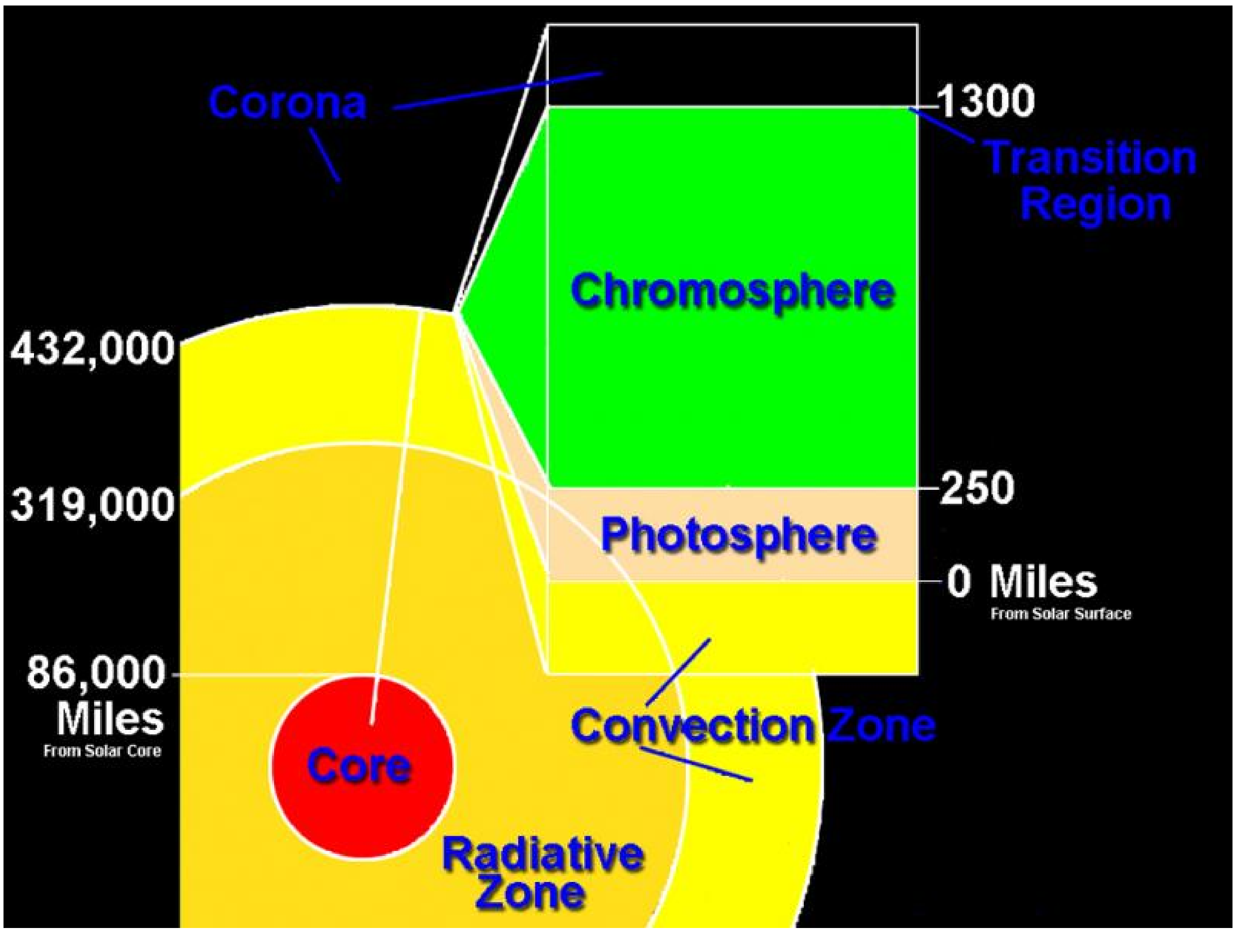
The Multi-Order Solar EUV Spectrograph, or MOSES-2, launch will be investigating the transition region of the sun, the layer of material where the photosphere—the layer of the sun we see—becomes the corona.

"The transition region is a pretty interesting place," said Charles Kankelborg, principal investigator for MOSES-2 at Montana State University, Bozeman, Montana.

The so-called coronal heating problem is based in the fact that the sun produces energy by fusing hydrogen at its center—so material generally gets cooler as you move outward from that incredibly hot core. The one exception is the sun's atmosphere, the corona. Though the corona is farther from the core than any other part of the sun, it is unexpectedly hotter than many of the layers below. Scientists have proposed several theories to explain this mystery heating, ranging from the possibility of thousands of mini solar flares to complicated magnetic wave processes.

Kankelborg and his team are hoping to catch images of an explosive event in the transition region, one possible cause of coronal heating. Similar to a solar flare, such explosive events are thought to be caused by magnetic reconnection, a sometimes violent process in which magnetic field lines disconnect and reconfigure, releasing energy and heat. The MOSES team says that watching magnetic reconnection may well be easier in the transition region that it is in the larger solar flares.

"It's very difficult to see the actual magnetic reconnection in a solar flare," said Kankelborg. "Solar flares happen in the sun's upper atmosphere, the corona, where material is relatively sparse, so there's not much stuff there to let off light and show us what's happening."



This graphic shows a model of the layers of the Sun, with approximate mileage ranges for each layer: for the inner layers, the mileage is from the sun's core; for the outer layers, the mileage is from the sun's surface. Credit: National Solar Observatory

On the other hand, the transition region is relatively dense, meaning that researchers have a chance to observe magnetic reconnection more directly if they catch an explosive event.

The MOSES-2 instrument is finely tuned to see material in this region. Because different elements emit light at different temperatures and wavelengths, scientists can focus on a particular temperature—and therefore a particular layer of material—by taking images in a corresponding wavelength. MOSES-2 is configured to take pictures at 465 Angstroms, which represents material at a temperature of about 900,000 degrees Fahrenheit.

MOSES-2 will begin taking data when the rocket reaches a height of around 100 miles, 107 seconds after launch. Even 100 miles above the surface, there is still enough atmosphere that only about half of the sun's EUV light is visible. However, at the peak of the rocket's flight, nearly 187 miles in altitude, there is so little atmospheric material that any EUV light blocking is negligible. The total flight time is around 15 minutes, with about five minutes of data collection.

Though the period of data collection is short, sounding rockets are a valuable way to access space for a low cost.

"For about one percent of the cost of a satellite mission, you can spend five minutes taking data in space," said Kankelborg. "It's a great way to demonstrate cutting-edge instruments and new ways of doing science."

The MOSES-2 sounding rocket payload undergoes final testing in preparation for its August 25 launch from White Sands Missile Range in New Mexico. The sounding rocket will fly for 15 minutes, carrying the Multi-Order Soalr EUV Spectrograph, or MOSES-2, instrument. MOSES-2 will take images of the sun in extreme ultraviolet light from outside Earth's atmosphere. It is impossible to take these kinds of images from Earth, since Earth's atmosphere blocks all extreme ultraviolet light. Credit: NASA

The lower budget and shorter timeline of sounding rocket missions also make them ideal for university and student involvement.

"In a university setting, it's easier to run a research program based on sounding rocket missions than satellite missions," said Kankelborg. "You can get students involved in building instruments hands-on." Three students from the Montana State University MOSES-2 team will attend the launch at White Sands Missile Range in New Mexico.

The launch window for MOSES-2 opens on Aug. 25, and the team will wait for favorable weather conditions before launching. This is the second flight for the MOSES instrument. In 2006, MOSES flew on a sounding rocket to make similar observations of the sun, but in a different wavelength. The team plans to fly MOSES a third time in 2018 along with a new spectrograph to make more observations of the transition region.

The MOSES-2 launch is supported through NASA's Sounding Rocket Program at the Goddard Space Flight Center's Wallops Flight Facility in Virginia. NASA's Heliophysics Division manages the sounding rocket program.

Provided by NASA

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