HI-C sounding rocket mission has finest mirrors ever made

July 6 2012, By Karen C. Fox

Waiting for launch: NASA's HI-C mission, sitting in the front of this image, will launch on July 11, 2012 to observe the sun's corona in the highest detail ever captured during a 381-second flight. Credit: NASA

(Phys.org) -- On July 11, NASA scientists will launch into space the highest resolution solar telescope ever to observe the solar corona, the million degree outer solar atmosphere. The instrument, called HI-C for High Resolution Coronal Imager, will fly aboard a Black Brant sounding

rocket to be launched from the White Sands Missile Range in New Mexico. The mission will have just 620 seconds for its flight, spending about half of that time high enough that Earth's atmosphere will not block ultraviolet rays from the sun. By looking at a specific range of UV light, HI-C scientists hope to observe fundamental structures on the sun, as narrow as 100 miles across.

"Other instruments in space can't resolve things that small, but they do suggest – after detailed computer analysis of the amount of light in any given pixel – that structures in the sun's atmosphere are about 100 miles across," says Jonathan Cirtain, a solar scientist at NASA's Marshall Space Flight Center in Huntsville, Ala. who is the project scientist for HI-C. "And we also have theories about the shapes of structures in the atmosphere, or corona, that expect that size. HI-C will be the first chance we have to see them."

The spatial resolution on HI-C is some five times more detailed than the Atmospheric Imaging Assembly (AIA) instrument on the Solar Dynamics Observatory (SDO), that can resolve structures down to 600 miles and currently sends back some of our most stunning and scientifically useful images of the sun. Of course, AIA can see the entire sun at this resolution, while HI-C will focus on an area just one-sixth the width of the sun or 135,000 miles across. Also, AIA observes the sun in ten different wavelengths, while HI-C will observe just one: 193 Angstroms. This wavelength of UV light corresponds to material in the sun at temperatures of 1.5 million Kelvin and that wavelength is typically used to observe material in the corona.

During its ten-minute journey, HI-C will focus on the center of the sun, where a large sunspot is predicted to be – a prediction based on what the sun looked like 27 days previously, since it takes 27 days for the sun to complete a full rotation.

"We will start acquiring data at 69 seconds after launch, at a rate of roughly an image a second," says Cirtain. "We will be able to look through a secondary H-alpha telescope on the instrument in real time and re-point the main telescope as needed."

In addition to seeing the finest structures yet seen in the sun's corona, the launch of HI-C will serve as a test bed for this high-resolution telescope. Often one improves telescope resolution simply by building bigger mirrors, but this is not possible when constraining a telescope to the size of a sounding rocket, or even a long-term satellite. So HI-C's mirror is only about nine and a half inches across, no bigger than that of AIA. However, the HI-C mirrors, made by a team at Marshall, are some of the finest ever made, says Cirtain. If one could see the surface at an atomic level, it would show no greater valleys or peaks than two atoms in either direction.

"So it's super smooth," says Cirtain.

In addition, the team created a longer focal length – that is, they increased the distance the light travels from its primary mirror to its secondary mirror, another trick to improve resolution – by creating a precise inner maze for the light to travel from mirror to mirror, rather than a simple, shorter straight line.

NASA's Marshall Space Flight Center is leading the international effort for Hi-C. Key partners include the University of Alabama at Huntsville, Smithsonian Astrophysical Observatory, University of Central Lancashire in Lancashire, England, and the Lebedev Physical Institute of the Russian Academy of Sciences.

Provided by NASA