NuSTAR opens out-of-this-world view thanks to Livermore Lab technology

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For astrophysicist Bill Craig and his team, NASA's NuSTAR will open up a whole new world. In fact, NuSTAR will allow them to observe a new class of objects in space, called extreme objects, which have never been seen.

The Nuclear Spectroscopic Telescope Array (or NuSTAR), is the first focusing, high energy X-ray NASA satellite that will open the hard X-ray sky for sensitive study for the first time. It is scheduled for launch today (June 13) from Kwajalein Atoll in the Marshall Islands.

For Livermore, the predecessor to NuSTAR was a balloon-borne instrument known as HEFT (the High Energy Focusing Telescope) that was funded, in part, by a Laboratory Directed Research and Development investment in 2001. NuSTAR takes HEFT's X-ray focusing abilities and sends them beyond Earth's atmosphere on a satellite. The optics design and the proposed production process for NuSTAR are based on those used to build the HEFT telescopes.

NuSTAR will be hundreds of times more sensitive than any previous hard X-ray instrument, which will greatly improve image resolution. It will orbit Earth at an altitude of about 600 kilometers for three years, allowing researchers to take a census of black holes. They hope to measure both the rate at which black holes are growing and the accretion rate at which material has fallen into black holes over time.

"It's rare you get the chance of increasing a sensitivity factor by more

than 100 times better than current methods," Craig said. "This is really a game changer."

The Laboratory was involved in both the design and testing of the X-ray optics that will fly on NuSTAR. The lead optics engineer for the telescopes, Todd Decker, worked for NuSTAR while on leave from the Lab. As the manager of the payload (instrument) for NuSTAR, Craig was responsible for developing and integrating the instrument components and will be very involved in the science output (in addition to his role as LDRD director). Others at the Lab, primarily Mike Pivovaroff and Julia Vogel in the Physical and Life Sciences Directorate, played a key role in optics calibration and also will be involved in the science of NuSTAR.

NuSTAR will have more than 10 times the resolution and more than 100 times the sensitivity of its predecessors while operating in a similar energy range.

The mission will work with other telescopes in space now, including NASA's Chandra X-ray Observatory, which observes lower-energy X-rays. Together, they will provide a more complete picture of the most energetic and exotic objects in space, such as black holes, dead stars and relativistic jets (which are key to the production of gamma ray bursts and may be found near the centers of black holes) that travel near the speed of light.

As for the extreme objects, which emit the most energy in the universe in the shortest time frame, Craig said they "are a new class of objects that we've never been able to see before."

In addition, NuSTAR will enable the team to see the black holes that are believed to be in the center of all galaxies. In the early galaxies, dust skews the view of these black holes, but NuSTAR will see right through

that.

The NuSTAR mission was built by an international collaboration, led by Principal Investigator Fiona Harrison of Caltech. For more information, go to the NuSTAR Website.

Provided by Lawrence Livermore National Laboratory