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NASA, nation ready for eclipse

By Jay Levine

X-Press editor

The first total solar eclipse visible in the contiguous United States in 38 years is happening Aug. 21. Dr. Lika Guhathakurta, Heliophysics Science program manager at NASA Headquarters, explained elements of the phenomena June 5 at Armstrong.

A total solar eclipse occurs when the sun is completely obscured by the moon.

The lunar shadow enters the United States near Lincoln City, Oregon, at 9:05 a.m. PDT. Totality, where the moon completely



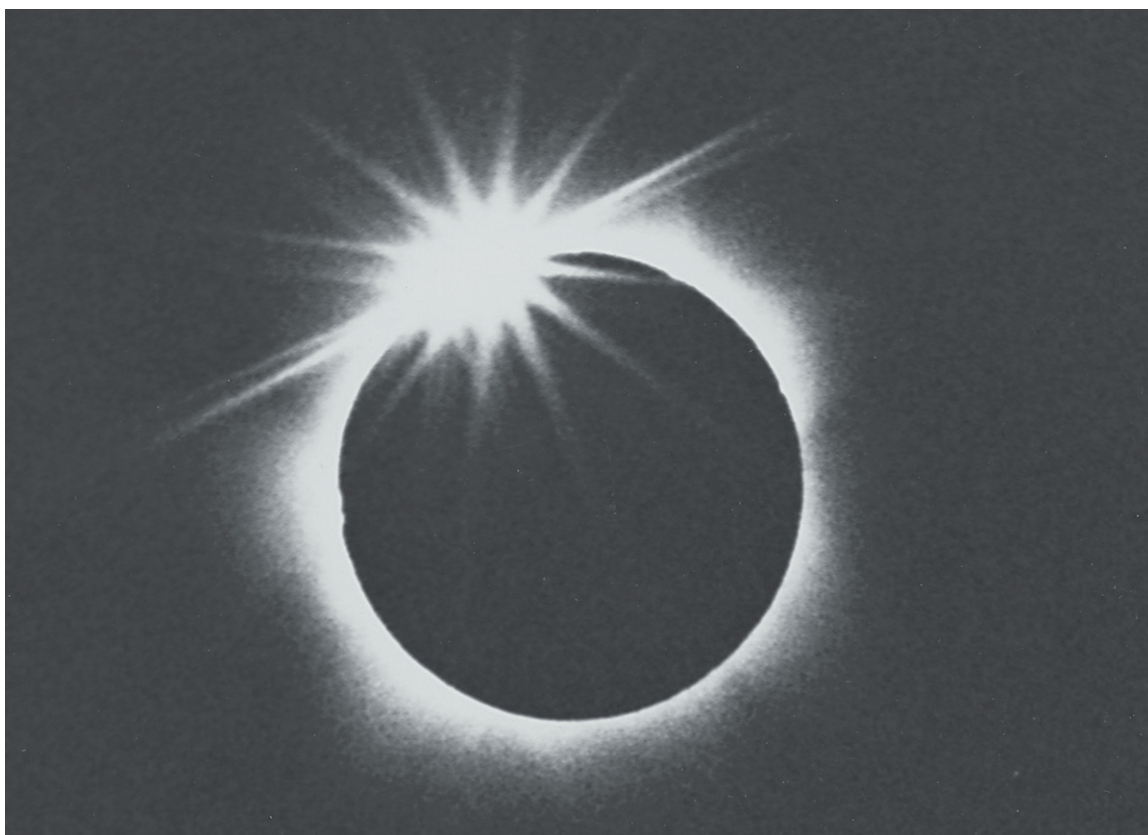
Lika Guhathakurta

covers the sun, begins in Lincoln City at 10:16 a.m. PDT.

The total eclipse will end in Charleston, South Carolina, at 2:48 p.m. EDT. The lunar shadow will leave the United States at 4:09 p.m. EDT. Outside the path of the total solar eclipse, a partial eclipse will be visible throughout the continental United States.

Armstrong is scheduled to support live NASA Television coverage of the eclipse and citizen science during the event by collecting video and photos from a NASA G-III aircraft, which is based at the center.

Guhathakurta, who is a long-standing eclipse enthusiast and



NASA

This image is from the March 7, 1970, total eclipse, that passed over NASA's Wallops Station in Virginia, which is now Wallops Flight Facility. For that event, the facility launched 32 suborbital rockets to conduct meteorology, ionospheric and solar physics experiments.

NASA's science lead for the upcoming eclipse, explained what people might see depending on where in the country they are watching. Some parts of the eclipse can be seen from anywhere in the U.S., but others can only be seen from a city directly in the path of the total eclipse, she said.

She also stressed the need to wear

eclipse glasses to prevent eye injury. Available at local science museums, schools and astronomy clubs, these lenses provide protection not offered by ordinary sunglasses, even very dark ones. NASA recommends using only eclipse glasses and handheld solar viewers that meet the ISO 12312-2 international standard to ensure adequate eye protection.

The various parts of an eclipse include the corona, prominences (or filaments when it is not an eclipse), polar plumes, helmet streamers and coronal loops, Guhathakurta explained.

The corona is the outermost layer of the solar atmosphere. It is

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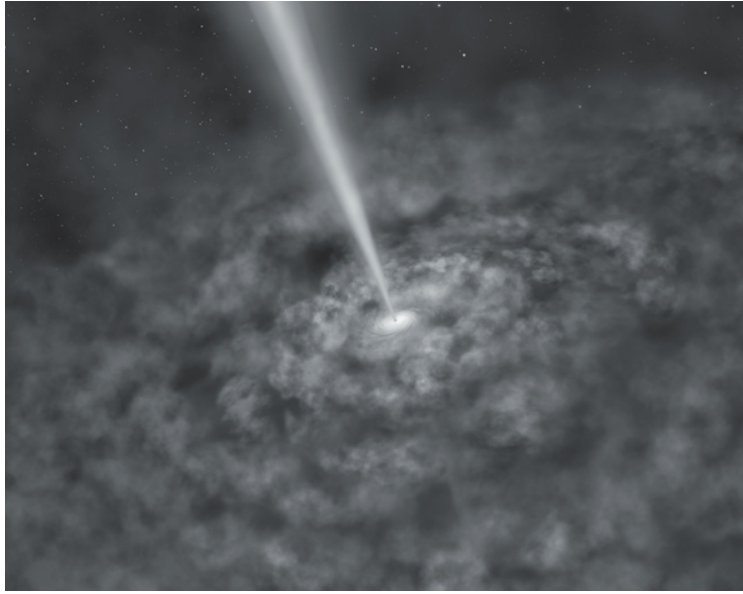
SOFIA leads to black hole discovery

By **Nicholas A. Veronico**
USRA/Ames Public Affairs

Researchers at the University of Texas San Antonio using observations from NASA's Stratospheric Observatory for Infrared Astronomy, SOFIA, found that the dust surrounding active, ravenous black holes is much more compact than previously thought.

Most, if not all, large galaxies contain a supermassive black hole at the centers. Many of these black holes are relatively quiet and inactive, like the one at the center of the Milky Way galaxy. However, some supermassive black holes are currently consuming significant amounts of material that are being drawn into them, resulting in the emission of huge amounts of energy. These active black holes are called active galactic nuclei.

Previous studies have suggested that all active galactic nuclei have essentially the same structure. Models indicate that active galactic nuclei have a donut-shaped dust structure, known as a torus, surrounding the supermassive black hole. Using the instrument called the Faint Object Infrared Camera for the SOFIA Telescope, FORCAST, the team observed the infrared emissions around 11 supermassive black holes in active galactic nuclei located at distances of 100 million light years and more,



NASA/SOFIA/Lynette Cook

Artist illustration of the thick ring of dust that can obscure the energetic processes that occur near the supermassive black hole of an active galactic nuclei.

and determined the size, opacity and distribution of dust in each torus.

In a paper published in the *Monthly Notices of the Royal Astronomical Society*, the team reports that the tori are 30 percent smaller than predicted and that the peak infrared emission is at even longer infrared wavelengths than previously estimated. The implication is that the dust obscuring the central black hole is more compact than previously thought.

They also indicate that active

galactic nuclei radiate most of their energy at wavelengths that are not observable from the ground because the energy is absorbed by water vapor in Earth's atmosphere. SOFIA, which is based at Armstrong's Hangar 703 in Palmdale, flies above 99 percent of the Earth's water vapor, enabling the research group to characterize the properties of the torus-shaped dust structures at far-infrared wavelengths.

"Using SOFIA, we were able to obtain the most spatially detailed observations possible

at these wavelengths, allowing us to make new discoveries on the characterization of active galactic nuclei dust tori," said Lindsay Fuller, graduate student at the University of Texas San Antonio and lead author of the published paper.

Future observations are necessary to determine whether or not all of the observed emission originates with the tori, or if there is some other component adding to the total emission of the active galactic nuclei.

"Next, our goal will be to use SOFIA to observe a larger sample of active galactic nuclei, and at longer wavelengths," said Enrique Lopez-Rodriguez, principal investigator of this project and Universities Space Research Association staff scientist at the SOFIA Science Center. "That will allow us to put tighter constraints on the physical structure of the dusty environment surrounding the active galactic nuclei."

SOFIA is a Boeing 747SP jetliner modified to carry a 100-inch diameter telescope. It is a joint project of NASA and the German Aerospace Center, DLR. NASA's Ames Research Center manages the SOFIA program, science and mission operations in cooperation with the Universities Space Research Association headquartered in Maryland and the German SOFIA Institute (DSI) at the University of Stuttgart.

Educators learn about eclipse science

By **Marshall Murphy**
NASA Armstrong Public Affairs

The first total solar eclipse to be visible across all of North America in nearly 40 years will occur Aug. 21. NASA Armstrong's Office of Education at the AERO Institute in Palmdale presented a solar eclipse workshop May 10 to regional educators to provide the resources needed to teach students about this phenomenon.

Educator professional development specialist Barbie Buckner gave workshop participants

an overview of the science behind eclipses and used demonstrations to explain eclipses to students.

Teachers used a flashlight to cast a tennis ball's shadow onto a beach ball, which simulated the sun casting the moon's shadow onto the Earth during an eclipse. In another exercise, educators used a flashlight to move a toy bear's shadow — which demonstrated how shadows change as light sources move.

Eric Becklin, chief science advisor for the Stratospheric Observatory for Infrared Astronomy, or SOFIA,

which is a joint project between NASA and the German Aerospace Center that uses a 747 aircraft with an onboard telescope that serves as a flying observatory, spoke to workshop participants about his experiences observing solar eclipses.

"It was otherworldly," Becklin said about a total solar eclipse he viewed from Hawaii's Mauna Kea volcano. "I couldn't believe how much the landscape looked like the moon!"

Becklin explained his participation in a 1988 solar

eclipse observation just north of Guam aboard the Kuiper Airborne Observatory, a predecessor to SOFIA. The 1988 observation took advantage of the eclipse's unique lighting conditions to glean data about the sun's atmosphere.

Becklin urged workshop participants to witness the August eclipse for themselves.

"Go see the solar eclipse," he said. "Make sure you look at it and enjoy the feeling of it."

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F-8 DFBW research marks 45 years

The F-8 Digital Fly-By-Wire flight research project validated the principal concepts of all-electric flight control systems now used on nearly all modern high-performance aircraft and on military and civilian transports. The first flight of the 13-year project was on May 25, 1972, with research pilot Gary E. Krier at the controls of a modified F-8C Crusader that served as the testbed for the fly-by-wire technologies. The project was a joint effort between the NASA Flight Research Center (now Armstrong) and Langley Research Center. It included a total of 211 flights. The last flight was Dec. 16, 1985, with research pilot Ed Schneider at the controls. This technology was also honored in the Space Technology Hall of Fame.



NASA

News at NASA

New planet candidates introduced

NASA's Kepler space telescope team released a mission catalog of planet candidates that introduces 219 new celestial bodies, 10 of which are near-Earth size and orbiting in their star's habitable zone. These zones are the range of distance from a star where liquid water could pool on the surface of a rocky planet.

This is the most comprehensive and detailed catalog release of candidate exoplanets, which are planets outside Earth's solar system, from Kepler's first four years of data. It's also the final catalog from the spacecraft's view of the patch of sky in the Cygnus constellation.

With the release of this catalog, there are now 4,034 planet candidates identified by Kepler. Of those, 2,335 have been verified as exoplanets. Of roughly 50 near-Earth size habitable zone candidates detected by Kepler, more than 30 have been verified.

Results using Kepler data suggest two distinct size groupings of small planets and have implications on the search for life. The final Kepler catalog will serve as the foundation for more study to determine the prevalence and demographics of planets in the galaxy, while the discovery of the two distinct planetary populations shows that about half the planets known in the galaxy either have no surface, or lie beneath a deep, crushing atmosphere – an environment unlikely to host life.

The findings were presented June 19 at NASA's Ames Research Center in California.

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In order to safely watch the eclipse directly, observers need specialized solar filters, such as eclipse glasses or handheld solar viewers. Alternatively, people can watch the eclipse indirectly by projecting the sun's light through a small pinhole onto flat surfaces like the ground or a sheet of paper.

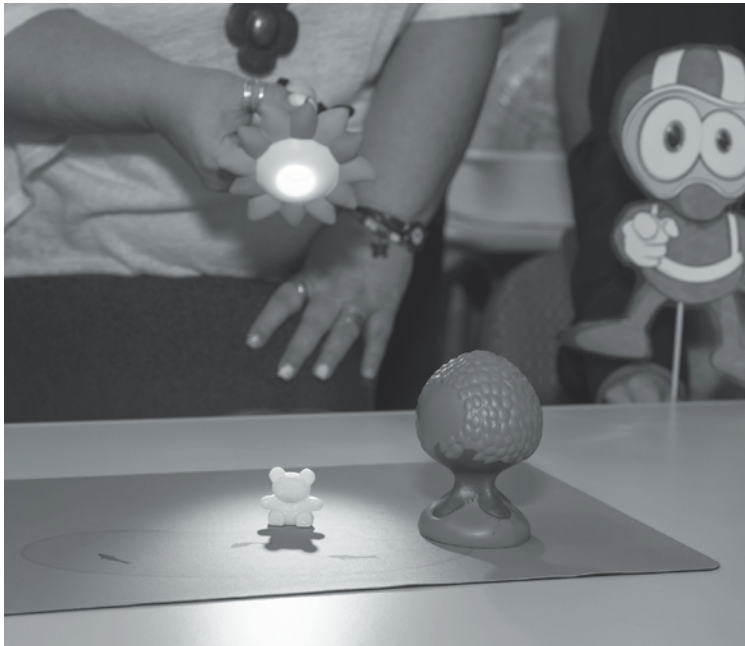
The workshop participants each received a set of eclipse glasses.

Cherise Robinson, a teacher from the iLEAD Lancaster Charter School in Lancaster, said the workshop gave her valuable teaching resources.

"The workshop was fascinating," she said. "I'm super excited about the upcoming event and about having a modality (or method) of delivering to my kids."

Kathleen Fredette, director of STEAM Initiatives for iLEAD Schools and SOFIA airborne astronomy ambassador, said Becklin's stories inspire listeners to learn more about astronomy.

"Dr. Becklin is always amazing, and his storytelling is beautiful," she said. "He makes you want to understand the hard stuff."



AFRC2017-0116-27

NASA/Lauren Hughes

Educators shine a flashlight onto a toy bear to simulate the physics behind solar eclipses.

The Aug. 21 eclipse will take around an hour and 40 minutes to cross the United States. Its path of totality – the path along the ground where the moon will completely block the sun's disk and cast the

most intense eclipse shadow – will travel from the Oregon coast to Charleston, South Carolina.

To learn more about the Aug. 21 eclipse, visit: <https://eclipse2017.nasa.gov/>

Eclipse... from page 1

made up of a tenuous ionized gas called plasma, with temperatures up to many millions of degrees Fahrenheit. The corona is visible to the naked eye (through protective eyewear) only during a total solar eclipse.

Prominences are structures in the corona made of relatively cool plasma supported by magnetic fields. These structures appear bright during the eclipse. These same structures appear dark against the sun ordinarily, when they are called filaments.

Polar plumes are the bright structures of fast-flowing solar material coming from coronal holes, areas with magnetic field lines open to interplanetary space. Coronal holes are more common near, but not exclusive to, the poles.

Helmet streamers are large, cap-like coronal structures with long peaks that usually lie over sunspots and active regions. These often have a prominence or filament at their base.

Finally, coronal loops are found around sunspots and in active regions. These structures are associated with the closed magnetic lines that connect magnetic regions on the solar surface.

The total eclipse will last up to two minutes and 20 seconds depending on its location across the U.S.

NASA has a number of ways to study the eclipse and Guhathakurta explained what some of those opportunities are including:

- New instruments will be tested and the skills of citizen scientists will

be tapped to expand understanding of the sun-Earth-moon system.

- Besides spacecraft, there will be experiments on the ground, on planes and balloons to study the sun and Earth, including study of land and atmospheric conditions.

- To study the sun's corona, scientists create special spacecraft instruments called coronagraphs to block the sun's light, but total eclipses provide the best possible observations of the corona.

- Ground-based observations, 11 NASA and NOAA satellites, 57 NASA-funded suborbital balloons and citizen scientists will capture a wealth of images and data that will be made available to the public before, during and after the eclipse.

- The Deep Space Climate Observatory will collect images every 15 minutes and provide them 24 hours later at <http://epic.gsfc.nasa.gov>

- Soon it will be known if the International Space Station will be in a position to observe the moon's umbral, or inner, shadow during the eclipse.

- NASA's Earth observing system satellites may also be in position for data collection.

- NASA's Lunar Reconnaissance Orbiter studies the moon and enables eclipse observations.

NASA will feature live broadcasts from one of three sources: <http://www.nasa.gov/TV>, <http://eclipse2017.nasa.gov> or <http://www.nasa.gov/eclipse>

Guhathakurta, who has been

heliophysics program manager at NASA Headquarters for 18 years, has led the Living with a Star Program for the past 15 years. That program aims to understand solar variability and its diverse effects on Earth, human technology and astronauts in space. She is the program scientist on such projects as the Solar Terrestrial Relations Observatory, Solar and Heliospheric Observatory and the Solar Dynamics Observatory.

Guhathakurta also has worked as an educator, scientist, mission designer, directed and managed science programs and has built instruments for spacecraft. She has been a co-investigator on five Spartan 201 missions. Spartan was a free-flying science instrument platform deployed during five space shuttle missions to study velocity and acceleration of the solar wind and observe the solar corona in white-light and ultraviolet radiation.

Barr, former engineer, passes

Gary Wayne Barr, a NASA Armstrong (then Dryden) engineer for more than three decades, died May 30. He was 65.

Barr retired in December 2010, capping a 32-year career. Before his retirement he was the engineer for operational spectrum management. In that job he ensured proper operation of aircraft transmitters, the telephone system and the land mobile radio system. The mobile radio system included 484 ground-based radios for security, medical, safety, flight operations and in support of the space shuttles when they landed at Edwards Air Force Base. He also was tasked with checking media frequencies for potential shuttle landings.

He was a member of the Antelope Valley Amateur Radio Club for 50 years, serving as treasurer and membership chair. He was also active on the Mission Trail Net for amateur radio, serving most recently as vice president, newsletter publisher and statistician. He also was an animal welfare advocate.

People who knew him said Barr worked behind the scenes making the work environment better for everyone.

Nicholson, tech expert, dies

Former Armstrong (then Dryden) information technology contractor John Nicholson died June 9. He was 50.

Nicholson worked here from 2004 to 2012. He was the center's subject matter expert on Macintosh operating systems and provided expertise in support of many aeronautics projects and the center's photo and video groups.

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