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NOFS CONTRIBUTES TO SOFIA'S SUCCESSFULL OBSERVATION OF CHALLENGING PLUTO OCCULTATION

NASA Ames Research Center/Geoff Chester, USNO O1P

On June 23, 2011, NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) observed the dwarf planet Pluto as it passed in front of a distant star. This event, known as an "occultation," allowed scientific analysis of Pluto and its atmosphere by flying SOFIA at the right moment to an exact location where Pluto's shadow fell on Earth.

Observations of Pluto and the target star obtained at the U.S. Naval Observatory's Flagstaff Station (NOFS) in Flagstaff, Ariz. were instrumental in guiding the airborne observatory to a precise rendezvous with Pluto's fleeting shadow for the successful observation of the event.

"This was the first demonstration in practice of one of SOFIA's major design capabilities," said Bob Meyer, SOFIA's program manager. "Pluto's shadow traveled at 53,000 mph across a mostly empty stretch of the Pacific Ocean. SOFIA flew more than 1,800 miles out over the Pacific Ocean from its base in Southern California to position itself in the center of the shadow's path, and was the only observatory capable of doing so."

SOFIA is a highly modified Boeing 747SP aircraft that carries a telescope with a 100-inch (2.5-meter) reflecting mirror that conducts astronomy research not possible with ground-based telescopes. By operating in the stratosphere at altitudes up to 45,000 feet, SOFIA can make observations above the water vapor in Earth's lower atmosphere.

"Occultations give us the ability to measure pressure, density, and temperature profiles of Pluto's atmosphere without leaving the Earth," said Ted Dunham of the Lowell Observatory in Flagstaff, Ariz., who led the team of scientists onboard SOFIA during the Pluto observations. "Because we were able to maneuver SOFIA so close to the center of the occultation we observed an extended, small, but distinct brightening near the middle of the occultation. This change will allow us to probe Pluto's atmosphere at lower altitudes than is usually possible with stellar occultations."

Dunham is the principal investigator for the High-Speed Imaging Photometer for Occultation (HIPO), essentially an extremely fast and accurate electronic light meter. He was a member of the group that originally discovered Pluto's atmosphere by observing a stellar occultation from SOFIA's predecessor, the Kuiper Airborne Observatory, in 1988. Pluto itself was discovered at Lowell Observatory in 1930. Pluto's largest moon Charon was discovered by astronomers at NOFS in 1978.

There were some tense moments for SOFIA's international science team in the minutes leading up to the occultation. Although the occultation path prediction was based heavily on the past year's astrometric observations taken with the NOFS 61-inch (1.55-meter) Kaj Strand astrometric reflecting telescope by NOFS astronomers Hugh Harris and Trudy Tilleman, the precise position of Pluto in relation to Earth could not be sufficiently refined until just a few hours before the event. That evening, Lowell astronomer Stephen Levine used the 61-inch telescope to take multiple images of Pluto and the target star mere hours before the occultation began. Those data were passed to collaborators at the Massachusetts Institute of Technology (MIT) in Cambridge, Mass., who refined their prediction of the exact position and timing of Pluto's shadow track. Levine subsequently observed the star's occultation by Pluto's moon Charon with the NOFS 51-inch (1.3-meter) telescope.

"We are grateful to NOFS for allowing use of [their] facilities to help in refining the prediction for this first occultation aboard the next generation of airborne observatory, SOFIA," said Amanda Bosh of the MIT team. "The ability to move the observer to an exact spot in the shadow path required an astrometric accuracy that had not been achieved in stellar occultation planning before this event." About two hours before the occultation, the MIT group contacted SOFIA in-flight with the news that the center of the shadow would cross 125 miles north of the position on which the airborne observatory's flight plan had originally been based. After recalculating and filing a revised flight plan, SOFIA's flight crew and science team had to wait an anxious 20 minutes before receiving permission from air traffic control to alter the flight path accordingly.

"We have already shown that SOFIA is a first-rank international facility for infrared astronomy research. This successful occultation observation adds substantially to SOFIA's ability to serve the world's scientific community," said Pamela Marcum, SOFIA project scientist.

SOFIA is a joint project of NASA and the German Aerospace Center (DLR), and is based and managed at NASA's Dryden Aircraft Operations Facility in Palmdale, Calif. for NASA's Science Mission Directorate in Washington, D.C. NASA's Ames Research Center in Moffett Field, Calif., manages the SOFIA science and mission operations in cooperation with the Universities Space Research Association headquartered in Columbia, Md., and the German SOFIA Institute (DSI) at the University of Stuttgart.



SOFIA during an early test flight (NASA image)



*The NOFS 61-inch (1.55-meter) Kaj Strand astrometric telescope
(USNO image by Geoff Chester)*