Eclipse science along the path of totality

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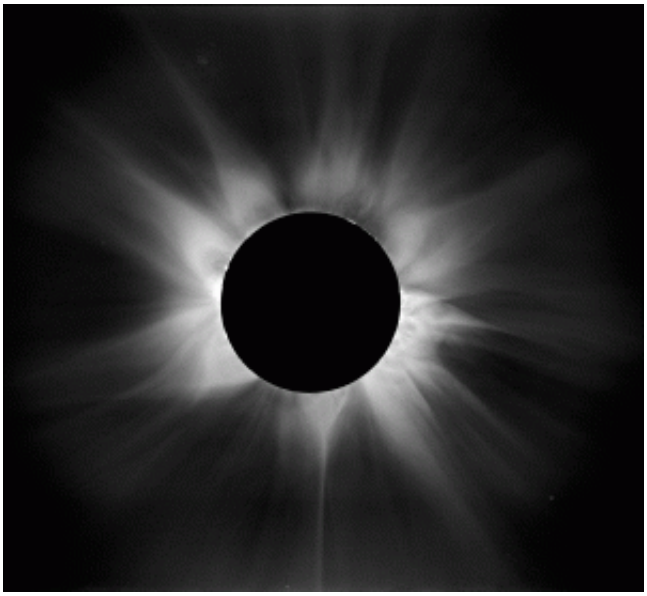

Total solar eclipse over India in 1980. Credit: UCAR, High Altitude Observatory

Leading U.S. solar scientists today highlighted research activities that will take place across the country during next month's rare solar eclipse, advancing our knowledge of the Sun's complex and mysterious magnetic field and its effect on Earth's atmosphere.

Experts at the National Science Foundation (NSF), National Aeronautics and Space Administration (NASA), and National Center for Atmospheric Research (NCAR) provided details at this morning's press conference about the array of technologies and methodologies that will be used to obtain unprecedented views of the Sun on Aug. 21. The

experiments, led by specialized researchers, will also draw on observations by amateur skywatchers and students to fill in the picture.

"This total solar eclipse across the United States is a fundamentally unique opportunity in modern times, enabling the entire country to be engaged with modern technology and social media," said Carrie Black, an associate program director at NSF who oversees solar research. "Images and data from potentially as many as millions of people will be collected and analyzed by scientists for years to come."

"This is a generational event," agreed Madhulika Guhathakurta, NASA lead scientist for the 2017 eclipse. "This is going to be the most documented, the most appreciated eclipse ever."

The scientific experiments will take place along the path of totality, a 70-mile wide ribbon stretching from Oregon to South Carolina where the moon will completely cover the visible disk of the Sun. Depending on the location, viewers will get to experience the total eclipse for as long as 2 minutes and 40 seconds. It will take about an hour and a half for the eclipse to travel across the sky from the Pacific Coast to the Atlantic.

NASA and other organizations are reminding viewers to take eye safety precautions because it is not safe to look at the Sun during an eclipse.

For scientists, the celestial event is a rare opportunity to test new instruments and to observe the elusive outer atmosphere of the Sun, or solar corona, which is usually obscured by the bright surface of the Sun. Many scientific questions focus on the corona, including why it is far hotter than the surface and what role it plays in spewing large streams of charged particles, known as coronal mass ejections, that can buffet Earth's atmosphere and disrupt GPS systems and other sensitive technologies.

Black noted that the moon will align exactly with the Sun's surface, which will enable observations of the entire corona, including very low regions that are rarely detectable. Obtaining observations from the ground is particularly important, she explained, because far more data can be transmitted than would be possible from space-based instruments.

"The moon is about as perfect an occulter as one can get," she said. "And what makes this an even more valuable opportunity is that everyone has access to it."

In addition to training ground-based instruments on the Sun, scientists will also deploy aircraft to follow the eclipse, thereby increasing the amount of time they can take observations.

An NCAR research team, for example, will use the NSF/NCAR Gulfstream-V research aircraft to take infrared measurements for about four minutes, helping scientists better understand the solar corona's magnetism and thermal structure. Scientists with the Southwest Research Institute in Boulder will use visible and infrared telescopes on NASA's twin WB-57 airplanes in a tag-team approach, enabling them to get a unique look at both the solar corona and Mercury for about eight minutes. The goal is to better understand how energy moves through the corona as well as learning more about the composition and properties of Mercury's surface.

Scientists will also study Earth's outer atmosphere during the eclipse. The ionosphere is a remote region of the atmosphere containing particles that are charged by solar radiation. Disturbances in the ionosphere can affect low-frequency radio waves. By blocking energy from the Sun, the eclipse provides scientists with an opportunity to study the ionosphere's response to a sudden drop in solar radiation.

For example, a Boston University research team will use off-the-shelf

cell phone technology to construct a single-frequency GPS array of sensors to study the ionospheric effects of the eclipse. This project could lay the foundation for using consumer smartphones to help monitor the outer atmosphere for disturbances, or space weather events, caused by solar storms. Another experiment, run by researchers at the University of Virginia and George Mason University, will use transmitters broadcasting at low frequencies to probe the response of regions of the ionosphere, while a Virginia Tech team will use a network of radio receives and transmitters across the country to observe the ionosphere's response during the eclipse.

Citizen scientists also are expected to play a major role in taking valuable observations during the eclipse.

"This is a social phenomenon, and we have a significant opportunity to promote this and do all the science that we can," Guhathakurta said.

The Citizen Continental-America Telescopic Eclipse (CATE) Experiment by the National Solar Observatory, for example, will rely on volunteers from universities, high schools, informal education groups, and national labs for an eclipse "relay race." Participants spaced along the path of totality will use identical telescopes and digital camera systems to capture high-quality images that will result in a dataset capturing the entire, 93-minute eclipse across the country. And a project led by the University of California Berkeley will assemble a large number of solar images, obtained by students and amateur observers along the eclipse path to create educational materials as part of the Eclipse Megamovie project.

"As these projects show, the eclipse will place the Sun firmly in the forefront of the national eye," said Scott McIntosh, director of NCAR's High Altitude Observatory. "This is a unique opportunity to communicate the fact that our star is complex, beautiful, and mysterious.

At the same time, it is more critical than ever to study it, as solar activity can pose significant threats to our technologically driven society."

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