Expedition measures solar motions seen during last summer's total solar eclipse

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"During the August 21, 2017, solar eclipse, our dozens of telescopes and electronic cameras collected data during the rare two minutes at which we could see and study the sun's outer atmosphere, the corona," reported solar-astronomer Jay Pasachoff to the American Astronomical Society, meeting in Denver during June 4-7. Pasachoff, Field Memorial Professor of Astronomy at Williams College, discussed results from his team's observations made in Salem, Oregon, and measurements that his team has made of extremely rapid motions in the corona.

"We could see giant streamers coming out of low solar latitudes as well as plumes out of the sun's north and south poles, all held in their beautiful shapes by the sun's magnetic field," he said. "In the months since the eclipse, we have used computers to pick out the best part of dozens of the images to make extremely high-contrast images that allow us to measure motions at extremely high speeds in the corona, as we compare our composite images with some made by coordinated colleagues 65 minutes farther east along the path of totality." The motions reach hundreds of miles per second, thousands of times faster than normal terrestrial speeds.

The Williams College series of expeditions has also been studying how the corona changes over the 11-year sunspot cycle, which is now approaching its minimum. As a result, the coronal streamers that extend millions of miles into space are located only near the sun's equator, and thin plumes of gas extend north and south of the solar disk, as though there was a giant bar magnet in it guiding iron filings. The last time the

team had such a good view of the polar plumes was at an eclipse viewed from Russia 10 years ago and at an eclipse viewed from China 9 years ago.

The Williams College team's main observations were to study the solar corona, which is a million times fainter than the everyday sun and normally hidden behind the blue sky. "Only at a total solar eclipse, when the blue sky goes away because normal sunlight is hidden by the moon, can we see the corona at all this well. And because the sun's magnetic field changes over the 11-year sunspot cycle and erratically as well, each time we look at the corona—even when we get only a couple of minutes to see it every couple of years somewhere in the world—we have a new sun to study, just as a cardiologist-researcher who looked inside someone's heart in, say, Africa two years ago for a couple of minutes would still have lots to learn by looking at a new patient in the U.S. a couple of years later."

"We are learning about the sun's influence on the Earth," said Pasachoff, "which we now call space weather. Eruptions on the sun can zap and kill satellites in Earth orbit and even cause surges on power lines and blackouts. We want to understand how to predict and monitor solar eruptions that affect us on Earth, and observations during our rare opportunities at total solar eclipses contribute to these goals."

Along with an international team of professional colleagues, eight William College undergraduates as well as several recent alumni graduate students and Ph.D.s participated, many programming and operating computer-controlled cameras to record the event. All are coauthors of the iPoster available at this week's AAS meeting.

In Oregon last summer, Pasachoff viewed his 66th solar eclipse. He serves as Chair of the International Astronomical Union's Working Group on Solar Eclipses, and as such helped coordinate scientific

colleagues' visits to the U.S. for eclipse observing from, among other countries, China, Japan, Venezuela, Bulgaria, Greece, Poland, and Slovakia.

Pasachoff worked closely over several months with the NOVA program on PBS, which pushed through a revised final 20 minutes of their hour-long show, "Eclipse Over America," at 9 p.m. on eclipse night, with a revised version airing two nights later and an international edition now in circulation.

One of the main scientific conundrums that the team tackled is the cause of the heating of the solar corona to millions of degrees. The scientists operated special fast cameras that have negligible dead time between high-quality frames, using the POETS (Portable Occultation, Eclipse, and Transit System) devices that were purchased a dozen years ago jointly by MIT's occultation-research group and Williams College with a NASA equipment grant. The data were successfully recorded and are being analyzed.

In collaboration with NASA's Goddard Space Flight Center (Greenbelt, Md.), a combination of space observations at the time of the eclipse with the Williams team's composite images emphasizing coronal structure was released by NASA and a version of the combination image with the hot gas on the disk of the sun that was hidden at the eclipse but shown with the Solar Ultraviolet Imager (SUVI) on NOAA's GOES-16 spacecraft was assembled by U-Colorado/ NOAA scientist Daniel Seaton. Such combined images are part of the Denver presentation.

Provided by Williams College

https://phys.org/news/2018-06-solar-motions-summer-total-eclipse.html