Astronomers prepare for transcontinental solar eclipse
Next year, moon’s shadow will race across United States, from Oregon to South Carolina

BY CHRISTOPHER CROCKETT

Eeriness creeps in. Colors change and shadows sharpen. The last minutes before a total solar eclipse trigger a primal reaction in the human psyche, says astronomer Jay Pasachoff.

“You don’t know what’s going on,” says Pasachoff, of Williams College in Williamstown, Mass. “But you know something is wrong.”

Millions of people will know something is wrong on August 21, 2017, when a total eclipse of the sun sweeps across the country, the first to grace the continental United States since 1979 (and the first to go coast-to-coast since 1918). The roughly 120-kilometer-wide path of totality created by the moon’s shadow will travel through 12 states, from Oregon to South Carolina. And although it’s still a year away, researchers and non-researchers alike are gearing up to make the most of this rare spectacle—they won’t get another chance in the United States until 2024.

Eclipse enthusiasts will travel from all over the world to experience up to nearly three minutes of midday twilight and glimpse the seldom-seen solar corona, a halo of light from plasma that will frame the blacked-out sun. “People cheer and people cry,” says Pasachoff, who has seen 33 total solar eclipses and 30 partial ones.

Though some of the corona is visible all the time to a few telescopes in space, the region where the corona meets the surface is masked by the sun’s intensity. “Only on days of eclipses can we put together a complete view of the sun,” Pasachoff says. For researchers, the 2017 eclipse is another chance to connect what they see on the surface of the sun to what’s happening in the outer reaches of the corona.

One enduring mystery is why the corona is millions of degrees hotter than the surface of the sun, which is a relatively balmy 5,500° Celsius. “The consensus is that the sun’s magnetic field is responsible,” says Paul Bryans, a solar physicist at the National Center for Atmospheric Research in Boulder, Colo. “But it’s not clear how.”

The magnetic field in the corona is too tenuous to study directly. Instead, researchers want to look at the effect of magnetism on certain wavelengths of infrared light emitted by the corona. Bryans is leading a team that will point a spectrometer at the sun during the eclipse to detect that light. “The plan is to put us in the back of a trailer, drive north to Wyoming and just sit and stare at the sun,” says Bryans, for whom the 2017 eclipse will be his first. “People keep telling me it’s a terrible thing to do because I’ll be stuck in the back of the trailer.”

This experiment will test whether the corona emits light at the predicted wavelengths and, if so, how brightly. (Scientists will have to wait for improved instruments and another eclipse to see how these wavelengths are distorted by the magnetic field.) One of the advantages of a mobile observatory, Bryans says, is that the team can look at weather forecasts the day before and drive to clear skies.
Another option is to point an infrared spectrometer out the window of a Gulfstream V jet and cruise at an altitude of about 15 kilometers along the path of the eclipse. That is what Jenna Samra, a Harvard University applied physics graduate student, will be doing. Aside from getting away from weather intrusions, the flying telescope will soar above much of Earth’s water vapor, which absorbs a lot of infrared light.

The moon’s shadow, racing across the country at about 2,700 kilometers per hour, will catch up with the jet in southwest Kentucky. “We won’t be able to keep up with it,” Samra says. “But we will be able to stay in for about four minutes.” That’s more than a minute longer than for anyone stuck on the ground.

For earthbound observers, the eclipse first touches U.S. soil at 10:16 a.m. Pacific time near Oregon’s Depoe Bay. The shadow moves through five state capitals—Salem, Ore.; Lincoln, Neb.; Jefferson City, Mo.; Nashville; and Columbia, S.C.—and even a few national parks: Grand Teton, Great Smoky Mountains, and Congaree. A spot in the Shawnee National Forest (just southeast of Carbondale, Ill.) has the honor of longest time in darkness: about 2 minutes, 42 seconds. Cape Island, S.C., is the shadow’s final stop, before leaving the continent around 2:49 p.m. Eastern time, just about an hour and a half after entering Oregon.

Based on typical weather patterns in late August, the weather has a better chance of cooperating in the western half of the eclipse path, from Oregon to western Nebraska. That’s why Pasachoff will be setting up in Salem. He won’t be looking for elusive infrared photons, but instead will be taking rapid-fire images of plasma loops—coils of ionized gas trapped in billowing magnetic fields—arching off the sun and peeking out from behind the moon. One idea for why the corona is so hot is that these loops subtly jiggles, which stirs up the surrounding plasma and heats the corona. By looking for subsecond oscillations along the loops, Pasachoff’s team will see if this hypothesis holds up.

“For those who can’t make it to the eclipse path, or who get stuck under cloudy skies, the ballooning project will serve up live feeds from a vantage point unlike any other: roughly 30 kilometers above the ground. More than 50 teams of high school and college students will launch cameras on additional balloons from 30 sites along the eclipse path. Video and images will be transmitted in real time and be accessible via a website.

“Seeing the shadow of the moon come across the Earth gives you an amazing perspective of what’s going on.”

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**New brain map is most detailed yet**

Analyzing a bevy of diverse data, scientists have drawn a new map of the human brain in extreme relief. Their approach demarcated 180 areas in each half of the outer layer of the brain—including 97 regions in each half that haven’t been described before. The high-resolution map will allow scientists to more precisely scrutinize brain regions and see how they change with, for instance, age and disease.

Many previous brain maps have been built with just one type of data. The new map, described online July 20 in *Nature*, forms a holistic view by combining several different types of information. These specs include brain activity while doing certain tasks or nothing at all, as well as detailed anatomical data about the shape and thickness of the brain. Using these metrics from 210 healthy people, neuroscientist David Van Essen of Washington University in St. Louis and colleagues found that each hemisphere contains 180 distinct areas (separated by black lines in image above). In this view, colors show how tightly linked each area is to other brain areas that handle auditory (red), touch and movement (green) or visual (blue) information. — Laura Sanders