

The Great American Eclipse approaches

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This summer, darkness will fall across the face of America.

In August, a total solar eclipse will sweep across the continental United States. Astronomers are calling it the Great American Eclipse.

For the amateur sky-watcher, a total eclipse presents a rare opportunity to witness a cosmic hiccup in our day-night cycle.

For solar astronomers, the eclipse offers something else: three minutes (give or take) to collect as much data as possible about the sun's usually hidden outer atmosphere.

Researchers have been anticipating the event for years.

Some will take measurements from the sky; others have engaged vast networks of citizen scientists to track the eclipse as its shadow moves across the ground. Ultimately, they hope their findings will tell them more about the sun's magnetic field, the temperature of its outer atmosphere and how energy moves through the star and out into space.

Doing science during a total eclipse may be exciting, but it can also put you on edge. No matter how carefully you plan, nature may conspire against you with something as trivial as a cloud momentarily passing through the wrong patch of sky.

"I've had those experiences and it's heartbreaking," said Shadia Habbal of the University of Hawaii's Institute for Astronomy.

If you remember donning those paper eclipse glasses to watch as the moon appears

to take a bite out of the sun, you may think you have seen a total eclipse. But you haven't.

What you witnessed was a partial eclipse, a phenomenon as different from a total eclipse as day is from night. Literally.

The sun is so bright that even when 99 percent of it is covered by the moon, the remaining 1 percent is still bright enough to make the sky blue, said Jay Pasachoff, an astronomer at Williams College in Massachusetts, who has seen 33 total eclipses and 32 partial eclipses. During a total solar eclipse, the moon completely obscures the face of the sun, causing the daytime sky to darken by a factor of 1 million.

This moment of totality lasts only a few minutes. Those who have seen it say it's unlike anything they've ever experienced.

"It's a really unique feeling, standing in the shadow of the moon," said Matt Penn, an astronomer at the National Solar Observatory in Tucson who has witnessed two total eclipses. "Crickets start to chirp. Birds start to roost. Chickens do weird things. And it's all in reaction to the strange light."

On Aug. 21, what's known as the path of totality will cut a 70-mile-wide arc across the United States, beginning in Oregon at 10:15 a.m. local time and ending in South Carolina about an hour and a half later.

Most researchers plan to study the sun's outer atmosphere, or corona. This is a vast region of superheated gas held in place by the sun's magnetic field.

Under normal circumstances, we can't see the corona from the ground because it is overwhelmed by the brightness of the photosphere, the sun's main disk. But with

the photosphere blocked, the corona will become the main event in the sky — a pale, spiky halo of streamers that appears to radiate from the blacked-out solar surface.

Composite images and measurements made during other eclipses reveal that the corona is composed of a complex swirl of gases much hotter than what you'd find on the surface of the sun. The surface is a toasty more than 10,000 degrees Fahrenheit, but the temperature of the corona averages 1.8 million degrees.

"The fundamental question we are asking is, what is causing the atmosphere to heat up like that?" said Habbal. "This is one of the scientific mysteries regarding the sun that remains unanswered."

She and her colleagues will make the most of the Great American Eclipse by viewing it through custom-made cameras from five distinct sites from Oregon to Nebraska.

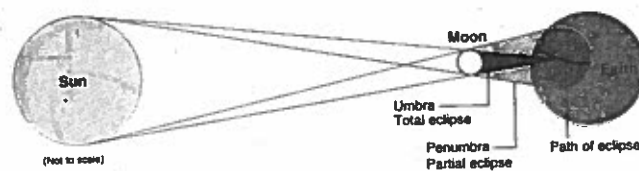
Any answers Habbal comes up with would shed light on the processes that shape not only the solar atmosphere, but the atmosphere of other stars that are similar to the sun, she said.

On the other side of the country, researchers from the Harvard-Smithsonian Center for Astrophysics are planning to study the corona from a plane flying at 49,000 feet.

The group, led by solar physicist Ed DeLuca, is building an instrument that will allow them to examine the solar atmosphere in infrared wavelengths. Their ultimate goal is to better understand the magnetic fields in this outer region of the sun — in part because this is where coronal

The 'Great American Eclipse'

For the first time since 1918, a total solar eclipse will be visible coast to coast in the Lower 48 states. Los Angeles will see a partial eclipse.



Where the scientists will be



mass ejections originate.

"Measuring these magnetic fields is really useful for understanding how energy is stored in the corona and when we expect it to be released," DeLuca said. "Once we understand that, we can make better space weather predictions."

A coronal mass ejection sends millions of tons of the sun's material hurtling through space. If a well-aimed one hits Earth, it can mess with the planet's magnetosphere and inflict damage on satellites, astronauts and even the power grid.

Water in Earth's atmosphere can interfere with infrared measurements, but the higher up in the atmosphere you go, the less water you'll find. At an altitude of nearly 50,000 feet, the researchers say,

their instruments will be able to measure 100 times more infrared light coming from the corona than if they were at sea level.

DeLuca is hoping the weather won't be a problem. The flight is over Tennessee, where thunderstorms have been known to go quite high, but they usually don't develop until later in the afternoon.

This isn't just any plane. The modified Gulfstream GV jet is owned by the National Science Foundation and has been turned into a flying laboratory.

The plane will fly along with the shadow of the moon, giving the scientists an additional minute of observing time. That may not sound impressive, but every minute counts when you have less than five minutes to collect data.