SDO Observes Massive Eruption, Scorching Rain

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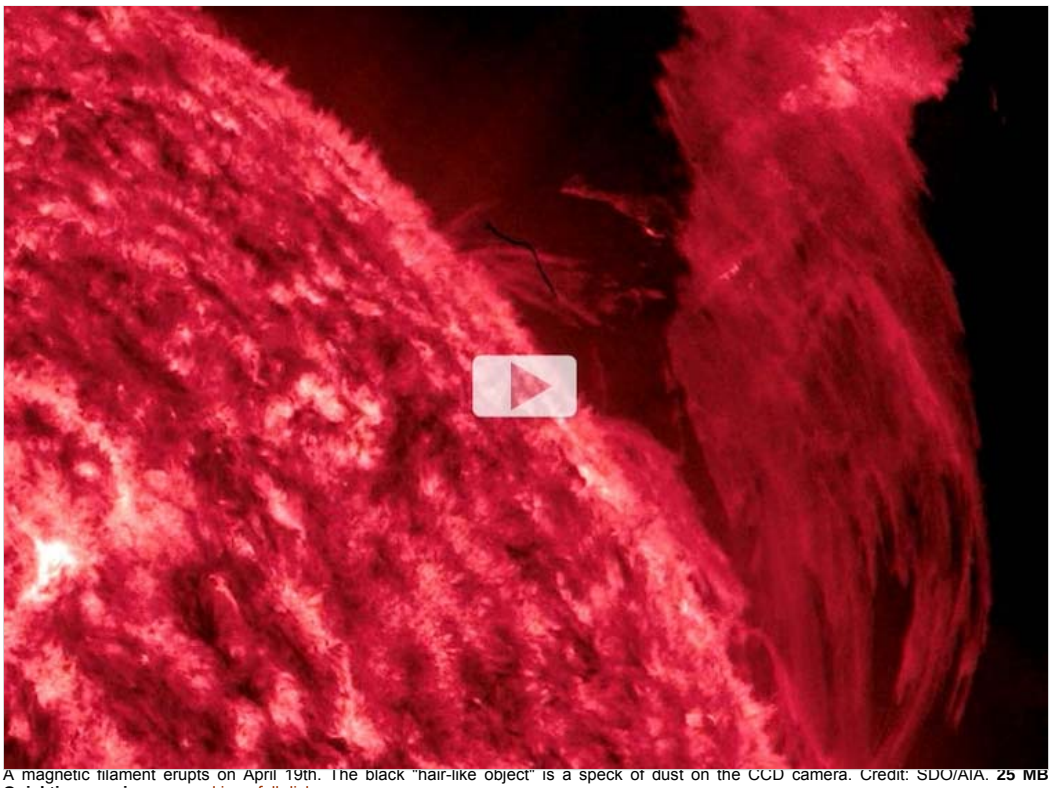
April 27, 2010: Just last week, scientists working with NASA's new Solar Dynamics Observatory (SDO) released the most astonishing movies of the sun anyone had ever seen. Now, they're doing it again.

"SDO has just observed a massive eruption on the sun—one of the biggest in years," says Lika Guhathakurta of NASA headquarters in Washington DC. "The footage is not only dramatic, but also could solve a longstanding mystery of solar physics."

Karel Schrijver of Lockheed Martin's Solar and Astrophysics Lab is leading the analysis. "We can see a billion tons of magnetized plasma blasting into space while debris from the explosion falls back onto the sun surface. These may be our best data yet."



A magnetic filament erupts on April 19th. The black "hair-like object" is a speck of dust on the CCD camera. Credit: SDO/AIA. **25 MB Quicktime movies:** zoomed in or full disk.

The movie, recorded on April 19th, spans four hours of actual time and more than 100,000 km of linear space. "It's huge," says Schrijver. Indeed, the entire planet Earth could fit between the plasma streamers with room to spare.

Astronomers have seen eruptions like this before, but rarely so large and never in such fluid detail. As science team member Alan Title of Lockheed Martin pointed out at last week's press conference, "no other telescope comes close to the combined spatial, temporal and spectral resolution of SDO."

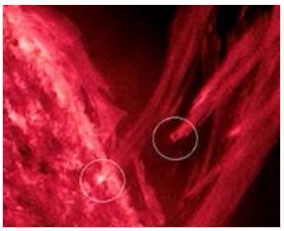
Schrijver says his favorite part of the movie is the coronal rain. "Blobs of plasma are falling back to the surface of the sun, making bright splashes where they hit," he explains. "This is a phenomenon I've been studying for years."

Coronal rain has long been a mystery. It's not surprising that plasma should fall back to the sun. After all, the sun's gravity is powerful. The puzzle of coronal rain is how slowly it seems to fall. "The sun's gravity should be pulling the material down much faster than it actually moves. What's slowing the descent?" he wonders.

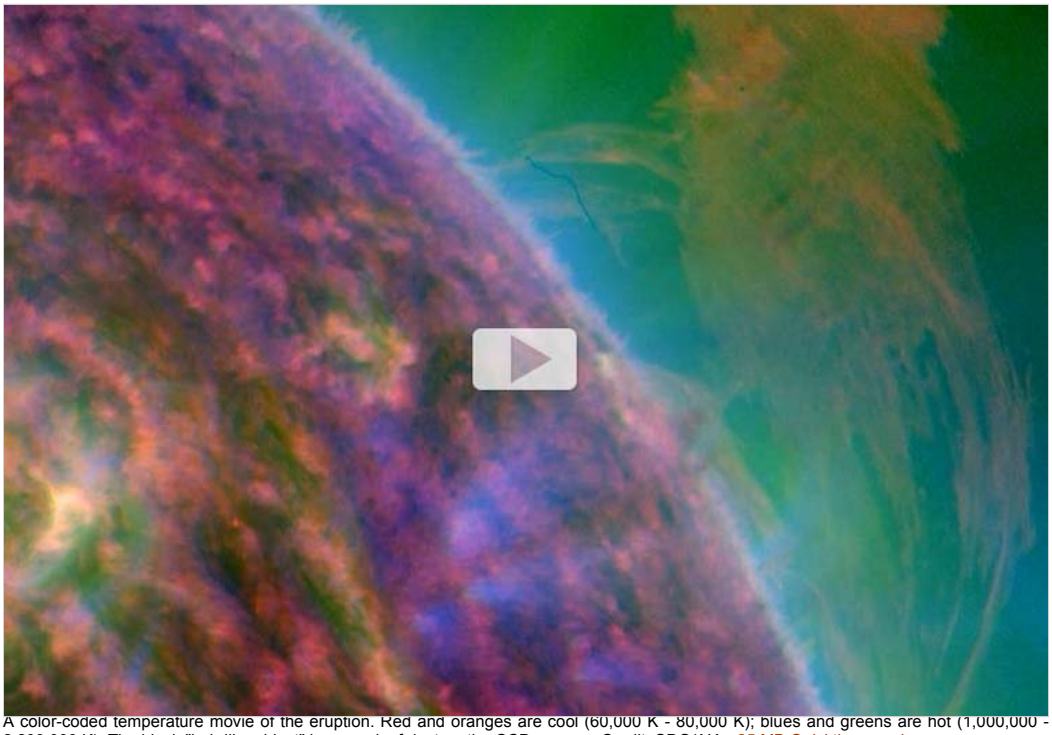
For the first time, SDO provides an answer.

"The rain appears to be buoyed by a 'cushion' of hot gas," says Schrijver. "Previous observatories couldn't see it, but it is there."

One of SDO's game-changing capabilities is temperature sensing. Using an array of ultraviolet telescopes called the Atmospheric Imaging Assembly (AIA), the observatory can remotely measure the temperature of gas in the sun's atmosphere. Coronal rain turns out to be relatively cool—"only" 60,000 K. When the rains falls, it is supported, in part, by an underlying cushion of much hotter material, between 1,000,000 and 2,200,000 K.



Coronal rain. Encircled are two plasma streamers, one hitting the sun's surface and another incoming behind it.



A color-coded temperature movie of the eruption. Red and oranges are cool (60,000 K - 80,000 K); blues and greens are hot (1,000,000 - 2,200,000 K). The black "hair-like object" is a speck of dust on the CCD camera. Credit: SDO/AIA. 25 MB Quicktime movie.

"You can see the hot gas in the color-coded temperature movie," says Schrijver. "Cool material is red, hotter material is blue-green. The hot gas effectively slows the descent of the coronal rain."

Dick Fisher, the head of NASA's Heliophysics Division in Washington DC, has been working in solar physics for nearly forty years. "In all that time," he says, "I've never seen images like this."

"I wonder, what will next week bring?"

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