

SCIENCE

Solving the Scorching Mystery of the Sun's Erupting Plasma Jets

Trilobites

By NICHOLAS ST. FLEUR JUNE 23, 2017

Spiky bursts of plasma called spicules swirl around the surface of the sun. Millions erupt every moment, spurting solar material some 6,000 miles high at speeds of about 60 miles per second.

“These things are very violent,” said Bart De Pontieu, a research scientist with Lockheed Martin Solar and Astrophysics Lab in Palo Alto, Calif. “The gas in spicules is about 10,000 degrees and they travel the length of California in just a minute or so.”

Scientists have studied spicules for decades, but were not sure how the plasma jets formed. Now, Dr. De Pontieu and his colleagues think they have solved the searing mystery. They published their findings Thursday in the journal *Science*.

Using data gathered by high-powered land and space telescopes, they created a computer simulation that reconstructed the conditions between the sun's surface and its atmosphere, where spicules form.

Powerful magnetic fields are created in the interior of the sun. There,

the high density keeps them tangled and tamed. But near the surface, the magnetic fields can use neutral particles, atoms that do not carry an electric charge, to diffuse into the sun's atmosphere. The fields enter a reddish layer called the chromosphere where their violent nature is unleashed.

“It's a sling shot effect,” said Mats Carlsson, a professor of astrophysics at the University of Oslo in Norway, and co-author of the paper.

The density in the chromosphere is significantly lower than in the sun's interior, so the magnetic fields are no longer suppressed and are able to straighten out. As they unwind and release their tension, they fling hot plasma at incredible speeds, creating the spicules. The spicules surge thousands of miles high, passing through the chromosphere and into the sun's corona before collapsing.

To create a computer simulation that accurately reflected what was happening on the sun, Dr. Carlsson said they needed to incorporate the effects of neutral particles. In earlier simulations they did not differentiate neutral particles from charged particles in the sun. Those models made it seem as if the edge between the sun's atmosphere and surface was fully electrically charged.

“We had an absence of spicules,” said Dr. Carlsson. “In our previous model we had one instead of the millions you have in the sun.”

But when they plugged distinct neutral particles into their simulation, they produced a model that had the same features seen on the sun.

Juan Martínez-Sykora, an astrophysicist with Lockheed Martin as well as the Bay Area Environmental Research Institute and lead

author of the study, said the team's next steps were to see if the spicules played a part in fueling the sun's corona and solar winds. If so, their simulation may help answer the million-degree mystery of what makes the corona so hot.

Like the Science Times page on Facebook. | Sign up for the Science Times newsletter.

A version of this article appears in print on June 27, 2017, on Page D2 of the New York edition with the headline: Sun Bursts: How Plasma Jets Form.

© 2017 The New York Times Company