SOLAR PHYSICS

Unseen Link May Solve the Mystery Of the Sun's Superhot Corona

Why would the sun's faint, thin crown of ionized gas—so prominent during an eclipse—be at 1,000,000°C when the underlying surface is only 6000°C? Good question, solar physicists say. The energy ultimately comes from below, but how does it get to the corona? Researchers watching the sun from the ground in unprecedented detail think they have an answer: The energy is piped upward in the form of curious, twisty magnetic waves detected on the sun for the first time.

The new observations are "very exciting," says solar physicist Markus Aschwanden of Lockheed Martin's Solar and Astrophysics Laboratory in Palo Alto, California. "The measurements are getting better and better." Still, he adds, there are other explanations for what scientists are seeing, and most solar physicists remain unconvinced that it's anything fundamentally new.

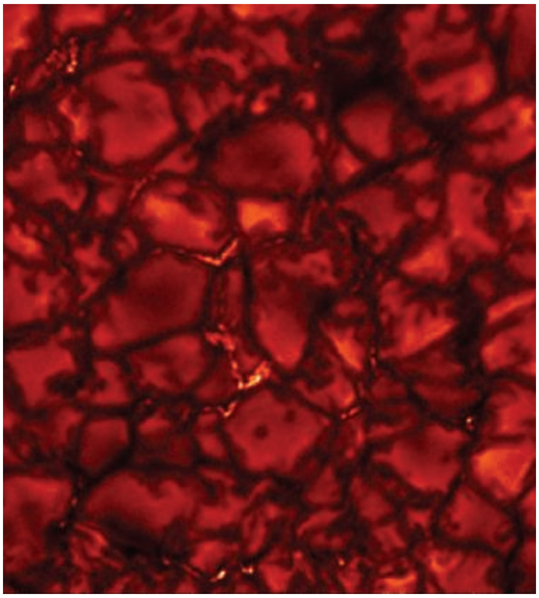
On page 1582, solar physicist David Jess of Queen's University Belfast and colleagues explain how they peered into an apparently empty layer just above the sun's visible surface, or photosphere, looking for an energy connection to the corona. Both above and below the photosphere, the sun is nothing but ionized gas—plasma—permeated by powerful magnetic fields. Energy is flowing every which way in the form of waves and oscillations in the plasma and along the magnetic fields. The problem for solar physicists has been that none of the detectable energy flows looked big enough to heat the corona to a million degrees.

Jess and his colleagues took a closer look at one patch of the sun using the Swedish 1-m Solar Telescope on La Palma in the Canary Islands. Using adaptive optics to remove blurring due to Earth's turbulent atmosphere, they could resolve features as small as 110 kilometers and detect spectral shifts around the wavelength of the hydrogen-alpha absorption. Looking above a tight bunch of particularly bright spots on the photosphere, called a bright point group, they found distinctive oscillations in the motions of plasma revealed as Doppler shifts.

The group interprets the oscillations as Alfvén waves driven upward from the churning photosphere in the form of a flaring tube to the bottom of the corona 5000 kilometers above. Long hypothesized but never directly detected on the sun, Alfvén waves are twisting oscillations along magnetic field lines formed as if you could grab the ends of the field lines and twist them one way and then the other, sending your energy out in the twists propagating along the field lines. The group calculates that there are enough bright point groups on the sun for their Alfvén waves to heat the corona to its observed million degrees. "We have conclusive evidence that Alfvén waves do exist [on the sun], and they have the potential to transport all the needed energy," Jess says.

"There's definitely something there," Aschwanden says. "The question is whether Alfvén waves are the only way to interpret it. Theirs is one interpretation. Their measurements must stand the test of time." Most other solar physicists agree. Even if powerful Alfvén waves exist, they add, no one has explained how the waves break into the corona and dissipate their energy there. Many favor a different heating source, tiny but abundant solar nanoflares. Aschwanden's conclusion: "We need better measurements."

–RICHARD A. KERR



Tiny but potent? Magnetic waves from bright specks on the sun (here in false color) may be heating the solar corona.

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Split-personality superconductor. Researchers have long divided superconductors into two broad groups, depending on how they react to a magnetic field. Now, experiments by a group led by Victor Moshchalkov at the Catholic University of Leuven in Belgium show that one well-studied superconductor, magnesium diboride, actually belongs to both groups at the same time. That surprising finding suggests that superconductivity, which has already netted four Nobel Prizes, may be an even richer phenomenon that previously thought. The results will be published in *Physical Review Letters*.

Self-medicating caterpillars. Woolly bear caterpillars (*Grammia incorrupta*) like to dine on plants loaded with toxic pyrrolizidine alkaloids. Evolutionary ecologist Michael Singer of Wesleyan University in Middletown, Connecticut, and his colleagues surmised that the toxin may help the caterpillars overcome an infestation with the larvae of parasitic tachinid flies, a common scourge of these caterpillars. In the lab, the researchers provided infested and uninfested woolly bear caterpillars with either pyrrolizidine alkaloids or sugar. Infested caterpillars ate twice as much toxin as their uninfested brethren did, and the alkaloids increased their survival by 20%. This suggests that when the caterpillars feed on toxic plants, they are self-medicating, says Singer. It is believed to be the first time scientists have shown that an invertebrate can self-medicate when sick. The findings were published online in *PLoS ONE*.

Ancient lefties. Right-handed people may predominate here on Earth, but all of us are built from amino acids that are chemically "left-handed." Two NASA scientists studying meteorites older than our planet report in the *Proceedings of the National Academy of Sciences* that they have found a majority of left-handed amino acids, suggesting that our solar system has always had a preference for southpaws.

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