Record-Breaking Detection of Solar Photons

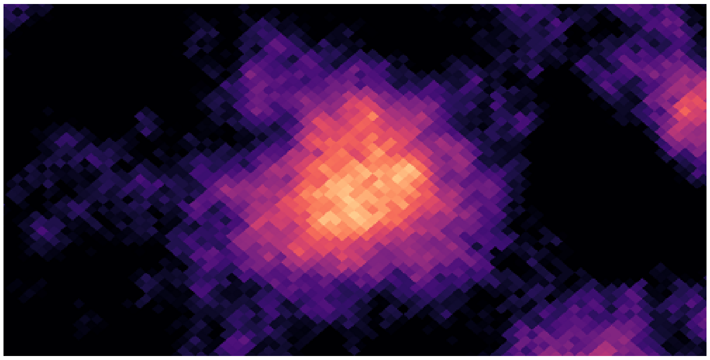
Measurements of the highest-energy radiation from the Sun ever seen highlight the need for better solar models.

By **Ryan Wilkinson**

Observations over the past decade or so have shown that the Sun emits many more gamma rays at GeV energies than is expected from modeling. Now a collaboration operating the High-Altitude Water Cherenkov (HAWC) Observatory in Mexico show that this gamma-ray excess extends up to TeV energies [**1**]. This finding has implications for our understanding of both stellar atmospheres and astroparticle physics.

Solar gamma rays are produced when high-energy particles called cosmic rays head toward the Sun's surface but are turned around by the solar magnetic field. As these particles then travel away from the Sun's surface, they interact with gas in the solar atmosphere to create gamma rays. Models predict the number of emitted photons of a given energy by assuming certain properties of the cosmic rays, the Sun's magnetic field, and the solar atmosphere.

The HAWC Collaboration presents the first detection of TeV gamma rays from the Sun, a finding based on more than six years of data. The flux is much higher than predicted, indicating that the interactions between the cosmic rays and the solar atmosphere are remarkably efficient at producing gamma rays. Moreover, the TeV-gamma-ray flux varies in inverse proportion to the level of solar activity, suggesting that the Sun's magnetic field affects the flux—a result that will be useful for modeling.



Credit: A. Albert *et al.* (HAWC Collaboration) [**1**]

The researchers say that their work calls for a revised theoretical framework that can explain the excess of solar gamma rays at both GeV and TeV energies.

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REFERENCES

1. A. Albert *et al.* (HAWC Collaboration), "Discovery of gamma rays from the quiescent Sun with HAWC," **Phys. Rev. Lett. 131, 051201 (2023).**