Explaining the mystery of the missing sunspots

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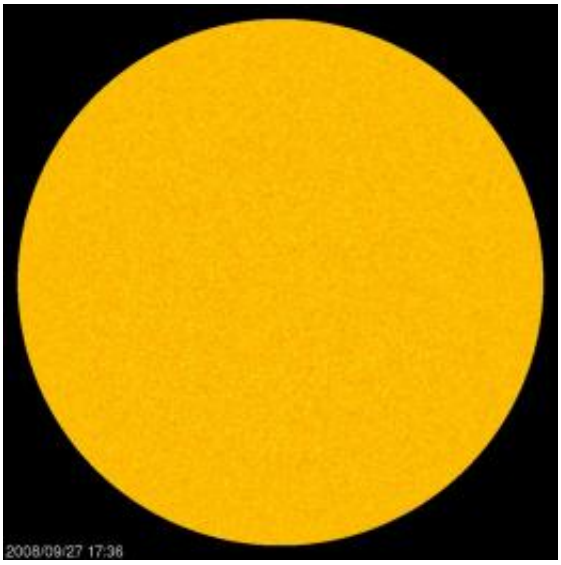

The "naked" sun, free of sunspots, as seen during its recent solar minimum. Credit: NASA/SOHO

Sunspots have been observed for about four centuries, since they were first reported by Galileo. Appearing in roughly eleven-year cycles of activity, sunspots are regions of strong and complex magnetic fields which are also home to large releases of energy and furious solar storms. These storms modulate winds of energetic charged particles that cause significant disruption to communications and power grids when they reach the Earth.

Furthermore, the eruption and decay of sunspots and their associated magnetic fields modulate solar irradiance and extra-galactic cosmic rays, quantities that also affect the Earth's climate.

Modeling sunspots and their influences are important goals of solar astrophysics, and today, four hundred years after their discovery, there has been significant progress.

The number of sunspots at any given time changes during a cycle. The minimum in the last one, numbered Cycle 23, was striking, however: the sun entered the quietest period it has had in 100 years, spending almost two years (2008-2010) devoid of sunspots.

In a paper in the recent issue of the journal *Nature*, CfA astronomers Andres Munoz-Jaramillo, Petrus Martens, and a colleague explain the unusual extended minimum of Cycle 23 in terms of the surface flow of hot material from the sun's equator towards its poles (and its counter-flow deep inside the sun).

They find that a more sophisticated accounting of these flows of material can explain the main characteristics of this extended minimum.

In particular, they argue that a faster flow at the beginning of the Cycle, which slows down after the Cycle's peak, diminished the magnetic field strength at the poles and increased the number of days without sunspots.

The new results are a significant advance in our understanding of a dramatic phenomenon that has been well-known but mysterious since the time of Galileo.

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