The origin of the magnetic field covering the Sun has been discovered

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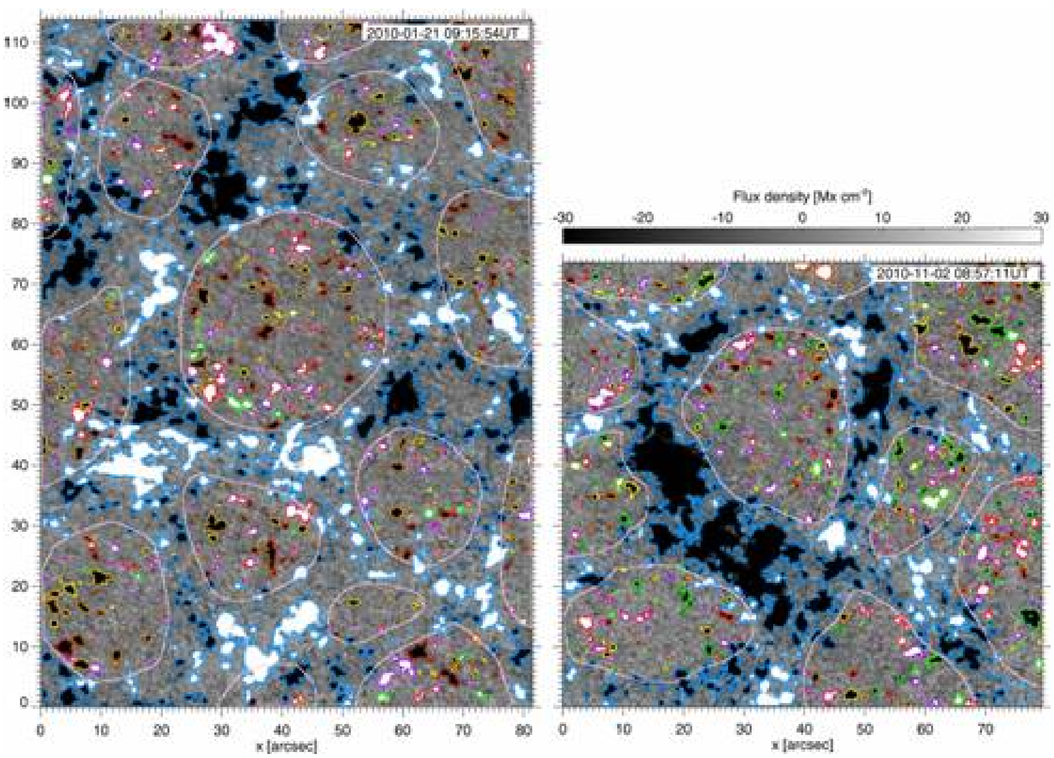

Image showing how the magnetic flux is transmitted. The red contours indicate intranet elements contributing to the overall magnetic web, while the green contours show flow cancellations. The blue contours represent concentrations of magnetic field. The edge of the supergranule cells is defined in pink.

The magnetic field that covers the sun and determines its behavior –the eleven year cycles no less than such conspicuous phenomena as solar spots and solar storms– also has another side to it: a magnetic web that covers the entire surface of the sun at rest and whose net magnetic flow is greater than that of the active areas. A study led by the Institute of Astrophysics of Andalusia (IAA-CSIC) has revealed where the flow that feeds this web comes from.

The outline of the solar magnetic web coincides with the boundaries of the so-called supergranules, structures linked to the existence of hot gas rising to the surface (similar to the bubbles made by boiling water) some twenty thousand kilometers in diameter.

"We have discovered that inside these supergranules, in what is known as intranetwork, small magnetic elements appear which travel toward the outer boundaries and interact with the web", says Milan Gosic, IAA researcher in charge of the study.

The monitoring of these heretofore little known elements was a considerable advance in and of itself, but the calculation of their contribution to the solar magnetic web has come as a major surprise: these small elements can generate and transfer, in the span of barely fourteen hours, the entire magnetic flow detected on the web. "Bearing in mind that only about 40% of this flow ends up on the web, we find that the intranetwork can replenish the flow of the web in twenty four hours", says Luis Bellot (IAA-CSIC), a member of the research team.

Paradigm change

The dominant model until now postulated that the magnetic fields of the web resulted from the decay of active zones such as spots, on the one hand, and from structures known as ephemeral regions, which provide a lot of flow but are not very common, on the other.

In that sense, the study by Gosic et al. has triggered a paradigm change because it has shown that ephemeral regions are too scarce to have significant impact. "In the course of forty hours we detected only two ephemeral regions, so their contribution to the web cannot be more than 10% of the total flow. By contrast, the small elements in the intranetwork are continuous and clearly dominant. ", says Gosic (IAA-CSIC).

The finding was made in the course of extraordinarily long temporal sequences of observation – about forty hours – using the high resolution Japanese HINODE satellite – a record for this type of instruments - which made it possible to monitor the evolution of supergranular cells throughout their life.

"It is believed that the magnetic elements of the intranetwork and their interactions with the web might be responsible for the warming up of the outer layers of the sun's atmosphere, one of the most pressing unsolved problems of Solar Physics", says Luis Bellot (IAA-CSIC). The study of the magnetic elements using the Hinode data will permit a more efficient scientific use of the data of the European Space Agency's Solar Orbiter mission, for which IAA-CSIC is building the IMAX instrument.

More information: M. Gosic et al. "The solar internetwork. I. Contribution to the network magnetic flux". The *Astrophysical Journal* doi:10.1088/0004-637X/797/1/49

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