Musical sun reduces range of magnetic activity

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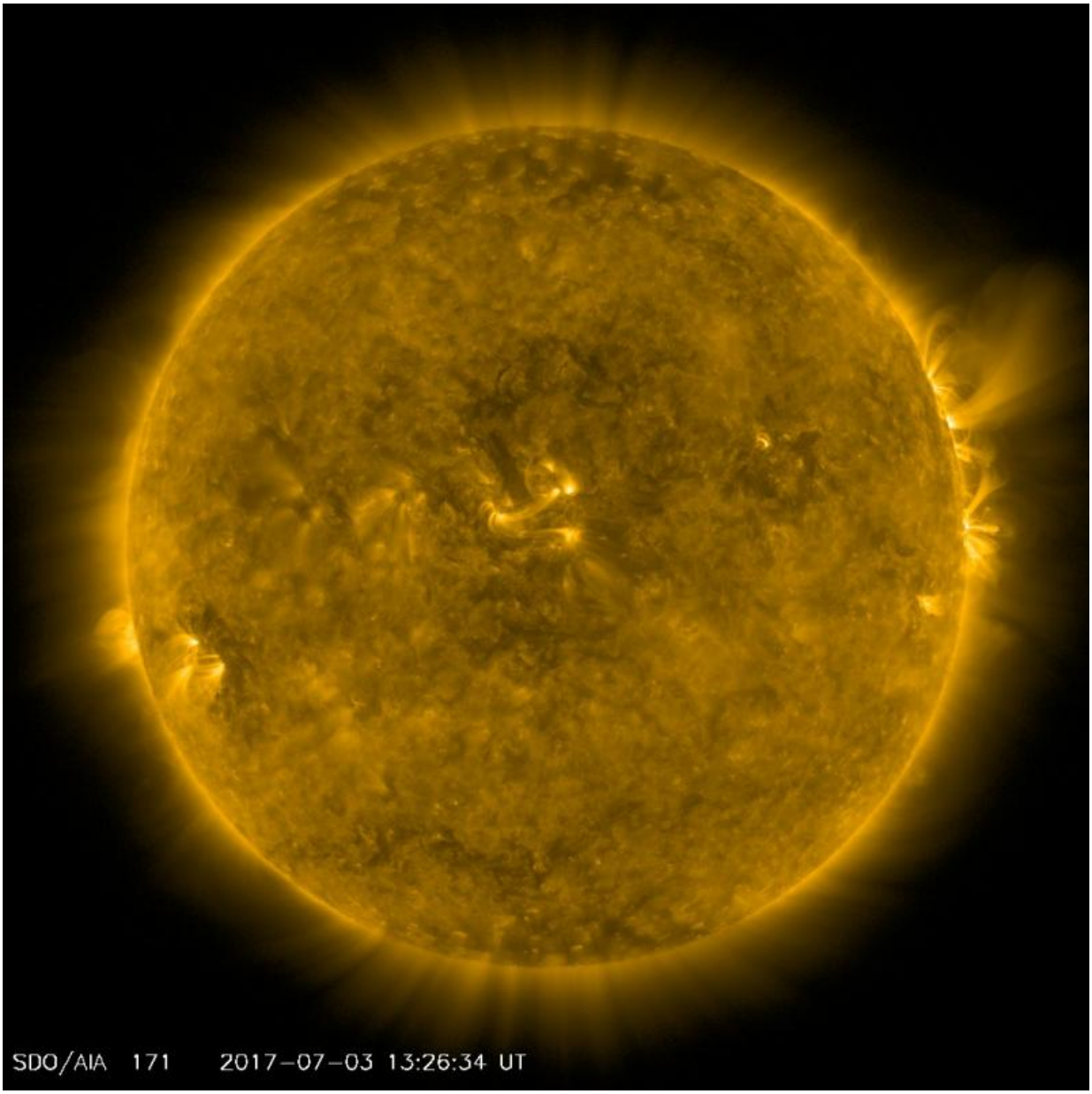

The Birmingham Solar-Oscillations Network (BiSON) station at Las Campanas, Chile. It is equatorially mounted and housed in a small dome. This site consistently produces the best BiSON data. Credit: S.J. Hale/University of Birmingham/BiSON

A study of the sun using sound waves suggests that the layer in which the significant magnetic activity is located has grown thinner in recent years. Prof Yvonne Elsworth will present results at the National Astronomy Meeting at the University of Hull on Tuesday, 4th July.

Prof Yvonne Elsworth, of the School of Physics and Astronomy at the University of Birmingham, explains: "The sun is very much like a musical instrument except that its typical notes are at a very low frequency – some 100,000 times lower than middle C. Studying these sound waves, using a technique called helioseismology, enables us to find out what's going on throughout the sun's interior."

The sun acts as a natural cavity to trap sound, which is generated by turbulence in the outermost few-hundred-kilometres of the convection zone. The University of Birmingham is one of the pioneers in the field of helioseismology and researchers have been using the Birmingham Solar Oscillations Network (BiSON) to study the sun through sound waves since 1985. This period covers three of the sun's 11-year activity cycles, which see fluctuations in the rate at which energetic particles are created by the interaction between the sun's magnetic field and its hot, highly charged outer layers.

The sun is currently heading towards a period of minimum activity and an international team has used the full BiSON dataset to try to look for clues in previous cycles as to what might be causing some unusual solar activity observed lately.

"Recent activity maxima have actually been rather quiet and the last cycle had a long, extended minimum," notes Elsworth. "It will be interesting to see if the minimum of this current cycle is extended in the manner of the previous one or if it will soon be back to the conditions of the past. However, if it is a normal minimum it will also be interesting to ask why the previous one was unusual."

In work just published in the *Monthly Notices of the Royal Astronomical Society*, the team shows that the interior of the sun has changed in recent years, and that these changes persist in the current cycle. In combination with theoretical models, the observations suggest that the magnetic field distribution in the outer layers may have become a bit thinner. Other seismic data shows that the rotation rate of the sun has also undergone some changes in the way the sun rotates at different latitudes.

"Again, this is not how it used to be and the rotation rate has slowed a bit at latitudes around about 60 degrees. We are not quite sure what the consequences of this will be but it's clear that we are in unusual times. However, we are beginning to detect some features belonging to the next cycle and we can suggest that the next minimum will be in about two years," says Elsworth.

More information: R. Howe et al. The Sun in transition? Persistence of near-surface structural changes through Cycle 24, *Monthly Notices of the Royal Astronomical Society* (2017). DOI: 10.1093/mnras/stx1318

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