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Sun stays nearly spherical, even when it freaks out

Understanding the structure of Earth's closest star could help to predict solar activity.

Marissa Fessenden

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NASA/SDO and the AIA, EVE, and HMI science teams

The Sun is surprisingly round according to recent measurements.

An article from Scientific American.

The 11-year solar cycle swoops between peaks of intense magnetic activity—apparent as sunspots, coronal loops and flares—and relative quiescence, when the Sun's face is free of blemishes. New research shows that despite this tumult, the Sun remains remarkably constant in its globular shape—findings that have left researchers scratching their heads.

Earth's closest star is one of the roundest objects humans have measured. If you shrank the Sun down to beach ball size, the difference between its north-south and the east-west diameters would be thinner than the width of a human hair, says Jeffery Kuhn, a physicist and solar researcher at the University of Hawaii at Manoa. "Not only is it very round, but it's too round," he adds. The Sun is more spherical and more invariable than theories predict.

Scientists have long tried to assess the Sun's shape, in part because understanding its structure would help them predict when a flare might shoot toward Earth and disrupt communication satellites and power grids. Measuring the orb has been tricky, however, and no two observations have matched exactly, Kuhn says. Researchers accounted for the discrepancies by assuming the Sun's figure varied with the solar cycle.

To measure the Sun's precise shape, Kuhn and his colleagues analyzed images captured by the Helioseismic and Magnetic Imager (HMI) carried on board NASA's Solar Dynamics Observatory. They shared their findings online August 16 in *Science*. The HMI snaps nearly 15,000 portraits of the Sun daily. It measures the Sun's magnetic field flux and seismic surface ripples generated by constantly churning plasma. In this August 1 image, the solar disk captured by the HMI (right) shows the Sun's light intensity; the other view, obtained by the Atmospheric Imaging Assembly on the spacecraft, renders the Sun in extreme ultraviolet.

In the last two years, the Sun's activity has exploded after a long period of relative quiescence, giving Kuhn and his colleagues an opportunity to watch the evolution of the solar cycle. Previous instruments for observing the star were mostly ground-based, and thus had to peer through the blur of Earth's atmosphere. Researchers may have thus measured atmospheric changes correlated with the solar cycle and not changes in the star itself, Kuhn says.

Although the HMI images are crisper and more accurate than ground-based observations, researchers still need to account for tiny movements of the spacecraft and distortions in its lenses. To sort out the Sun's movements from those of the probe, they rotate the satellite and combine multiple images to eliminate distortions. The probe takes nearly a full day to roll through its calibration and does so every six months.

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