

THE SUN BRINGS OUT A FRESH BATCH OF SUNSPOTS

Relevant for: Geography | Topic: The Earth and the Solar System

Not sedate: Huge solar flares and coronal mass ejections spew material from the solar surface into outer space | Photo Credit: [SOHO](#)

Sun spots are relatively cooler spots on the Sun's surface. Their number waxes and wanes in cycles that last 11 years approximately. We are currently at the minimum of one such cycle. Amidst claims that the Sun would "go silent" and not give out sunspots for an extended period, a group from IISER Kolkata has shown that the next sunspot cycle has begun and the Sun has indeed spoken. Their results were published in Research Notes of the American Astronomical Society.

From our safe distance of about 148 million km, the Sun appears to be sedate and constant. However, huge solar flares and coronal mass ejections spew material from its surface into outer space. They originate from sunspots, an important phenomenon that people have been following for hundreds of years.

Sunspots occur in pairs, with a leader and a follower. They originate deep within the Sun and become visible when they pop out. Their number is not constant but shows a minimum and then rises up to a maximum and then falls again in what is called the solar cycle. So far, astronomers have documented 24 such cycles, the last one ended in 2019.

Following a weakening trend in activity over the last few cycles, there were predictions that the Sun would go silent into a grand minimum in activity, with the disappearance of cycles. However, a team from IISER Kolkata has shown that there are signs that cycle 25 has just begun. They used the data from the instrument Helioseismic and Magnetic Imager aboard NASA's space-based Solar Dynamics Observatory for their calculations.

"There has been a lot of controversy about solar cycle 25 stemming from observations of a weakening trend in solar activity over the past three sunspot cycles. This has led to speculation that the solar cycle is about to die and we are going to enter a grand minimum in solar activity lasting many decades. Some groups have claimed that this would give rise to a mini ice age and cooling of global climate," says Dibyendu Nandi of IISER Kolkata who led the effort. "Our findings indicate that sunspot cycle 25 fields have already started appearing, implying that we are going to have a solar cycle. Speculation and predictions of a grand minimum are unfounded."

Why is this so important to us on earth? After all the sunspots look small and are hardly even visible to us. Contrary to this, sunspot activity may be correlated with climate on earth. In the period between 1645 and 1715, sun spot activity had come to a halt on the Sun – a phenomenon referred to as the Maunder minimum. This coincided with extremely cold weather globally. So sunspots may have a relevance to climate on earth. Such links are tenuous, but definitely solar activity affects space weather, which can have an impact on space-based satellites, GPS, power grids and so on.

Given the high temperatures in the Sun, matter exists there in the form of plasma, where the electrons are stripped away from the nuclei. The Sun is made of hot ionised plasma whose motions generate magnetic fields in the solar interior by harnessing the energy of the plasma

flows. This mechanism is known as the solar dynamo mechanism (or magnetohydrodynamic dynamo mechanism). "Simply stated, it is a process by which kinetic energy of plasma motions is converted to magnetic energy, which generates the magnetised sunspots, giving rise to the solar cycle," explains Prof. Nandi.

Because of the nature of the solar dynamo, the part of its magnetic field that gives rise to sunspots reverses direction when it moves from one solar cycle to another. This can be inferred by observing when the relative orientation of the sunspot pairs flip. Studying 74 such pairs of magnetic regions, the researchers find that in 41 the orientation corresponds to cycle 24, and in 33 the orientation corresponds to cycle 25. Thus they conclude that the Sunspot cycle 25 is brewing within the solar interior.

"Small magnetic regions and a few full grown sunspots with the magnetic polarity orientation that is expected of sunspot cycle 25 have already started appearing on the solar surface. This means that we have either already seen the start of sunspot cycle 25 or it is just about to start," says Prof. Nandi.

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