

Century-long data of Kodaikanal Observatory reveals clues to Sun's future

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19th November, 2025: A new way uncovered by astronomers to reconstruct the Sun's past polar magnetic behaviour by digging into historical solar images taken at the Kodaikanal Solar Observatory (KoSO) more than 100 years ago provide clues to it's future.

For over a century, scientists have tried to decipher the Sun's mysterious rhythms, patterns of sunspots, flares, and magnetic storms that can affect everything from satellite operations to power grids on Earth. One of the key pieces of this solar puzzle lies in the polar magnetic fields of the Sun, which help shape each solar cycle and hold the crucial key for predicting future solar activity. As direct measurements of the polar magnetic fields of the Sun only began in the 1970s, we have very little knowledge about the polar field of the sun for the major part of the last century.

Researchers from the Aryabhata Research Institute of Observational Sciences (ARIES), an autonomous institute under the Department of Science & Technology (DST), Govt. of India, along with the collaborators from Indian Institute of Space Science and Technology, Southwest Research Institute, Boulder, USA; Max Planck Institute for Solar System Research, Goettingen, Germany and INAF Osservatorio Astronomico di Roma, Rome, Italy found a solution to the puzzle.

The team led by Dibya Kirti Mishra has uncovered a way to reconstruct the Sun's past polar magnetic behaviour by digging into historical solar images taken at the Kodaikanal Solar Observatory (KoSO) more than 100 years ago. KoSO is a field station of the Indian Institute of Astrophysics (IIA), situated in Bangalore, and it is also another autonomous institute under the Department of Science & Technology (DST), Government of India.

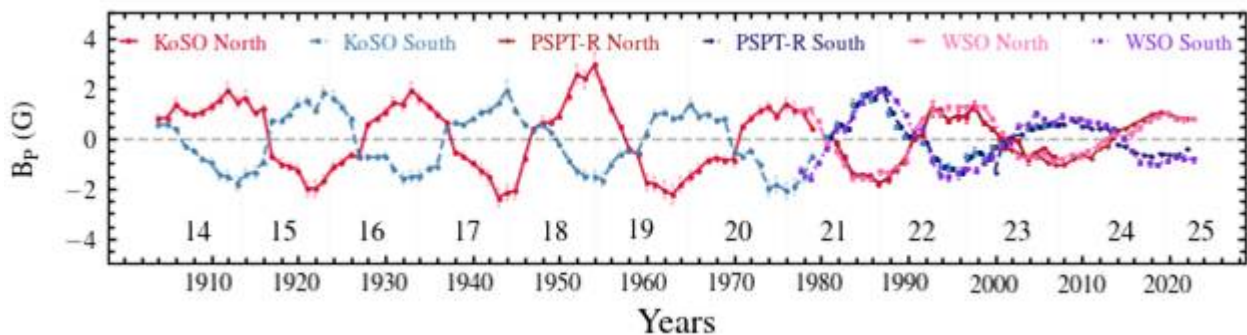


Figure: Temporal variation of the polar magnetic fields reconstructed from KoSO (solid red for the northern hemisphere and dashed blue for the southern hemisphere) and PSPT-R (solid dark red for the northern hemisphere and dashed navy for the southern hemisphere) over the period 1904–2022.

For comparison, direct polar field measurements from WSO (Wilcox Solar Observatory) are shown for the overlapping period 1976–2022, with dashed–dotted pink and dotted purple lines representing the northern and southern hemispheres, respectively.

At KoSO, solar astronomers began observing the Sun in a special wavelength called Ca II K as early as 1904. This wavelength captures chromospheric activity of the Sun. The chromosphere of the Sun is a layer just above the visible surface, where bright patches called plages and networks form due to magnetic activity, and thus these observations hold the secret of solar magnetism for more than a century.

The KoSO archive can be considered as a big data source for AI/ML applications, with over 100 years of observations now digitized into images. By combining this data with more recent observations from Italy’s Rome-PSPT, the research team used advanced feature identification algorithms to identify tiny bright features near the Sun’s poles, called the polar network. This helped them to estimate the polar field of the Sun over the last century.

Researchers reported that the polar network is a powerful “proxy”, a stand-in for the polar field strength. The researchers even used this reconstruction to estimate the strength of ongoing Solar Cycle 25.

Understanding the Sun’s magnetic behaviour helps scientists predict solar storms, which can damage satellites, disrupt GPS, and even knock out power grids. This new approach, using historical images and an automatic algorithm, gives us a much longer and more reliable view of solar magnetism than we’ve ever had.

The full dataset, including the reconstructed polar field and Polar Network Index (PNI) series, is freely available to the public on GitHub and Zenodo, enabling researchers worldwide to dig deeper into the mysteries of our star.

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