Kodaikanal Solar Observatory: Unravelling the mysteries of the Sun for the last 125 years

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On April 1, the Indian Institutes of Astrophysics (IIA) Kodaikanal Solar Observatory (KSO) will celebrate its quasquicentennial anniversary.

The KSO, located at an altitude of 2,343 meters in the Palani range of hills, was established in 1899 after the Madras Observatory shifted to the picturesque hills of Kodaikanal and since then, for the last 125 years, it has been unraveling the mysteries of the Sun.

According to Ravindra B., professor, Solar Physics, Solar Photosphere, Magnetic Field Measurements, Optical Instrumentation, IIA, one of the observatory's earliest triumphs was the discovery of the Evershed effect in 1909 by John Evershed.

"Imagine a giant whirlpool within a sunspot – that's the essence of this captivating phenomenon. KSO observations revealed the swirling motion of hot gas inside sunspots, with speeds reaching an impressive two kilometers per second. This discovery provided crucial insights into the Sun's internal dynamics and the complex interplay of magnetic fields within sunspots," said Professor Ravindra.

He added that KSO's inquisitive gaze extended beyond sunspots and significantly contributed to understanding solar prominences, the bright, gaseous features that erupt from the Sun's edge.

A view of Kodaikanal Solar Observatory in 1905. FILE PHOTO

Early stalwarts

Some of the stalwarts who solidified KSO's reputation as a leader in solar research are astronomers like John Evershed, T. Royds, and A.R. Narayan.

Professor Ravindra said Royds achieved a remarkable feat by capturing the first-ever photograph of specific oxygen lines in the chromosphere (the layer of the Sun's atmosphere just above the photosphere) outside an eclipse.

"This groundbreaking image provided valuable insights into the Sun's composition and structure. Narayan, along with his team, made critical observations during solar flares, noticing a broadening in spectral lines.

"Their analysis revealed the influence of the Doppler effect, providing a deeper understanding of the physical processes at play during these explosive events," Professor Ravindra said.

Ideal location

Why did the Madras Observatory move to Kodaikanal? It is due to the evaluation (2,343 meters) which is said to provide an ideal vantage point for observing and understanding ionospheric processes.

Prof. Ravindra said that recognising the critical link between solar activity and Earth's upper atmosphere, the ionosphere, an ionospheric and magnetospheric laboratory was established.

"Kodaikanal's unique location near the geomagnetic equator, the imaginary line around the Earth where the magnetic field is vertical, proved to be a significant advantage. Studies conducted here revealed unique features in the ionosphere, particularly the sporadic E layer. This layer exhibits a much higher occurrence rate (nearly 93% of daytime observations) at Kodaikanal compared to other latitudes, highlighting its sensitivity to solar radiation," Prof. Ravindra said.

He added that the observatory's impact transcended the realm of scientific discovery.

"KSO's data played a vital role in calibrating and validating measurements from other observatories around the world. This collaborative effort ensured consistent and reliable solar observations, fostering a global understanding of our star," he added.

Digitisation

The KSO has also consistently embraced technological advancements to push the boundaries of solar research.

The 20th century witnessed the incorporation of sophisticated equipment like spectroheliographs and photoelectric detectors.

It also has an ongoing project to digitise a vast archive of historical solar images. This includes white light data, crucial for studying sunspot evolution and surface features; Calcium-K (Ca-K) data, which provides insights into the chromosphere's temperature and structure; and solar prominence data, essential for understanding these dynamic features.

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