Kodaikanal Solar Observatory (KoSO)

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In news– For well over a century, the KoSO has been observing the Sun, capturing images of sunspots, and recording changes in its behaviour.

A brief history of Kodaikanal Solar Observatory-

- **KoSO, which is owned and operated by Indian Institute of Astrophysics (IIA),** is **one of the world's oldest observatories studying the Sun.**
- The idea of taking pictures of the Sun using a **20-inch telescope**, preferably from a location on a hill in Southern India, was **first proposed by the astronomer Norman Pogson, who was appointed Government Astronomer of the Madras Observatory in 1861.**
- **The Madras Observatory was set up as the private effort of an official of the British East India Company in 1786,** and came to be managed subsequently by the company.
- The decision to establish a solar observatory was finally taken in 1893, and Kodaikanal in present-day Tamil Nadu was chosen for its high altitude and dust-free environment.
- **Experts and equipment from the existing Madras Observatory were relocated to Kodaikanal.** The Solar Physics Observatory opened on April 1, 1899, and was later named KoSO.
- During the early decades of its operation, **the Bhavnagar Telescope**, named after the Maharaja of Bhavnagar, was one of the more famous instruments at KoSO. **This 16-inch Newtonian (later Cassegrain) mobile telescope remained India's largest from 1888 to 1968.**
- Imported from Dublin, Ireland, **it was first established at the Maharaja Takhtasinghji Observatory in Poona (now**

Pune) around 1888. But **after the observatory in Pune was shut, it was sent to KoSO in 1912. It is no longer in use today.**

Solar observations, one every day: how they are taken-

- **Since 1904, white light images of the Sun** (similar to viewing it with the naked eye using solar filters) have been **captured every day, using a 6-inch telescope.**
- Visible light images are taken because **they reveal sunspots on the surface of the Sun.**
- Solar physicists at the Indian Institute of Astrophysics (IIA), Bengaluru, and Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, both under the Department of Science and Technology, have now digitised 1.48 lakh solar images captured since 1904.

- **Earlier, a 15cm telescope was used to capture solar images onto a photographic film or plate.**
- Solar magnetic plages (a bright region on the Sun's chromosphere) are best captured in the strong chromospheric absorption lines, like the Ca II (called Ca II K).
- H-alpha observations and prominences, also recorded since 1911, taken on photographic films and plates, are available.
- **One image is taken daily around 8 am, which has been a fixed routine for over a century now.** At times, more than one image during a day has been taken, the observatory's archives show.
- Each observation accompanies the corresponding date and time, which is key for calibration purposes later.
- These plates or films are then sent to the darkroom and developed either the same day or the next day. Once the film has been developed, the date and time of observation are written on the plate, and also entered in the logbook.
- These plates or films are thereafter kept in an envelope

with the handwritten date and time of observation. All these envelopes are finally sorted annually and stored carefully in humidity-controlled rooms.

Arrival of new technology and the process of digitisation-

- **Between 1904 and 2017, all solar observations were traced onto photographic films and plates.** With advances in technology, and because of the difficulties in sourcing films or plates, observations using the traditional setup have not always been made in recent years. In the meantime, **a new telescope mounted with CCD cameras has taken over and, since 2017, continued to observe the Sun.**
- The mammoth task of **digitisation of the records was initiated in 1984**.
- **In 2018, digitised solar observations for the period 1921-2011 were made available to the scientific community.** Now, with the addition of raw and calibrated data for the period of 1904 to 2017, the digitisation process is nearly complete.
- Prof Banerjee, Director, ARIES, served as the Principal Investigator of the digitisation programme in its final stages. He was responsible for the development of the data search engine, and distributed the data to the global community through the IIA web portal.

KoSO is now home to a digital repository of a whopping 1.48 lakh solar images adding up to 10 terabyte of data.

- These include 33,500 white-light images (showing sunspots), 45,000 images of the Ca II K, 30,000 H-alpha images, and 40,000 Ca K-Prominences.
- **KoSO is the only observatory which provides high-resolution digitised images for such a long period (with coverage of more than 75 per cent).**

Studying the Sun’s historical past to predict the future-

- The Sun is the primary source of energy and the reason for the existence of most life on Earth. Even minor changes on the solar surface or its periphery can significantly affect the Earth’s atmosphere and influence the space weather. For instance, powerful solar storms, solar flares, are potentially harmful for satellite-based operations, power grids, and navigational networks.
- In this context, historical data on the Sun help solar physicists understand and predict its future, and its impact on life on Earth.
- Digitisation of the historical data, earlier available only as photographic plates or films, has removed the difficulties of handling and maintenance, and opened up a voluminous trove to solar physicists around the world.