



Latitudinal Variation in Sun's Rotation Speed

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Why in News?

Recently, **Indian astronomers** have mapped variation in the [Sun's rotation](#) speed from its **equator to its poles** for the first time.

- The study used 100 years of daily solar observations from the [Kodaikanal Solar Observatory, Tamil Nadu](#).

What are the Key Findings of the Study?

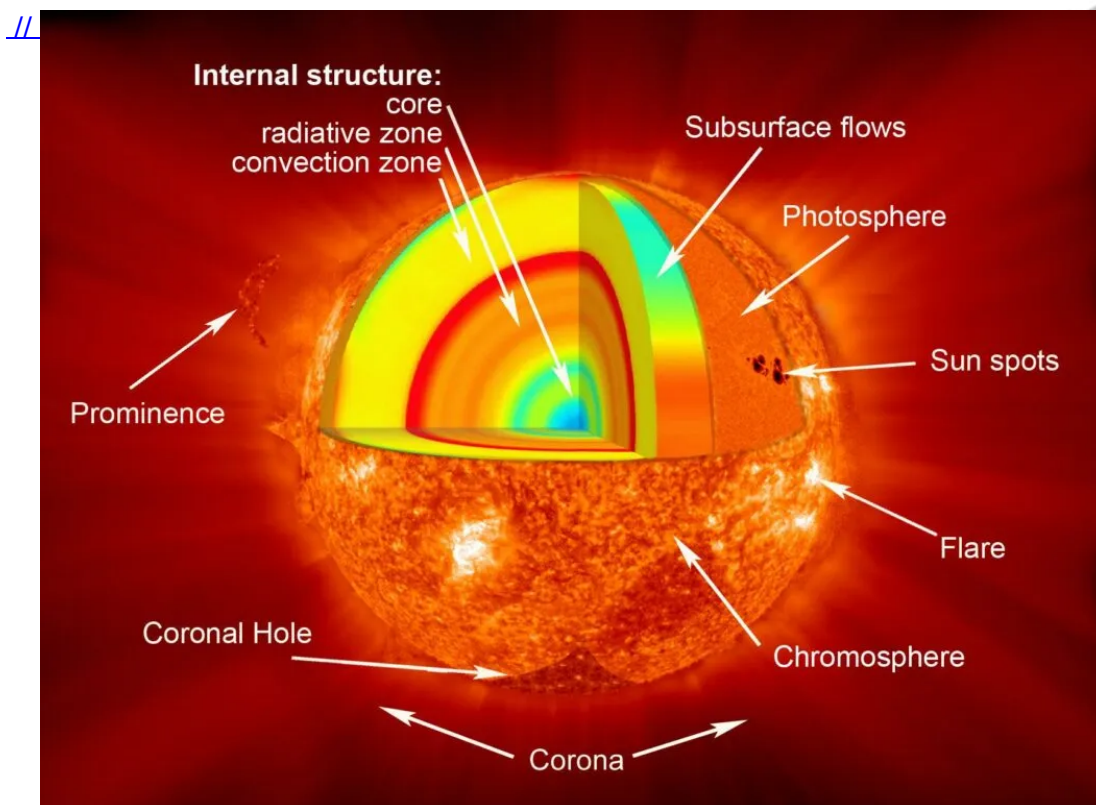
- **Sun's Chromospheric Rotation Mapped:** Astronomers have successfully mapped the variation in the rotation speed of the [Sun's chromosphere](#) for the **first time**.
 - The chromosphere is a **thin layer of plasma** that lies **between** the Sun's visible surface (**the photosphere**) and the [corona](#) (the Sun's upper atmosphere).
- **Differential Rotation of the Sun:** The Sun's **equator** spins much **faster** than its poles. It takes the equatorial region only about **25 days** to complete one rotation, while the **poles take 35 days**.
 - The Sun's **equator** rotates at **13.98 degrees per day**, while at **80 degrees latitude**, the rotation rate slows to **10.5 degrees per day**.
- **Contribution of Kodaikanal Solar Observatory:** Using **solar plages** and **network cells** from the observatory's records of 100 years, astronomers could measure the Sun's rotation speeds across **all latitudes**.
 - **Plages** are **brighter regions** with weaker magnetic fields. They are found in the **chromosphere** and are 3 to 10 times larger than sunspots.
 - **Network cells** have weaker magnetic fields and are slightly larger than individual **sunspots** but smaller than sunspot groups.
 - Unlike sunspots, **plages and networks are always present** on the Sun's surface, helping scientists study the rotation rate even at the poles.
 - **Sunspots** are areas that appear **dark on the surface of the Sun**. They appear dark because they are **cooler** than other parts of the Sun's surface.
- **Significance of the Findings:** Understanding this differential rotation is essential as it is behind the [solar dynamo](#), the [11-year solar cycle](#), and its periods of intense activity that even produce **magnetic storms** on Earth.

Note:

- **Richard Carrington**, an English astronomer in the **19th century**, first discovered **differential rotation** by observing [sunspots](#).
- However, sunspots are mostly limited to **latitudes below 35 degrees** and are not suitable for high-latitude rotation measurements.

What are the Key Facts About the Sun's Atmosphere?

- The Sun's atmosphere consists of **multiple layers**, each with distinct **characteristics and temperatures**:
 - **Photosphere**: The **visible surface** of the Sun, marking the **boundary** between the interior and the atmosphere.
 - **Chromosphere**: An **irregular layer** above the photosphere where the temperature rises from **6000°C to about 20,000°C**.
 - **Transition Region**: A thin and very irregular layer of the Sun's atmosphere that **separates** the **hot corona** from the much cooler **chromosphere**.
 - **Corona**: The Sun's **outer atmosphere**. It is **much hotter** than the underlying chromosphere or photosphere.
- **Beyond the corona** lies the **solar wind**, which is an outward flow of **charged particles (plasma)** originating from the corona.
 - The solar wind extends **far into space** affecting planetary atmospheres and causing phenomena like the **auroras on Earth**.



About Kodaikanal Solar Observatory

- It is operated by the **Indian Institute of Astrophysics (IIA)** is located in the Palani range of hills in Southern India.
 - IIA is an autonomous institute of **Department Of Science & Technology**.
- It was established to study the **Sun's impact on Earth's atmosphere** and better understand **monsoon patterns**.
- Solar observations at this observatory over **more than 100 years** provide one of the **longest continuous series** of solar data.
- One of the major milestones was the discovery of the **Evershed Effect** in **1909**, which is related to the **movement of gases in the solar atmosphere**.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Electrically charged particles from space travelling at speeds of several hundred km/sec can severely harm living beings if they reach the surface of the Earth. What prevents them from reaching the surface of the Earth? (2012)

- (a) The Earth's magnetic field diverts them towards its poles
- (b) Ozone layer around the Earth reflects them back to outer space.
- (c) Moisture in the upper layers of atmosphere prevents them from reaching the surface of the Earth
- (d) None of the statements (a), (b) and (c) given above is correct

Ans: (a)

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