Differential Rotation of the Sun's Chromosphere

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Context:

Astronomers at the **Kodaikanal Solar Observatory** have **mapped variation in the rotation speed of the Sun's chromosphere**, from the equator right up to its polar regions for the first time using 100 years of daily records of the Sun.

Key Findings from the Mapping of Sun's Chromosphere

Chromosphere: 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)**

- It extends for **at least 2,000 km (1,200 mi.)** above the surface
- It**appears bright red**because the hydrogen in the Sun emits a reddish-coloured light at high temperatures.

- **Differential Rotation Rates:**The Sun**rotates faster at the equator**(13.98 degrees per day) and**slower towards the poles**(10.5 degrees per day at 80 degrees latitude).
- **Similar Rotation of Features:****Plages and network** features**exhibit similar rotation rates**, suggesting a shared origin deep within the Sun.
- **First Mapping Achievement:**This study is the**first**to successfully use**chromospheric network cells to map the Sun's rotation from the equator to the poles.**

About Differential Rotation

- **Definition:**The**difference in rotation speed**between the**Sun's equator and poles**is known as differential rotation.
- **Earth vs. Sun's Rotation**
- **Earth's Uniform Rotation:**Earth rotates as a rigid body,**completing a full rotation every 24 hours,**with **uniform rotationspeed from equator to poles.**
- **Sun's Differential Rotation:**The**Sun**, **made of plasma**,**rotates at different speeds based on latitude.**
- The Sun's equator spins much faster than its poles.
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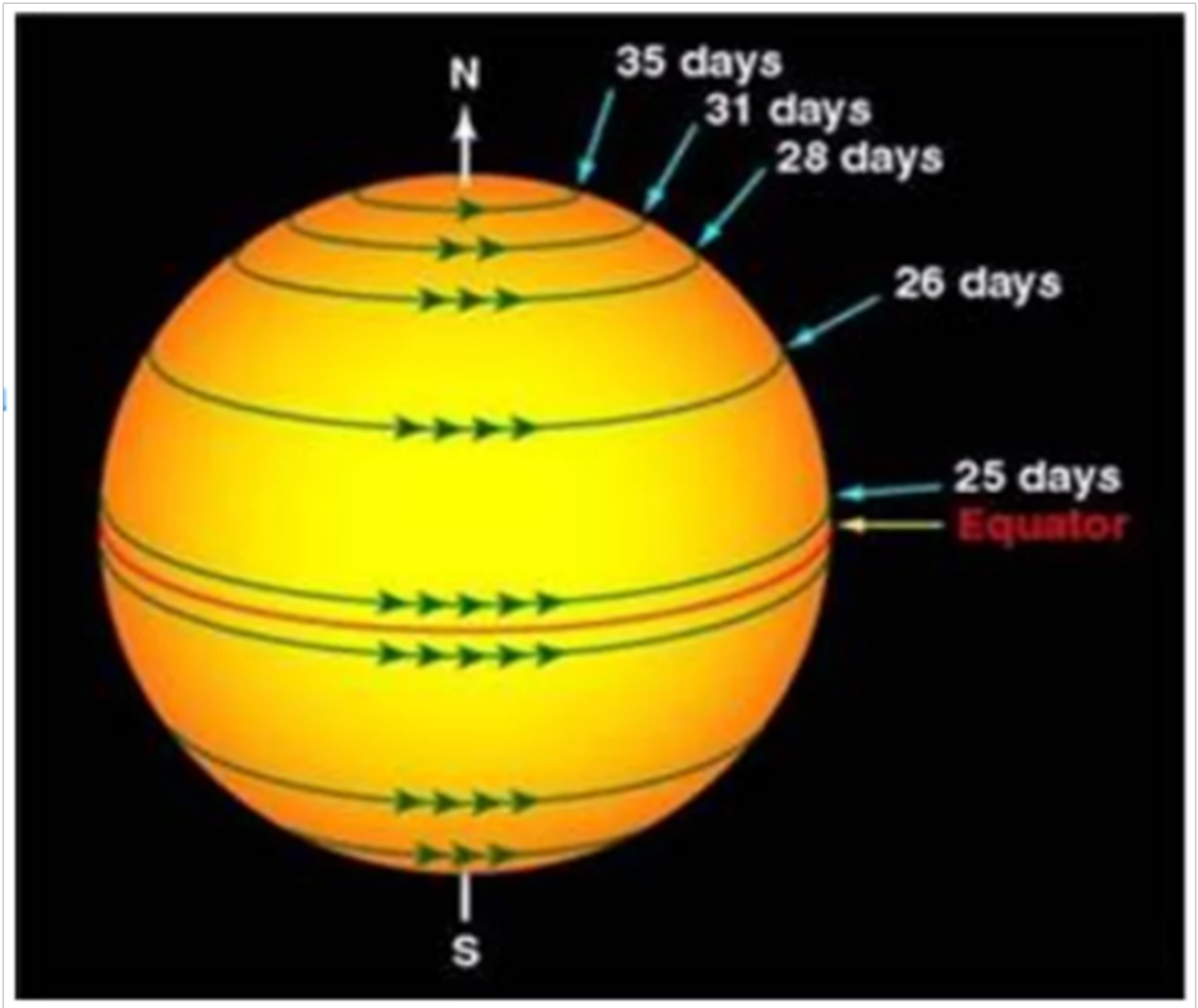
- It takes the equatorial region**only about 25 days**to complete one rotation, while the**poles take a leisurely 35 days. (**Diagram represents the Sun's differential rotation, where surface regions at various latitudes rotate at different speeds.)

Kamaraj IAS Academy
Plot A P.127, AF block, 6 th street, 11th Main Rd, Shanthi Colony, Anna Nagar, Chennai, Tamil Nadu 600040
Phone: **044 4353 9988 / 98403 94477** / Whatsapp : **09710729833**



- **Significance of Differential Rotation**
- Understanding the intricacies of the variation in rotation speed, as a function of latitude as well as time, is crucial to**understand the Sun itself.**
- It**drives the solar dynamo**, the 11-year solar cycle, and**periods of intense solar activity**that can trigger magnetic storms on Earth.

Discovery of Differential Rotation: The discovery of differential rotation **dates back to Carrington in the 19th century**, who observed that ***sunspots on the visible surface of the Sun rotate at different speeds depending on their latitude.***

Challenges of Relying on Sunspot Observations for Differential Rotation:

Limited Latitude Coverage: **Sunspots do not appear above 35 degrees latitude**, restricting their use in measuring the Sun's rotation closer to the poles.

Infrequency at High Latitudes: Sunspots occur **rarely at higher latitudes**, making data collection **sparse and unreliable for studying** the Sun's full rotational dynamics. This necessitated alternative methods

Inadequate for Time-Dependent Studies: **Sunspot-based methods are insufficient for tracking** how differential rotation varies over time, such as across the solar cycle, due to limited and sporadic data.