Near-Surface Shear Layer of the Sun

Why in News

Recently, **Indian astronomers** from **Aryabhatta Research Institute of Observational Sciences (ARIES),** and **Indian Institute of Science, Bangalore,** have for the **first time given the theoretical explanation** of the existence of a **near-surface shear layer (NSSL)** in the Sun.

- **ARIES** is an autonomous institute under the Department of Science and Technology.

Key Points

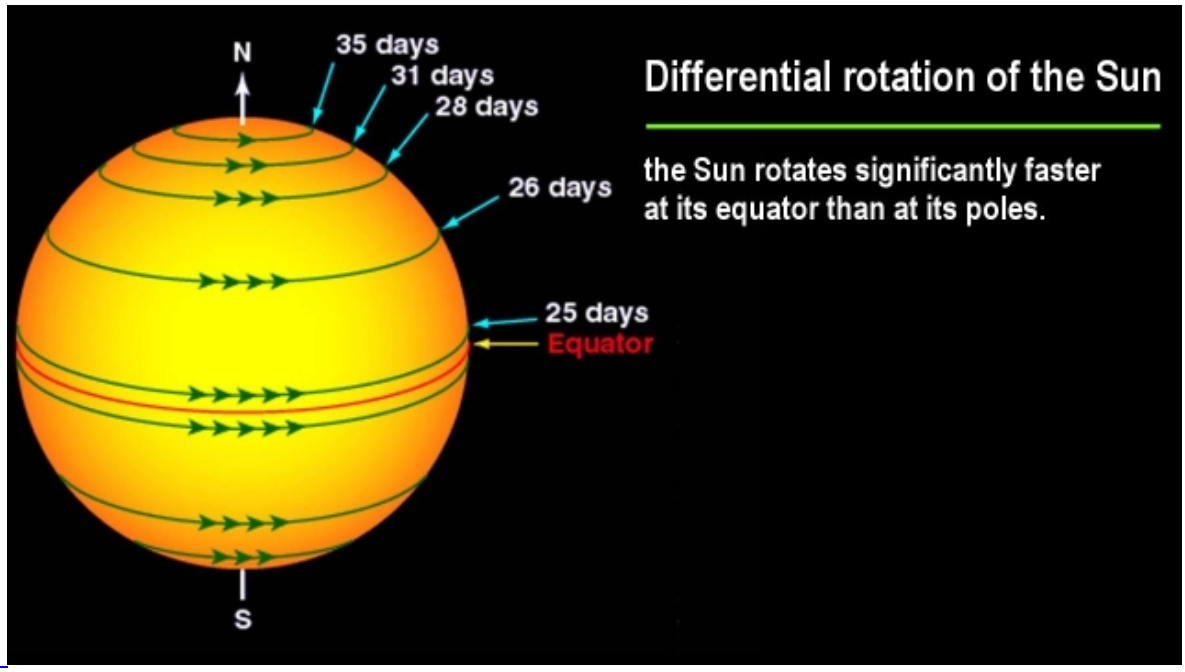
- **About Near-Surface Shear Layer (NSSL):**
    - Apart from differentiation rotation between equator and poles, the helioseismology has revealed that the Sun has a **Near-Surface Shear Layer (NSSL).**
    - The NSSL is the region very close to the visible solar surface, where there is a change in the rotation profile of the Sun.
    - This layer exists very close to the solar surface, **within which the angular velocity decreases rapidly with radius.**
    - This NSSL is thought to play a significant role in defining the nature of large-scale convective patterns that drive the Sun's magnetism.

Note

- **Angular velocity:** It is the time rate at which an object rotates, or revolves, about an axis, or at which the angular displacement between two bodies changes.
- **Helioseismology:** It is a technique of using sound waves to peek inside the Sun.

- **Findings of the Study:**
    - In their study, they have used an equation called the **thermal wind balance equation.**
        - It explains how the slight difference in temperature between solar poles and equator, called **thermal wind,** is balanced by the **centrifugal force appearing due to solar differential rotation.**
    - Understanding NSSL is crucial for the study of **several solar phenomena** like sunspot formation, solar cycle, and it will also help in understanding such phenomena in other stars.
- **About Differential Rotation of the Sun:**
    - It was long known that the Sun has **Differential rotation,** which means different parts of the Sun **rotate at different speeds.**
        - The Sun **rotates faster at the equator than at the poles.**
    - Over time, the Sun's differential rotation rates **cause its magnetic field to become twisted and tangled.**

- The **"tangles" in the magnetic field** lines can produce very, very strong **localized magnetic fields.**
- These localised magnetic fields on the surface of the Sun are active regions where **sunspots** occur.
    - Sunspots are areas that appear dark on the surface of the Sun (photosphere). They appear dark because they are cooler than other parts of the Sun's surface.
- Further, these active regions often generate solar storms**: solar flares and coronal mass ejections (CMEs).**



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