Hidden Flow in the Sun’s Upper Atmosphere

Prelims: *Current events of national and international importance | Science & Technology*

Why in News?

Recently, Scientists revealed a hidden flow in the Sun's upper atmosphere, providing new insights into space weather that affects satellites, communication, navigation and power grids on Earth.

- **Study led by –**
  - Aryabhatta Research Institute of Observational Sciences (ARIES), autonomous institute under the Department of Science and Technology (DST),
  - Physical Research Laboratory (PRL)
  - Indian Institute of Technology Delhi (IIT Delhi)
  - Indian Institute of Space Science and Technology (IIST)
  - NASA’s Goddard Space Flight Centre.

Key findings

- **Meridional flow –** The Sun has a *slow flow of hot gas or plasma moving from equator to poles like a conveyor belt*, this movement is called meridional flow.
- It plays and important role in controlling the 11-year solar cycle which *influences the appearance of sunspots*.
- **Upper Chromosphere** – The slow *poleward movement of plasma flow exists 3,000 km above the Sun’s visible surface* i.e. the upper chromosphere showing a *clear link between Sun’s surface and its upper layers.*
- **Magnetic Influence** – The discovery is important because, at these heights, the *Sun’s magnetic field strongly influences the movement of plasma in the Sun’s atmosphere.*
- **New Technique** – Instead of tracking individual sunspots or magnetic features, the team *developed a novel image-correlation technique.*

- **Novel image-correlation technique –** Used for *comparing thousands of full-disk radio images to map large-scale plasma movement.*
- **Speed –** Plasma moves poleward at *5–15 m/s, similar to deeper layers of the Sun.*
- The *plasma flow changes with the solar cycle*, and at times the *two hemispheres act differently based on magnetic activity*.
- **Magnetic link –** Bright features in radio images move in step with magnetic field transport, confirming the ***magnetic tree hypothesis*** (structures high above remain connected to deeper layers like branches to roots).
- **Evidence –** Based on 27 years of radio observations from Nobeyama Radioheliograph.

Nobeyama Radioheliograph (NoRH) *in Japan is a solar-dedicated radio telescope array built to study the Sun's magnetic fields and plasma.*

Significance

- **Solar dynamics –** Shows upper atmosphere retains information about motions deep inside the Sun.
- **Space weather –** Understanding plasma-magnetic field interaction crucial for predicting solar storms.
- **Scientific breakthrough –** Provides new tool for studying the **solar dynamo** (process generating Sun's magnetic field).
- **Global impact –** Helps forecast events that can disrupt satellites, navigation systems, communications and power grids.

Reference

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