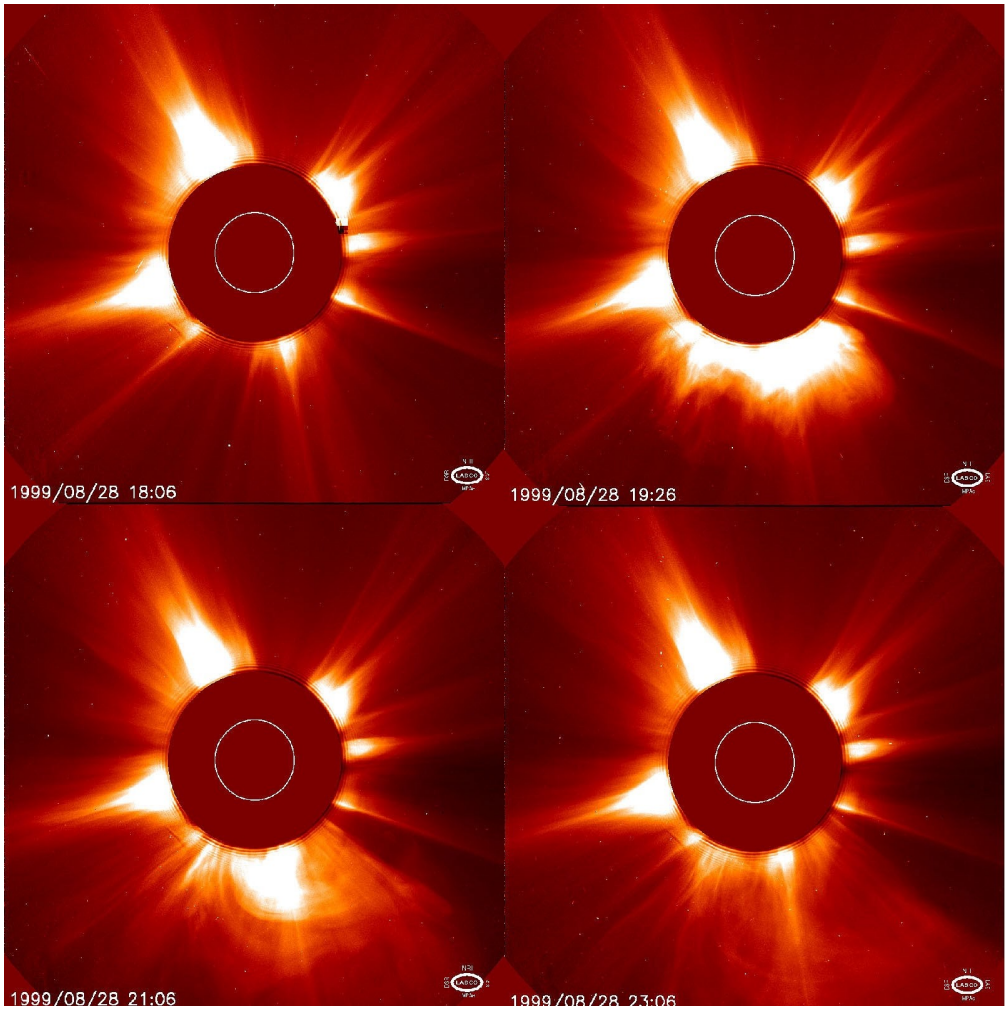
3-D computer forecasting Coronal Mass Ejections (CMEs)

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

Why in news?

Scientists have developed a 3-D computer simulation model that could help improve the forecasting of Coronal Mass Ejections (CMEs) and predict their characteristics.

- **Objective** – To trace how magnetic energy accumulates in the ***Sun's outer atmosphere*** and is eventually released during powerful solar eruptions.
- **Study led by** –
  - Indian Institute of Astrophysics (IIA), under the Department of Science and Technology (DST).
  - Collaboration with researchers from the United States, Hungary and Finland.
- At the centre of these CMR's are magnetic flux ropes (MFRs)-twisted structures made up of magnetic field lines embedded in solar plasma.
  - MFR's are considered key triggers of CMEs.
- The 3D MHD model traces the complete evolution of a magnetic flux rope.
- **Process** – Magnetic reconnection occurs when opposing magnetic field lines rearrange, releasing stored magnetic energy and accelerating solar plasma.
  - Initially slow, it intensifies through a thin current sheet, ultimately causing the rapid eruption of the magnetic flux rope.
- **Key Finding –** The study found a clear relationship between the rate of magnetic reconnection and CME acceleration.
  - Higher reconnection rate → greater CME acceleration.
- Therefore, reconnection flux could help predict the speed and energy of a CME, their potential impact on Earth.
- The model's results were validated using real-world data from *NASA's Solar Dynamics Observatory (specifically the HMI and AIA instruments).*
- **Significance –** The findings help improve in preparedness to protect infrastructures.



Quick facts

Coronal Mass Ejections (CMEs)
• **CMEs** are massive eruptions of magnetised plasma from the Sun that travels at millions of kilometres per hour. • Earth-directed CMEs can cause geomagnetic storms and disrupt – - Satellites - Communication systems - Power grids - Navigation systems

Reference

DD News| New computer model forecast solar storms

SHANKAR IAS PARLIAMENT
Information is Empowering