India’s Spherical Tokamak

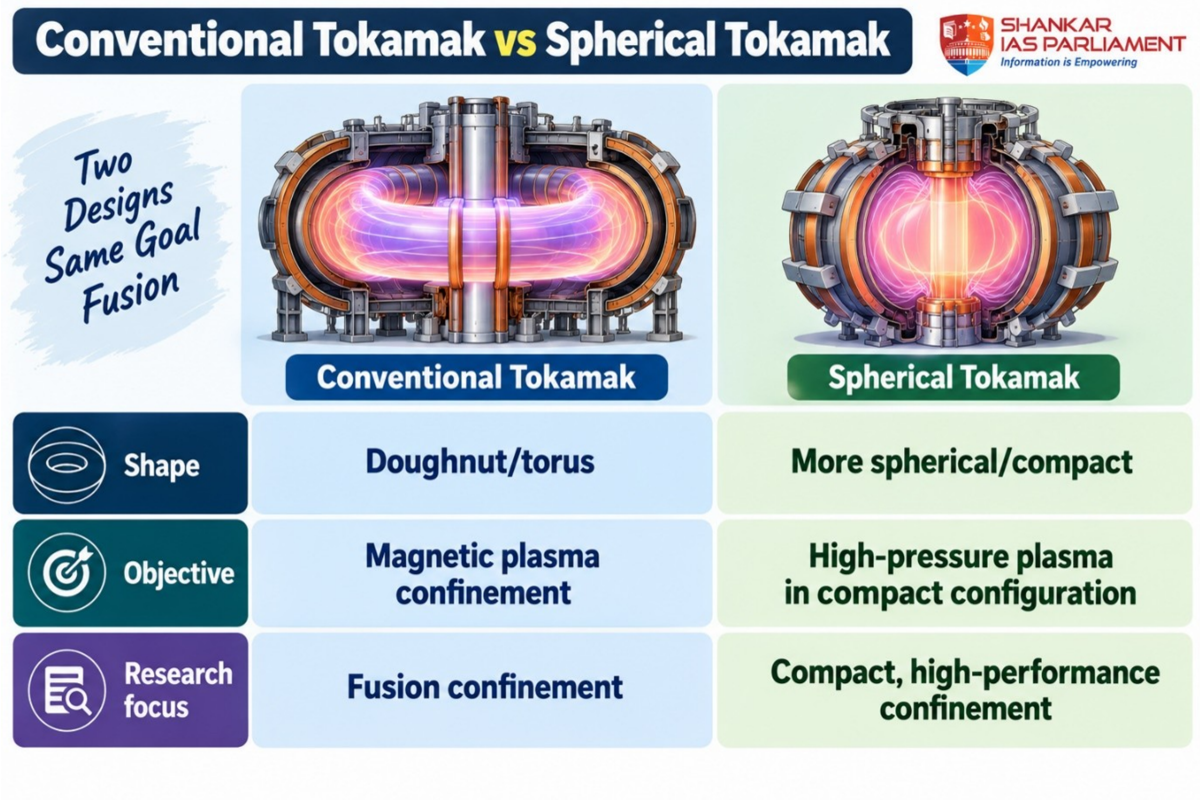
Prelims: *Current events of national and international importance | Science & Technonlogy*

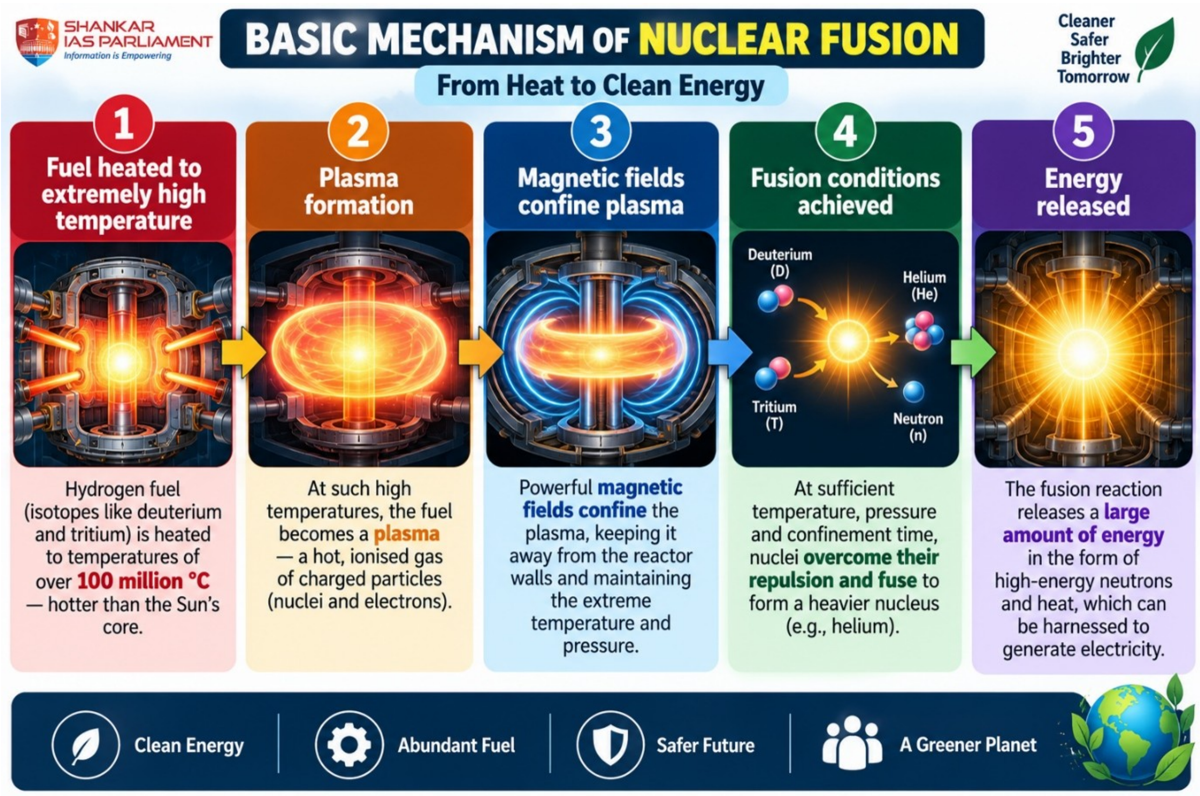
Why in News?

The Institute for Plasma Research (IPR) in Gujarat has commissioned the nation’s first spherical tokamak and initiated plasma experimentation.

- **Tokamak –** It is a device that confines extremely hot plasma through the use of magnetic fields, enabling the conditions necessary for nuclear fusion.
- **Rationale for Magnetic Confinement**
  - At the temperatures required for fusion, matter exists in the **plasma** state and cannot be contained by conventional material walls.
  - Therefore, powerful magnetic fields are employed to confine and **control the plasma**.

Global Spherical Tokamak Research
• India participates in a broader international research initiative. • Notable international examples • **United Kingdom** - MAST-U — Mega Ampere Spherical Tokamak Upgrade - ST40 — Tokamak Energy - STEP — Spherical Tokamak for Energy Production • **United States** - NSTX-U — National Spherical Torus Experiment Upgrade • **Japan** - QUEST — Q-shu University Experiment with Steady-State Spherical Tokamak • Additional countries with active spherical tokamak programs are as follows: - China - South Korea - Russia - Italy - Spain





- **Benefits**
- **Large-scale electricity generation –** It has the potential to produce substantial quantities of electricity on a continuous basis.
- **Low-carbon energy –** It could serve as a low-carbon power source, thereby reducing reliance on fossil fuels.
- **Absence of chain reaction –** In contrast to **nuclear fission**, fusion does not depend on a self-sustaining chain reaction.

- **Inherent safety –** It ceases automatically if the extreme conditions necessary for its maintenance are disrupted.
- **Potential energy security –** Commercially viable fusion could offer a long-term electricity supply and decrease dependence on imported fuels.
- **Technological advancement –** It fosters expertise in **plasma physics, superconducting magnets, advanced materials, and engineering**.

Reference

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