India’s Artificial Sun

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Why in News?

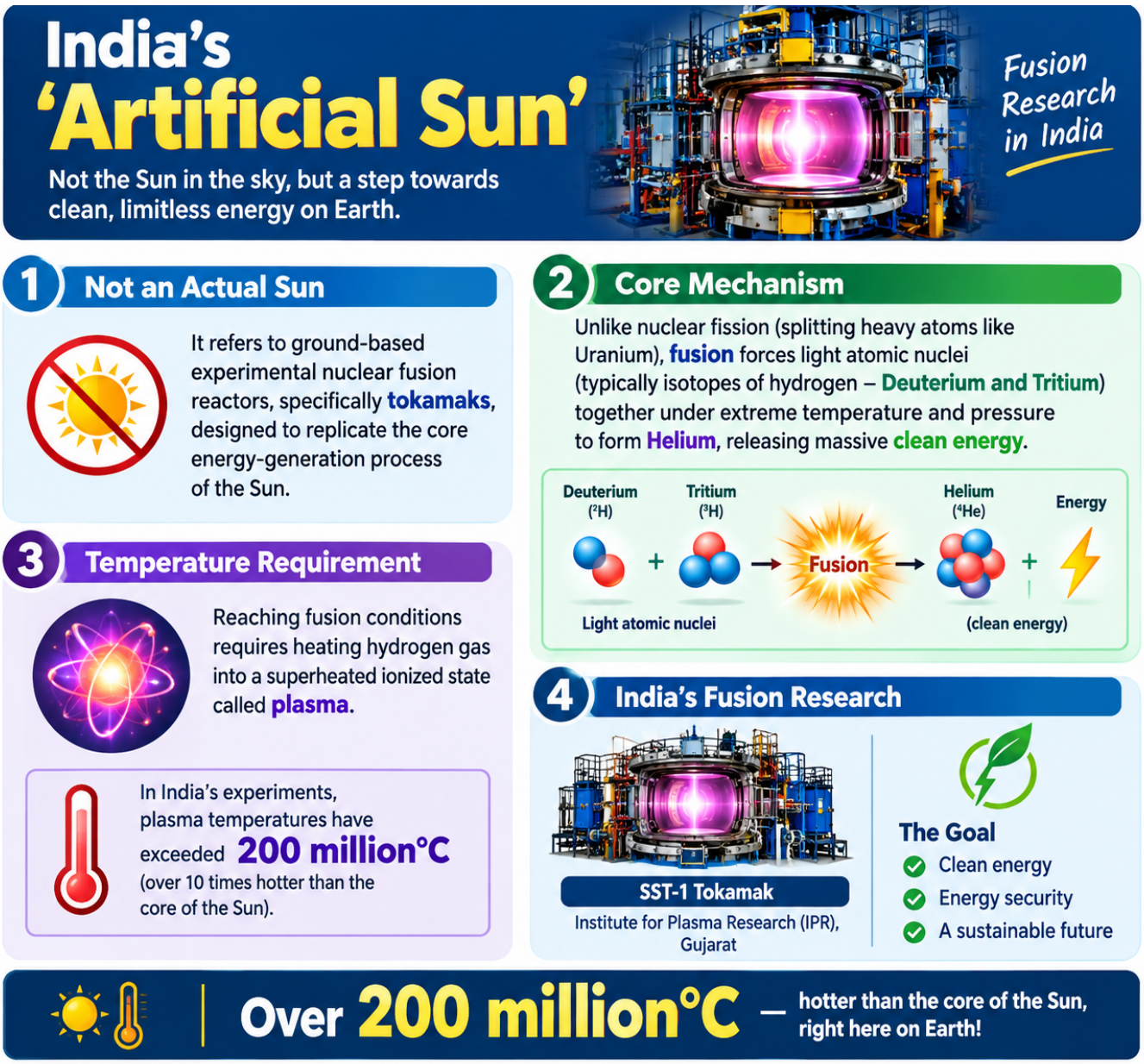
India’s indigenous nuclear fusion research reached a key milestone with the installation of Steady State Superconducting Tokamak-1 (SST-1) at the Institute for Plasma Research (IPR) in Gandhinagar, Gujarat.

India’s ‘Artificial Sun’

- **Not an Actual Sun -** It refers to ground-based experimental nuclear fusion reactors, specifically tokamaks, designed to replicate the core energy-generation process of the Sun.
- **Core Mechanism -** Unlike nuclear fission (splitting heavy atoms like Uranium), fusion forces light atomic nuclei (typically isotopes of hydrogen - Deuterium and Tritium) together under extreme temperature and pressure to form Helium, releasing massive clean energy.
- **Temperature Requirement -** Reaching fusion conditions requires heating hydrogen gas into a superheated ionized state called **plasma**.
- In India's experiments, plasma temperatures have exceeded ***200 million°C*** (over 10 times hotter than the core of the Sun).

Key Highlights of the SST-1 Upgrade

- **Role of the Gyrotron -** A gyrotron is a high-power vacuum tube device that generates high-frequency microwave energy.
- It provides **Electron Cyclotron Resonance Heating (ECRH)** to heat and sustain plasma.
- **Upgraded Performance-** Replaces older 42 GHz systems.
- Thus**,** enhancing India’s capacity to heat, maintain stability, and extend the confinement time of ultra-hot plasma without touching the reactor walls.
- **Magnetic Confinement-** Utilizes strong superconducting magnets to trap the plasma inside a donut-shaped chamber (*torus*).



India's Indigenous Tokamaks

- **ADITYA / ADITYA-U-** India's first medium-sized conventional air-core tokamak with copper coils, used for basic plasma physics research.
- **SST-1 (Steady State Superconducting Tokamak)-** India's ***first superconducting tokamak*** designed for long-duration, steady-state plasma operation.

Institute for Plasma Research (IPR) *Located in Gandhinagar (Gujarat), it is an autonomous R&D institute under the Department of Atomic Energy (DAE) leading domestic fusion research.*

Reference

News 18 | India's 'Artificial Sun' Project

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