China’s Artificial Sun

Why in News

China successfully powered up its **“artificial sun” nuclear fusion reactor** for the first time recently, marking a great advance in the country’s **nuclear power research capabilities.** The nuclear reactor is expected to provide clean energy.

Key Points

- The **HL-2M Tokamak reactor** is China’s **largest and most advanced nuclear fusion** experimental research device, and scientists hope that the device can potentially unlock a powerful clean energy source.
    - HL-2M Tokamak device is used in it to replicate the **nuclear fusion process that occurs naturally in the sun.**
- It uses a **powerful magnetic field** to fuse **hot plasma** and can reach temperatures of over **150 million degrees Celsius,** approximately **ten times hotter than the core of the sun.**
- Located in **Sichuan province,** the reactor is often called an **“artificial sun” on account of the enormous heat and power it produces.**
- **Other Similar Experiment:**
    - **International Thermonuclear Experimental Reactor**
        - International Thermonuclear Experimental Reactor (ITER) is a collaboration of **35 nations launched in 1985.**
        - It is located in **France.**
        - **Aim:**
            - It aims to build the world's largest tokamak to prove the feasibility of fusion as a large-scale and carbon-free source of energy.
            - The tokamak is an **experimental machine designed to harness the energy of fusion.** Inside a tokamak, the energy produced through the **fusion of atoms** is absorbed as heat in the walls of the vessel. Like a conventional power plant, a fusion power plant **uses this heat to produce steam and then electricity by way of turbines and generators.**

Nuclear Reactions

- **Description:**
    - A nuclear reaction is the process in which two nuclei, or a nucleus and an external subatomic particle, collide to produce one or more new nuclides.Thus, a nuclear reaction must cause a transformation of at least one nuclide to another.
- **Types:**
    - **Nuclear Fission:**

- The nucleus of an atom splits into **two daughter nuclei.**
- This decay can be natural spontaneous **splitting by radioactive decay,** or can actually be simulated in a lab by achieving necessary conditions **(bombarding with neutrons, alpha particles, etc.).**
- The resulting fragments tend to have a combined mass which is less than the original. The **missing mass is usually converted into nuclear energy.**
- Currently **all commercial nuclear reactors are based on nuclear fission.**

◦ **Nuclear Fusion:**

- Nuclear Fusion is defined as the **combining of two lighter nuclei** into a heavier one.
- Such nuclear fusion reactions are the **source of energy in the Sun** and other stars.
- It takes considerable **energy to force the nuclei to fuse.** The conditions needed for this process are extreme millions of degrees of temperature and millions of pascals of pressure.
- The hydrogen bomb is based on a **thermonuclear fusion** reaction. However, a nuclear bomb based on the fission of uranium or plutonium is placed at the core of the hydrogen bomb to provide initial energy.

Source:TH