CHINA EAST REACTOR: SCIENCE & TECHNOLOGY

NEWS: *China's EAST reactor keeps the fire of magnetic fusion burning*

WHAT'S IN THE NEWS?

On January 20, 2025, Chinese scientists achieved a significant milestone by maintaining plasma at 100 million degrees Celsius for 1,066 seconds in the EAST reactor, advancing global efforts in nuclear fusion technology and supporting the ITER project's aim to harness clean, sustainable energy.

Breakthrough in Nuclear Fusion Technology

Key Development On January 20, 2025, Chinese researchers achieved a significant milestone in nuclear fusion technology at the Experimental Advanced Superconducting Tokamak (EAST) reactor. They successfully maintained plasma at a temperature of 100 million degrees Celsius for 1,066 seconds. This advancement is crucial for the progress of the International Thermonuclear Experimental Reactor (ITER), a global collaboration aimed at harnessing nuclear fusion as a sustainable energy source.

Understanding Nuclear Fusion

- **Fundamental Process**: Nuclear fusion involves the merging of two atomic nuclei to form a heavier nucleus, releasing a substantial amount of energy. This process is distinct from nuclear fission, which splits atomic nuclei.
- **Clean Energy Potential**: Fusion is considered a clean energy source, as it produces minimal radioactive waste compared to fission, offering a sustainable alternative for future energy needs.

Challenges in Nuclear Fusion

- **The Tritium Issue**: Effective fusion reactions, such as those involving deuterium-tritium, require tritium, which is less abundant than deuterium and needs to be produced artificially in reactors across countries like Canada, India, and South Korea.
- **High Temperature Requirements**: Fusion requires temperatures exceeding 100 million degrees Celsius, surpassing the core temperature of the Sun, which poses significant technological challenges.

Tokamak Technology and Magnetic Confinement

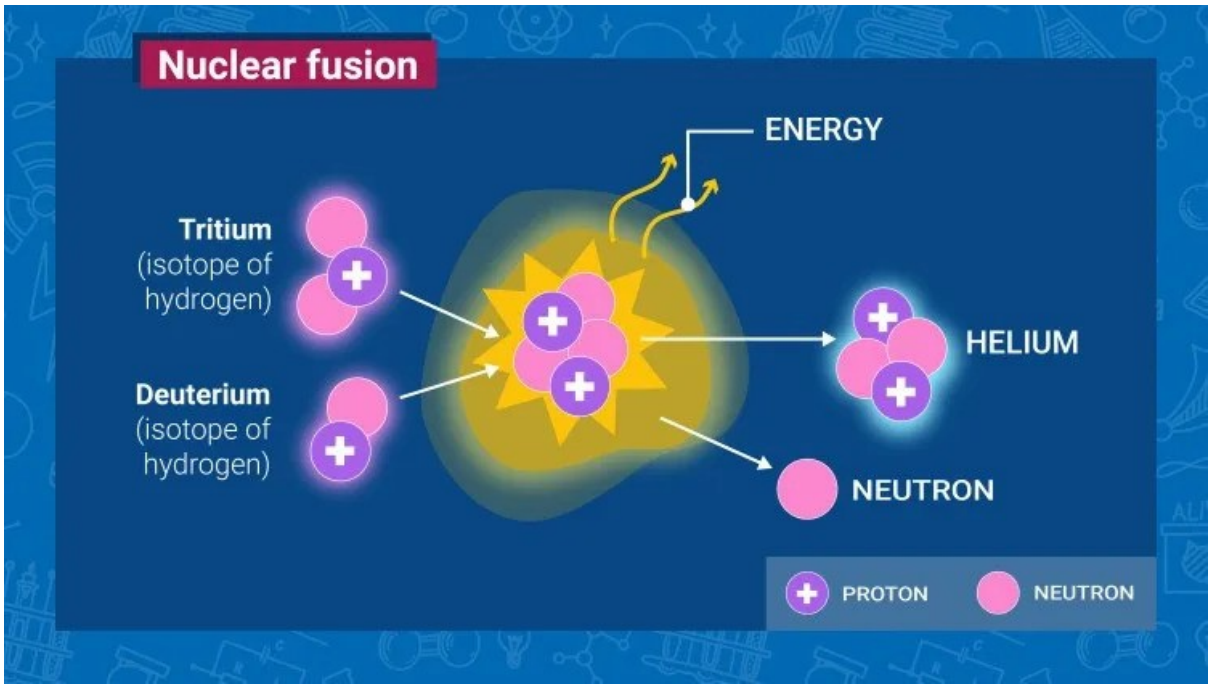
- **Tokamak Design**: A tokamak is a doughnut-shaped device designed to confine plasma using magnetic fields to achieve the high temperatures necessary for fusion.
- **EAST Achievements**: The EAST reactor, notable for its toroidal and poloidal magnetic fields, has progressively achieved longer durations of plasma confinement, culminating in the 2025 record of sustaining high-confinement plasma for 1,066 seconds.

Alternative Fusion Technologies

- **Stellarator**: This fusion device uses complex, twisted magnetic fields to confine plasma, offering an alternative to the tokamak.
- **Laser-Inertial Fusion**: In this approach, nuclear fusion reactions are initiated by compressing fuel pellets with high-energy lasers, a technique explored at facilities like the US National Ignition Facility, which achieved fusion ignition in 2022.

International Thermonuclear Experimental Reactor (ITER)

- **Global Collaboration**: ITER represents a major international effort to build the world's largest tokamak in France, involving 35 countries including China, the EU, India, Japan, Korea, Russia, and the USA.
- **Goals and Commitments**: The project aims to demonstrate the feasibility of fusion as a large-scale, carbon-free energy source. The participating countries contribute to the construction costs and share in the scientific outcomes and intellectual property.



Hydrogen Isotopes in Fusion Research

- **Protium**: The most abundant isotope of hydrogen, consisting of one proton, used primarily in basic scientific research.
- **Deuterium**: This isotope has one proton and one neutron, and is integral to nuclear fusion processes due to its availability and properties.
- **Tritium**: With one proton and two neutrons, tritium is radioactive and decays into helium-3, playing a critical role in fusion research despite its scarcity.

This comprehensive overview highlights the advancements and ongoing challenges in the field of nuclear fusion, illustrating the global efforts to harness this potent source of clean energy.

Source: https://www.thehindu.com/sci-tech/science/china-east-tokamak-keeps-fire-magnetic-fusion-burning/article69226043.ece#:~:text=On%20January%2020%2C%20Chinese%20scientists,Advanced%20Superconducting%20Tokamak%20(EAST).