

International Thermonuclear Experimental Reactor

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In News: Assembly of the world's largest nuclear fusion reactor began in France, It is known as the International Thermonuclear Experimental Reactor or ITER.

What ?

- The ITER project is a joint effort by countries such as Japan, India, the European Union, the United States, Russia, China and South Korea. It was launched in 2006, has a five-year assembly phase and plans to reach its maximum power output by 2035.
- ITER will be the first fusion device to produce net energy. ITER will be the first fusion device to maintain fusion for long periods of time.
- And ITER will be the first fusion device to test the integrated technologies, materials, and physics regimes necessary for the commercial production of fusion-based electricity.
- Thousands of engineers and scientists have contributed to the design of ITER since the idea for an international joint experiment in fusion was first launched in 1985.
- The ITER Members—China, the European Union, India, Japan, Korea, Russia and the United States—are now engaged in a 35-year collaboration to build and operate the ITER experimental device, and together bring fusion to the point where a demonstration fusion reactor can be designed.

Significance of ITER

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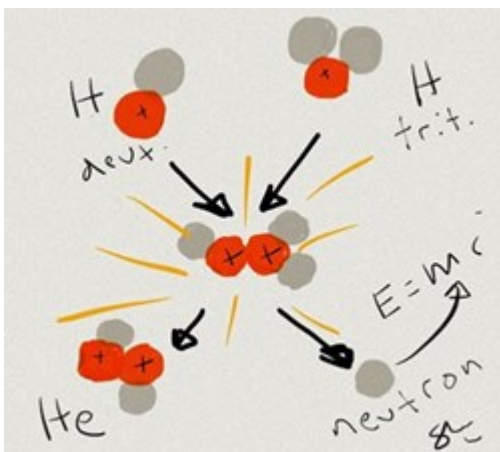
The project is funded and run by seven member entities

- The European Union, China, India, Japan, Russia, South Korea and the United States.

What Will ITER Do?

- Produce 500 MW of fusion power
- Demonstrate the integrated operation of technologies for a fusion power plant
- Achieve a deuterium-tritium plasma in which the reaction is sustained through internal heating
- Test tritium breeding
- Demonstrate the safety characteristics of a fusion device.

What Is Fusion?



- Fusion is the energy source of the Sun and stars. In the tremendous heat and gravity at the core of these stellar bodies, hydrogen nuclei collide, fuse into heavier helium atoms and release tremendous amounts of energy in the process.

- Twentieth-century fusion science identified the most efficient fusion reaction in the laboratory setting to be the reaction between two hydrogen isotopes, deuterium (D) and tritium (T). The DT fusion reaction produces the highest energy gain at the “lowest” temperatures.
- Three conditions must be fulfilled to achieve fusion in a laboratory
 - very high temperature (on the order of 150,000,000° Celsius);
 - sufficient plasma particle density (to increase the likelihood that collisions do occur);
 - sufficient confinement time (to hold the plasma, which has a propensity to expand, within a defined volume).
- At extreme temperatures, electrons are separated from nuclei and a gas becomes a plasma—often referred to as the fourth state of matter. Fusion plasmas provide the environment in which light elements can fuse and yield energy.
- In a tokamak device, powerful magnetic fields are used to confine and control the plasma.

What Is A Tokamak?

- 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. Just like a conventional power plant, a fusion power plant will use this heat to produce steam and then electricity by way of turbines and generators.
- The heart of a tokamak is its doughnut-shaped vacuum chamber.
 - Inside, under the influence of extreme heat and pressure, gaseous hydrogen fuel becomes a plasma—the very environment in which hydrogen

atoms can be brought to fuse and yield energy.

- The charged particles of the plasma can be shaped and controlled by the massive magnetic coils placed around the vessel; physicists use this important property to confine the hot plasma away from the vessel walls.
- The term “tokamak” comes to us from a Russian acronym that stands for “toroidal chamber with magnetic coils.”
- First developed by Soviet research in the late 1960s, the tokamak has been adopted around the world as the most promising configuration of magnetic fusion devices.
- ITER will be the world’s largest tokamak—twice the size of the largest machine currently in operation, with ten times the plasma chamber volume.