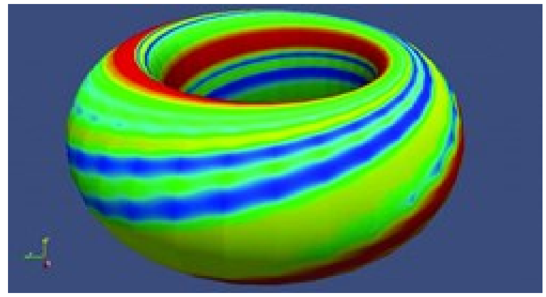
What will ITER do ?



The amount of fusion energy a tokamak is capable of producing correlates directly to the number of fusion reactions taking place in its core. Scientists know that the larger the vessel, the larger the volume of the plasma ... and therefore the greater the potential for fusion energy.

With ten times the plasma volume of the largest machine operating today, the ITER Tokamak will be a unique experimental tool, capable of longer plasmas and better confinement. The machine has been designed specifically to:

1) Produce 500 MW of fusion power for pulses of 400 s
The world record for fusion power is held by the European tokamak JET. In 1997, JET produced 16 MW of fusion power from a total input power of 24 MW (Q=0.67). ITER is designed to produce a ten-fold return on energy (**Q=10**), or 500 MW of fusion power from 50 MW of input power, for long pulses (400-600 s). ITER will not capture the energy it produces as electricity, but as the first of all fusion experiments in history to produce net energy ... it will prepare the way for the machine that can.

2) Demonstrate the integrated operation of technologies for a fusion power plant
ITER will bridge the gap between today's smaller-scale experimental fusion devices and the demonstration fusion power plants of the future. Scientists will be able to study plasmas under conditions similar to those expected in a future power plant and test technologies such as heating, control, diagnostics, cryogenics and remote maintenance in an integrated way.

3) Achieve a deuterium-tritium plasma in which the reaction is sustained through internal heating
Today, fusion research is at the threshold of exploring a *burning plasma*—one in which the heat from the fusion reaction is confined within the plasma efficiently enough for the reaction to be sustained for a long duration. Scientists are confident that the ITER plasmas will not only produce much more fusion power, but will remain stable for longer periods of time.

4) Test tritium breeding
One of the missions for the later stages of ITER operation is to demonstrate the feasibility of producing tritium within the vacuum vessel. The world supply of tritium (used with deuterium to fuel the fusion reaction) is not sufficient to cover the needs of future power plants. ITER will provide a unique opportunity to test mockup in-vessel **tritium breeding** blankets in a real fusion environment.

5) Demonstrate the safety characteristics of a fusion device

In 2012, when the ITER Organization obtained licensing as a nuclear operator in France, the ITER fusion device became the first in the world to have successfully undergone the rigorous examination of its safety case. One of the primary goals of ITER operation is to demonstrate control of the plasma and fusion reactions with negligible consequences to the environment.

The phases of ITER

$Q \geq 10$

ITER is designed to produce a ten times return on invested energy: 500 MW of fusion power from 50 MW of input power (Q=10). It will be the first of all fusion experiments in history to produce net energy.

The construction of the ITER scientific installation in St-Paul-lez-Durance, France, began in 2010 and is expected to last ten years. In parallel, manufacturing is underway in the ITER Members on the components of the ITER machine and shipments of completed components have been arriving since mid-2014.

Once access to the Tokamak Building is possible, the assembly and installation of the ITER machine will begin. The ITER assembly phase, which includes assembly of the main machine as well as the installation of all plant systems, will be followed by a commissioning phase to ensure all systems operate together. Commissioning will end with the achievement of First Plasma.

ITER's operational phase is expected to last for 20 years: first, a several-year "shakedown" period of operation in pure hydrogen is planned during which the machine will remain accessible for repairs and the most promising physics regimes will be tested. This phase will be followed by operation in deuterium with a small amount of tritium to test wall-shielding provisions. Finally, scientists will launch a third phase with increasingly frequent operation with an equal mixture of deuterium and tritium, at full fusion power.

3 RECOMMENDED ARTICLE(S)

The fellowship of fusion science

They are building the physics basis for ITER

"Code camp": sitting around the virtual plasma