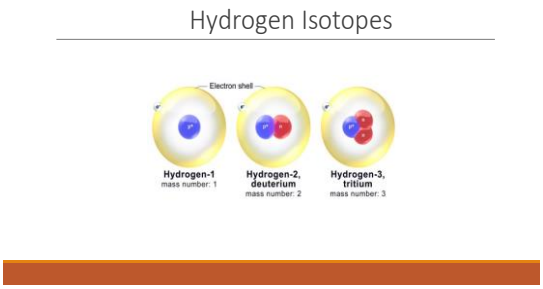
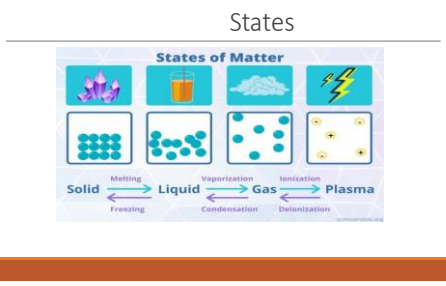
Nuclear Fusion Reactors

Nuclear Fusion Reactors have been much in the news during the last twelve months so we thought it was time we had a closer look.

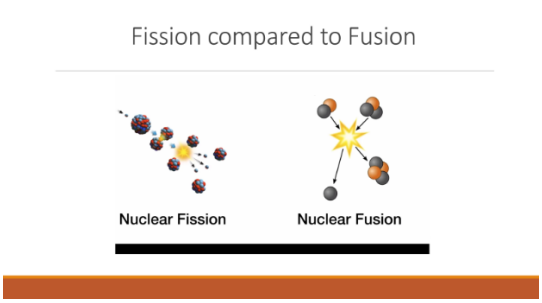
We did a quick review of atomic theory which was pretty well known by the 1930s due to the work of Rutherford, Neils Bohr, Chadwick and others. The conclusions were that the atom consisted of a positively charged nucleus comprising protons (positively charged, mass 1) and neutrons (no charge, mass 1) and electrons (negatively charged, mass negligable) which orbited the nucleus in one or more shells.

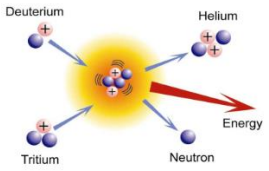
Nuclear fusion is mainly concerned about the light weight atoms of hydrogen and its isotopes below and also helium and lithium. Matter occurs in various states depending on the excitation (usually heat) of its atoms. Nuclear fusion occurs when gasses like hydrogen are heated to ionisation and plasma at temperatures of 100,000,000 degrees Celsius or more and with sufficient ion density in the plasma. A large amount of energy is released



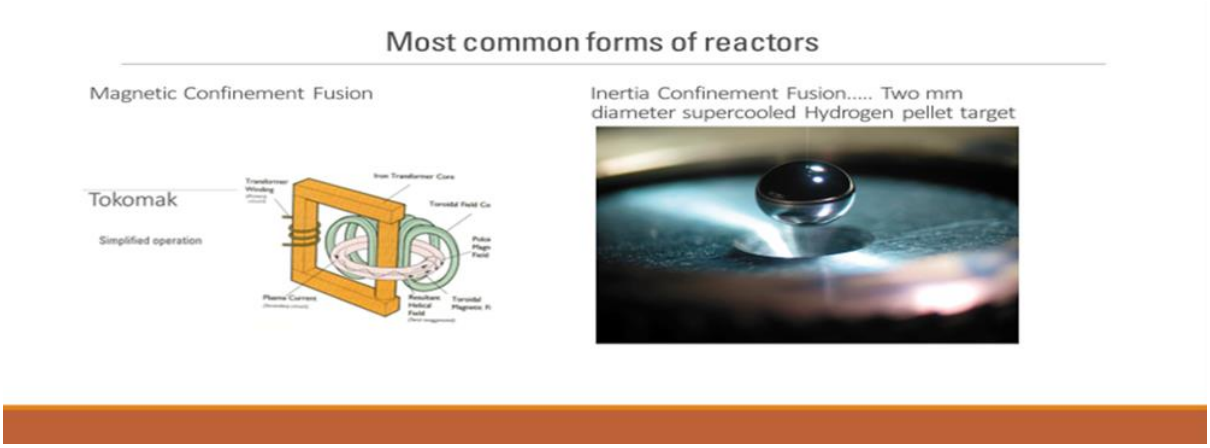


Nuclear fission occurs when heavy atoms like uranium (U235) are excited and split into several lighter atoms as well as neutrons. Both Fission and Fusion give off large amounts of energy in accordance with Einstein's formula **E=mC^2**. C^2 is a very large number so only a small change in mass is needed to produce a large amount of energy.



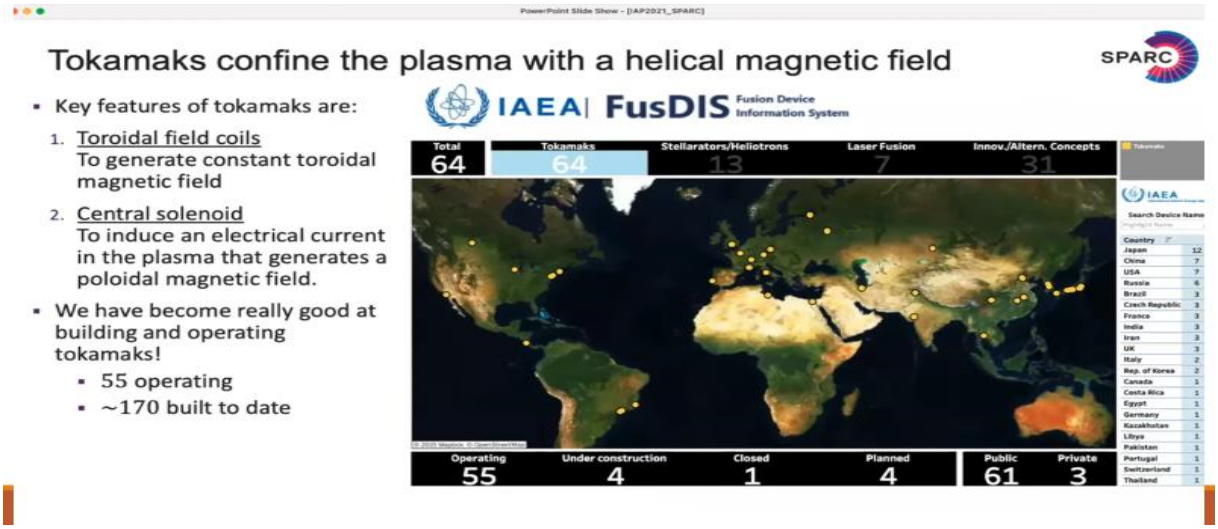


The most common form of fusion reactors is either Magnetic confinement Fusion or Inertia Confinement Fusion.



More recently Magneto Confinement Fusion has become popular with “start-ups” funded by entrepreneurs, who think they can achieve results faster and cheaper than governments. Helion is one such shown below, and the large 192 laser Inertia Reactor is also below.

Most work over the last 70 years has been done on the Tokomak style MCF reactors as shown in the diagram below.



In 1985 an agreement after much negotiation about nuclear disarmament was unsuccessful, Gorbachev and Reagan agreed to work together to try to successfully build an experimental Fusion reactor to benefit the world. ITER was born, originally with the US, Soviet Union, European Union and Japan.

Later China, India and Korea were included. Australia became a non-member inclusion in 2016.

The ITER reactor is 78% completed and is expected to produce plasma in 2025.

A great deal of activity is going on around the world to try to achieve a reactor able to efficiently supply electricity to the grid by the end of this decade.

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