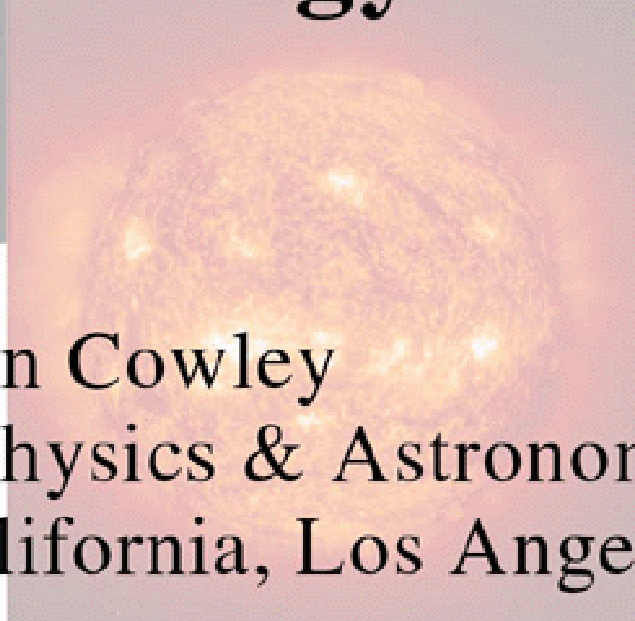
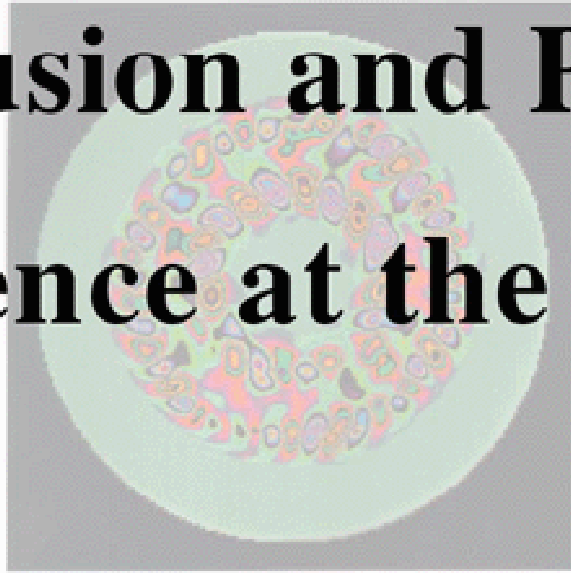


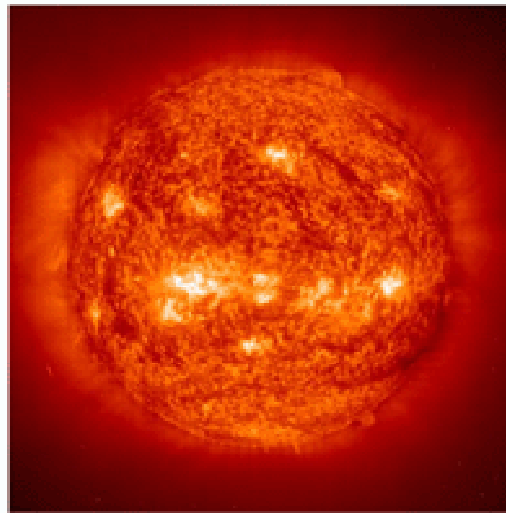
Fusion and Plasma Physics Science at the Energy Frontier



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What is fusion?

- Nature prefers medium sized nuclei/atoms
- Joining together of small nuclei/atoms release some usable energy - this is fusion
- Fusion keeps stars hot. Fusion in stars synthesizes all the elements.



- The easiest fusion reaction is between two forms of hydrogen.

DEUTERIUM (D) + TRITIUM (T) => HELIUM (He) + NEUTRON WITH ENERGY

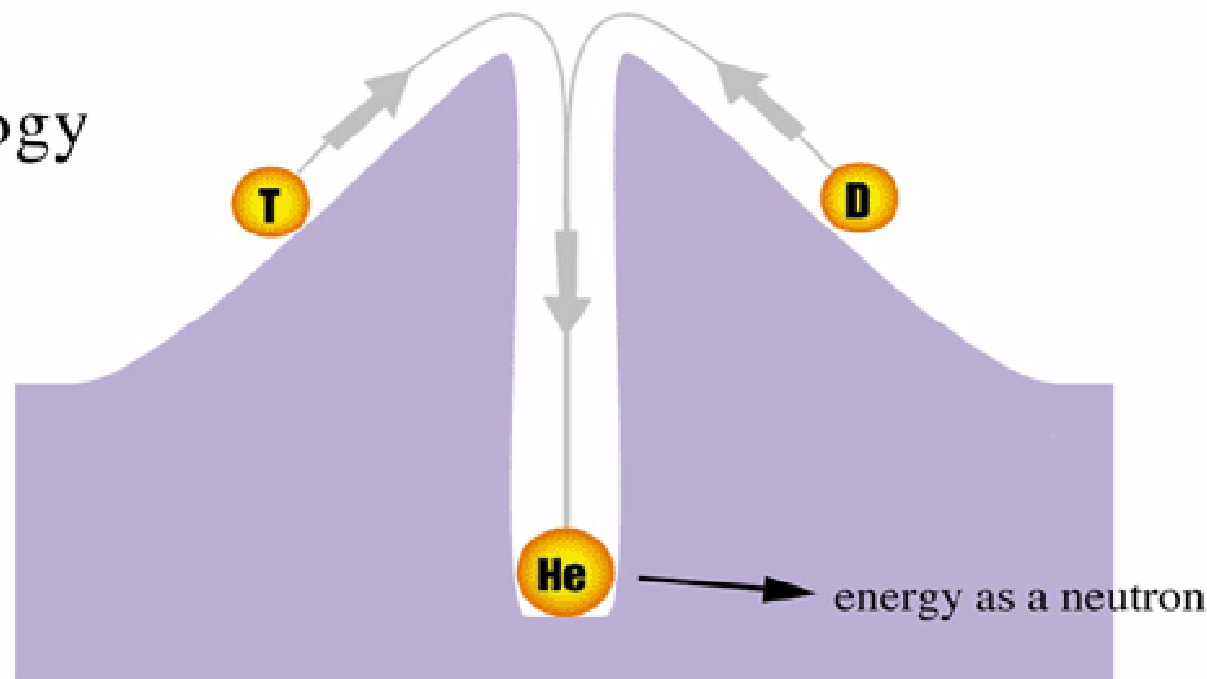
Why fusion?

- Plentiful fuel - thousands of years worth in sea water.
- Minimal production of radioactive waste.
- Minimal emission of carbon waste.
- Safe.

How do you make them stick?

- Because they are positively charged D and T nuclei repel until they are very close — then they attract strongly.

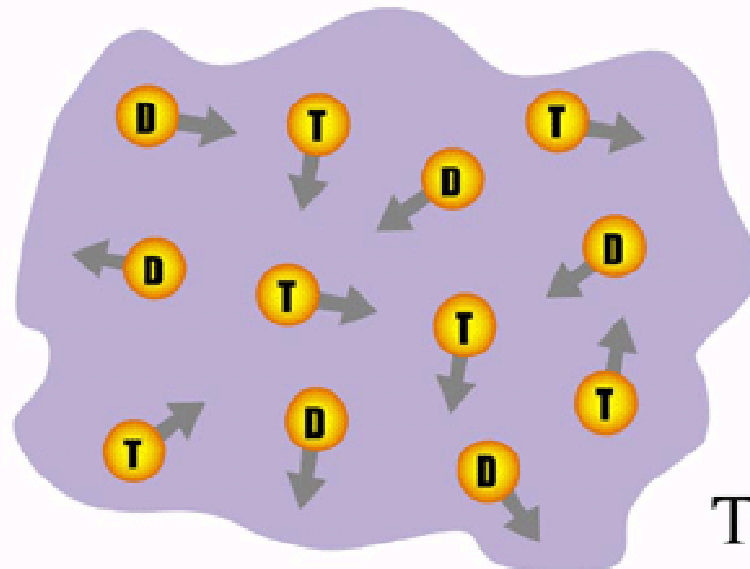
An analogy



- To get fusion we must ram D and T together fast enough to make them stick.

What is a Plasma?

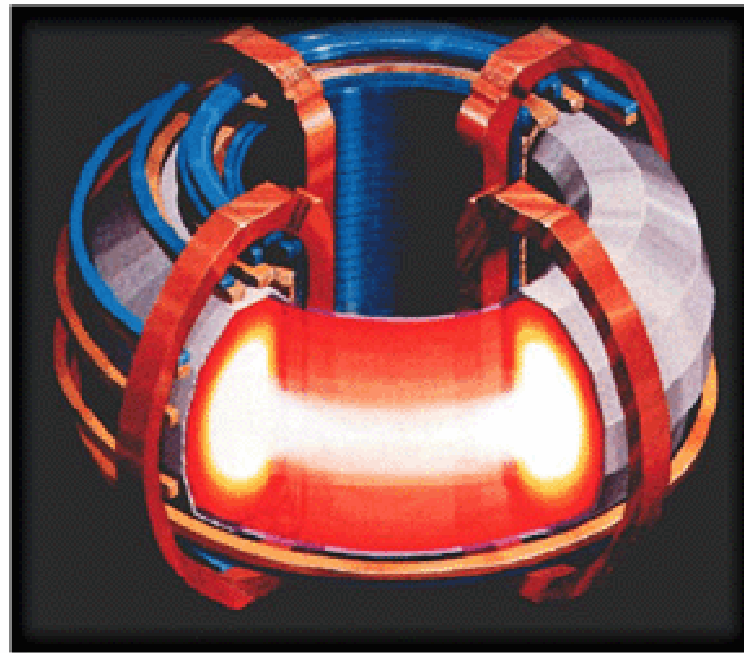
- Plasma is a very hot gas where the electrons are no longer attached to the nuclei.
 - Most of the matter in the universe is plasma
- Hot plasma has fast moving nuclei.
- At about 100 million degrees the nuclei collide hard enough to fuse – just like the sun.



This has been done.

Magnetic Confinement

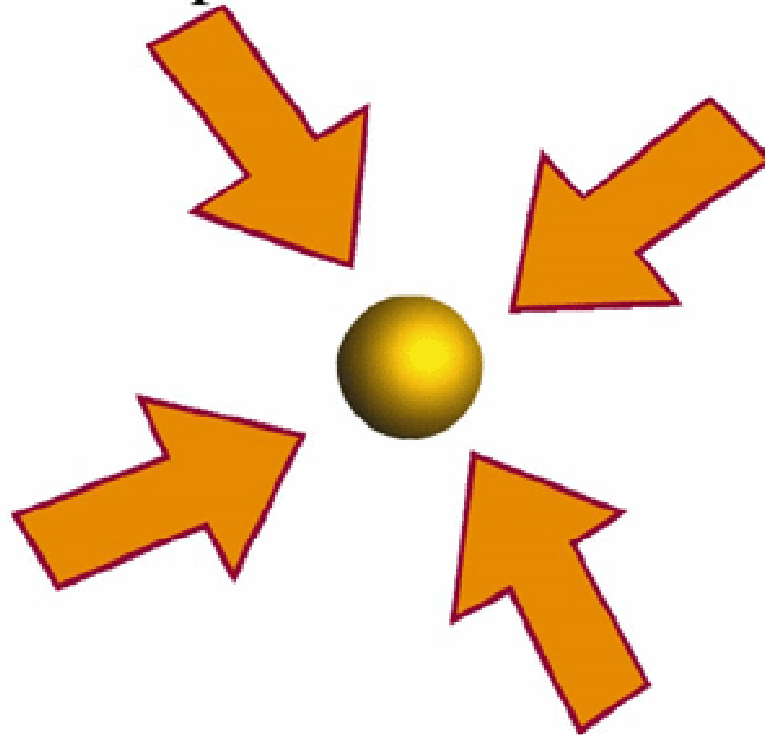
- One way to hold the hot plasma is with magnetic fields. The fields keep the plasma from touching the walls.



- A major challenge is to make a “magnetic bottle” which holds the plasma quiescently.

Inertial Confinement

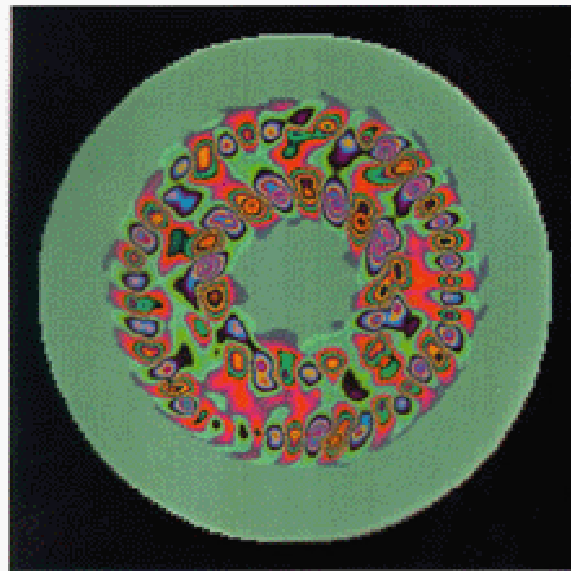
- Another way to “ignite” a plasma is to heat and compress a pellet of D and T so that it fuses before it blows apart.



- Particle beams or Lasers can be used to put the Energy in.
- A major challenge is to squeeze the pellet uniformly.

Science and Technology

- Making fusion practical requires advancing plasma and material science. It also requires technological innovation and development.
- There are some exquisite problems to solve.



- Plasma science is important to many areas of science and technology.