SAND2014-17518D

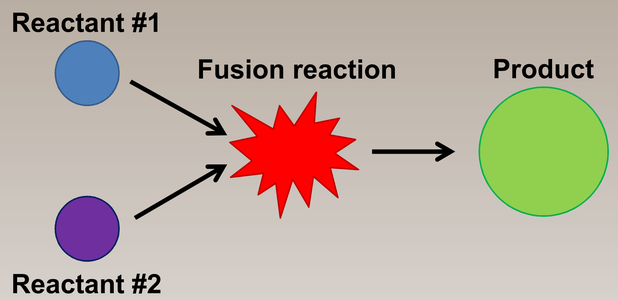
Exceptional service in the national interest

Sandia National Laboratories

Inertial Confinement Fusion Experiments on Z

What is nuclear fusion?

- **Nuclear fusion is the combination of two smaller atoms (reactants) into a larger atom (product)**

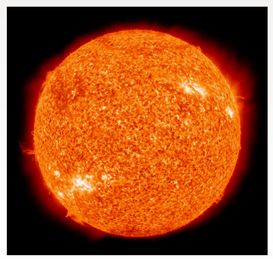


- **When the mass of the product is less than that of the reactants, energy is released**

$$E = mc^2$$

Energy Mass Speed of light

- **Fusion is what powers the sun and the stars**



What is inertial confinement and why do we need it?

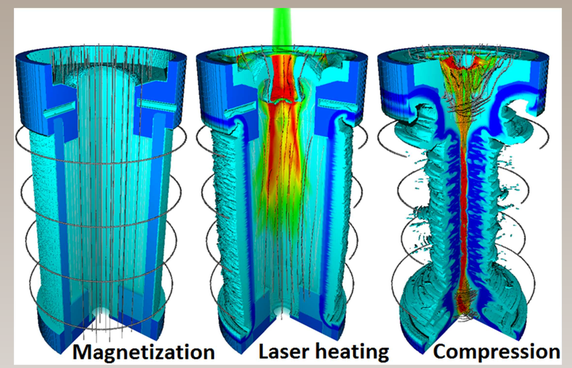
- **Nuclear fusion occurs at temperatures around 10 million degrees**

Metal melts at a few thousand degrees

- **No materials are capable of holding something that is millions of degrees**
- **However, if the reaction happens fast enough, there is no need to mechanically contain it… this is called inertial confinement**
- **All of the action is happening in about one billionth of a second**
- **These implosions happen at over 100,000 mph, but in a billionth of a second, they only move about half the thickness of a sheet of paper!**

What do we do at Z?

- **We start with a metal can about the size of a pencil eraser full of deuterium (heavy hydrogen)**



- **Next we apply a strong internal magnetic field to the can**
- **Then we use a high power laser to warm the deuterium**
- **Finally we use the Z machine current to crush the can**
- **These experiments produce long skinny plasmas columns that undergo about a trillion fusion reactions**