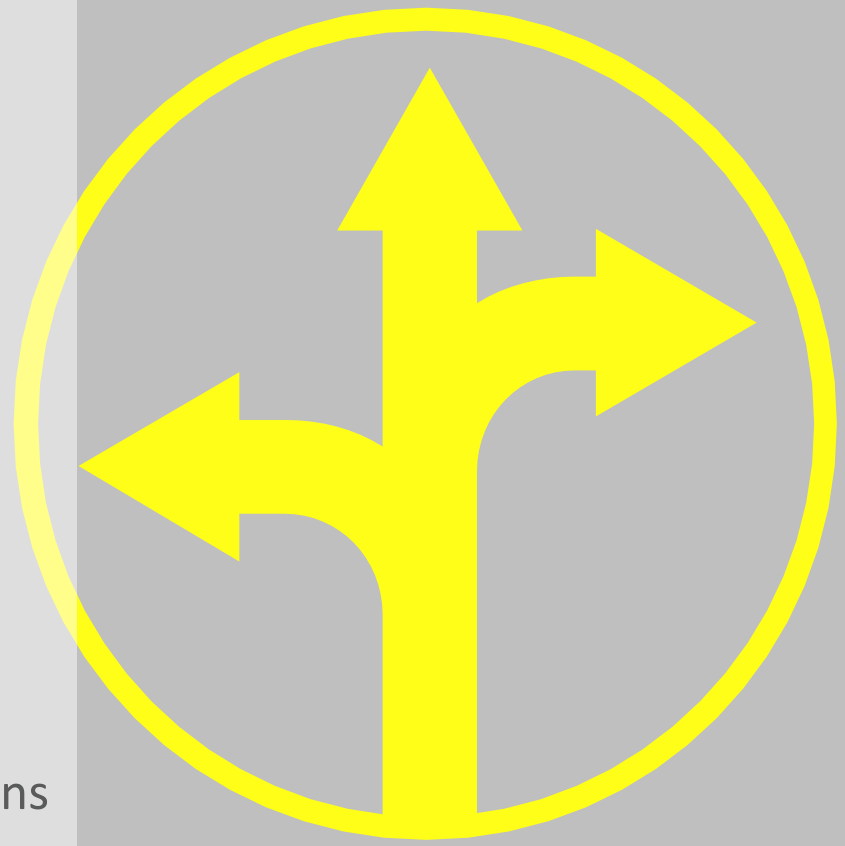
ALTERNATIVE CONCEPTS

Inertial confinement fusion: concept, description, direct vs. indirect drive

ICF facilities around the World

Non-mainstream concepts: Cold fusion and Bubble fusion

Thermonuclear weapons



INERTIAL CONFINEMENT FUSION

The plasma fuel is heated and compressed by a large number of energetic (~ MJ) **laser beams**.

Plasma density is very high: up to 100 times denser than lead.

Confinement time is very short: 10^{-10} seconds.

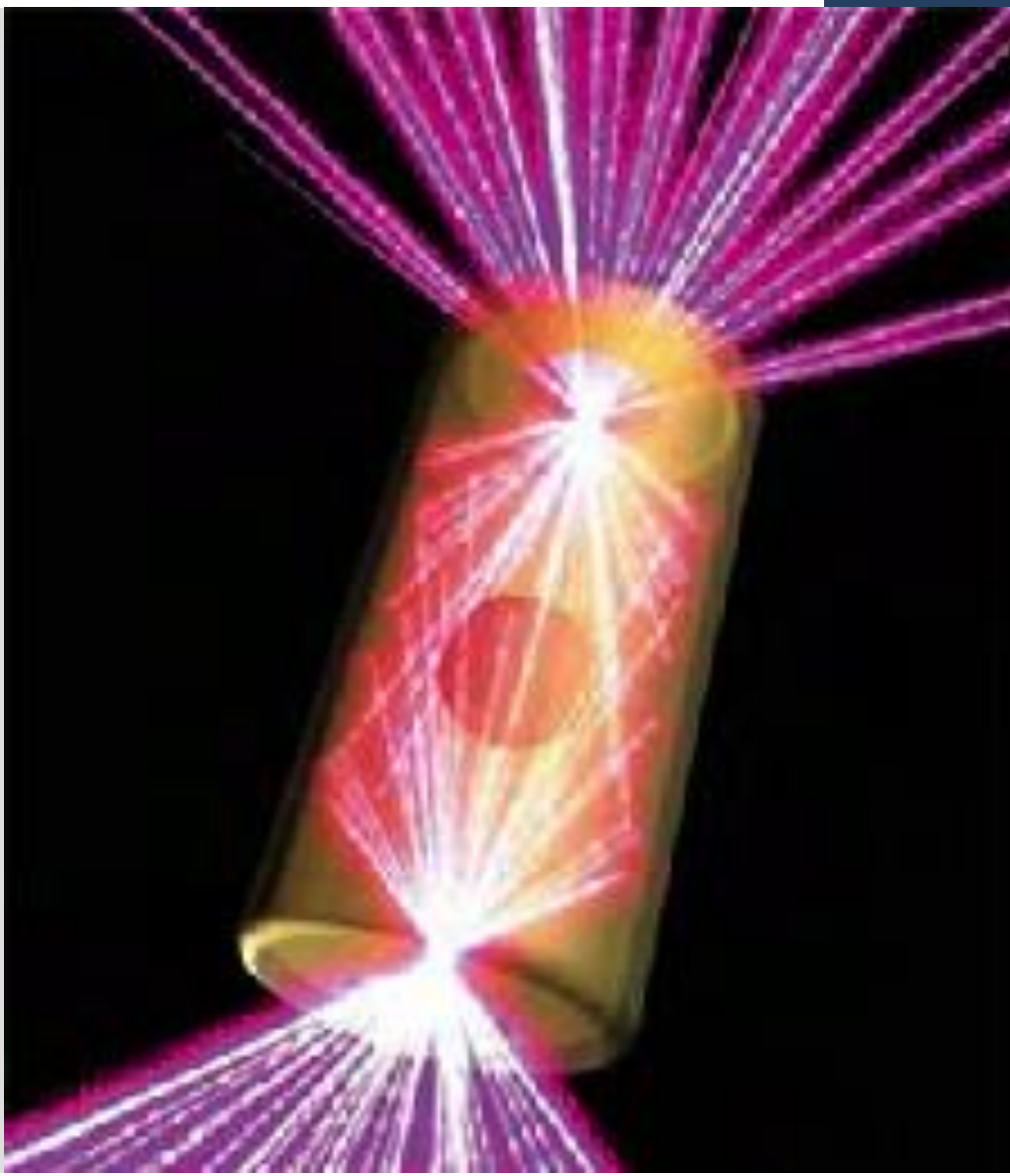


Image: Lawrence Livermore National Laboratory

A VERY LARGE NUMBER OF LASER BEAMS IS REQUIRED FOR INERTIAL CONFINEMENT

Because of symmetry conditions, the target must be illuminated uniformly.

The interaction takes place inside a large spherical vacuum chamber.

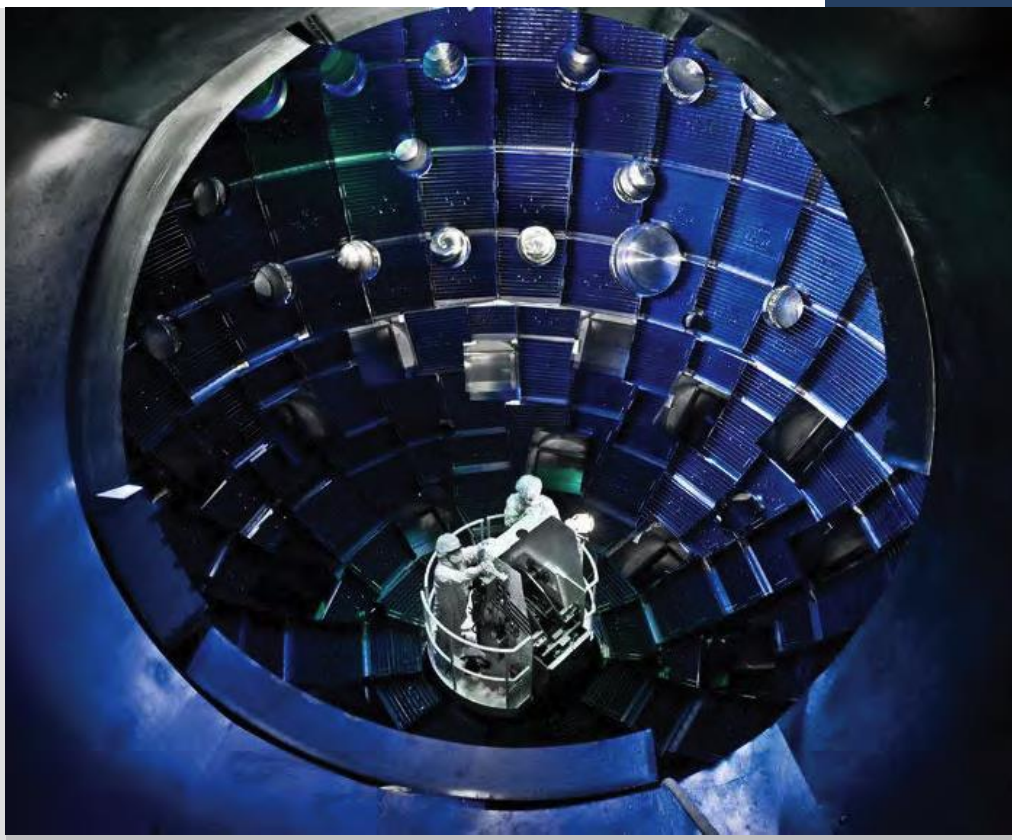


Image: Lawrence Livermore National Laboratory

INERTIAL CONFINEMENT FUSION

Energetic beams of lasers or particles are used to compress and heat a small mass of fusion fuel. The fuel undergoes nuclear fusion and burns.

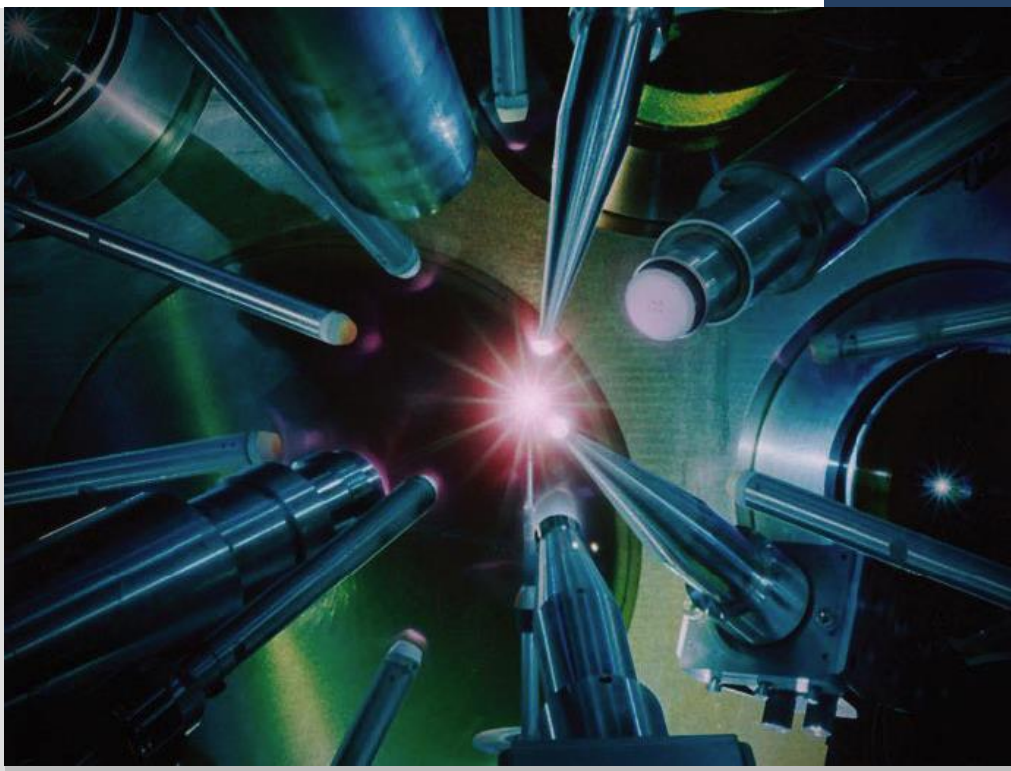
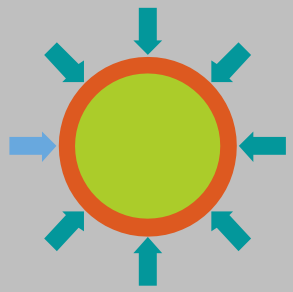


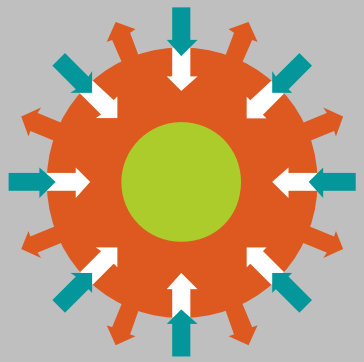
Image: Lawrence Livermore National Laboratory

INERTIAL CONFINEMENT FUSION IN FOUR STEPS:



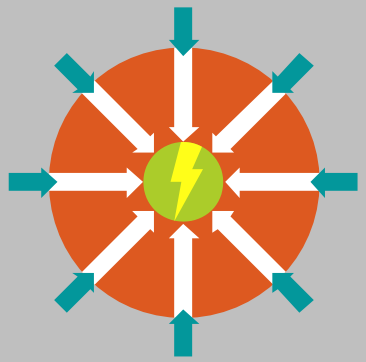
1

lasers shine on the target



2

the target is compressed



3

Ignition happens

4

the target burns

THERE ARE TWO APPROACHES FOR ICF

Direct drive
Laser light is shot directly at a tiny spherical capsule filled with frozen deuterium and tritium

Indirect drive
The capsule is placed inside a golden cylinder (*hohlraum*) and irradiated by x-rays

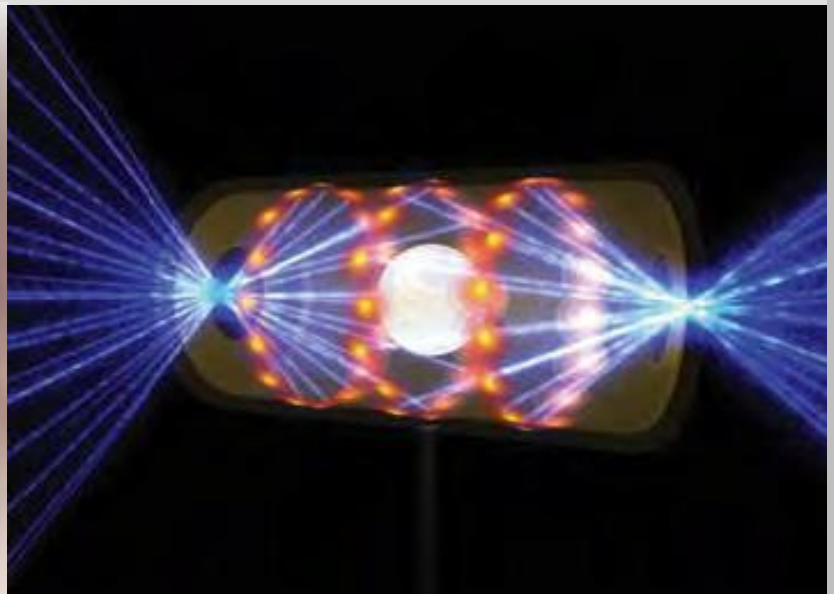
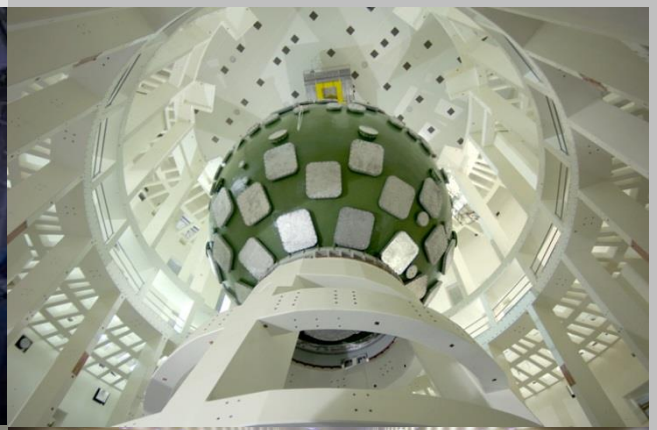


Image: Lawrence Livermore National Laboratory

ICF FACILITIES AROUND THE WORLD

OMEGA EP

Laser Megajoule



GEKKO XII

NIF

Images (left-right-top-down):
OMEGA EP University of Rochester – Laboratory for Laser Energetics, USA
LASER Megajoule
Image CEA, France
GEKKO XII, Osaka University, Japan
NIF: (NIF/Lawrence Livermore National Laboratory), USA

NON-MAINSTREAM CONCEPTS

Cold fusion

- alleged to happen at room temperature
- early (1989) »successful« experiments not replicated consistently
- no theoretical or practical model

Bubble fusion (or sonofusion)

- alleged to happen inside collapsing gas bubbles created by ultrasounds
- first announced in 2002
- subsequent tests were controversial, even with accusations of forged data