

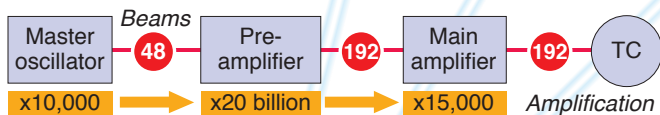
# A star is born – first steps to fusion power

As energy demand surges, U.S. scientists hope that a giant array of lasers will allow them to harness the process that powers the sun in controlled and sustainable miniature nuclear fusion explosions.

Inertial Confinement Fusion uses multiple lasers to rapidly compress and ignite readily available isotopes of hydrogen without producing hazardous radioactive waste

**TARGET CHAMBER (TC):** 10m diameter vacuum chamber, 10cm thick aluminium walls encased in 30cm thick concrete. Boron in casing absorbs X-rays and neutrons

**LASERS:** Low energy pulse from oscillator travels over 100m, its energy amplified billions of times and split into 192 intense laser beams



## THERMAL CONTROL PACKAGE:

Holds target which must be kept at temperature between -253°C and -255°C

Litho-etched cooling arms for precise conduction of heat away from target

Heaters maintain spherical **isotherm** – area of equal temperature – in core

**HOHLRAUM:** Heavy metal, e.g. gold or uranium cylinder

Gold absorbs UV energy, radiates **x-rays**

Lasers optically converted to **ultra-violet light**

192 beams provide even coverage of target

**FUEL CAPSULE TARGET:** Hollow plastic, carbon or beryllium sphere containing 150 micrograms of fuel

**Core:** Frozen tritium and deuterium fuel on inside wall

**1** Lasers fire 1.8 million joule burst – sufficient to light five trillion 100-watt lightbulbs – for 20 billionths of a second into Hohlraum

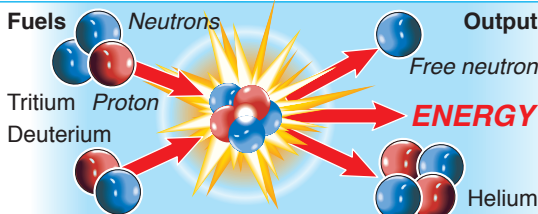
**2** X-rays bathe and rapidly heat surface of fuel capsule

**3** Surface expands, compressing core to **100bn atmospheres**

**4** Fuel core density exceeds **1000g/cm<sup>3</sup>**, 100 times that of lead

**5** Thermonuclear ignition of fuel at **100 million°C** – hotter than centre of sun

Energy released by fusion of tritium and deuterium atoms. Mini “star” lasts just fraction of a second but should emit 10-100 times energy used to ignite it. Only by-product is harmless helium



**Inexhaustible fuels:** Glass of water contains same energy as 40kg of coal. Fusion could provide clean solution to world's growing energy demand

