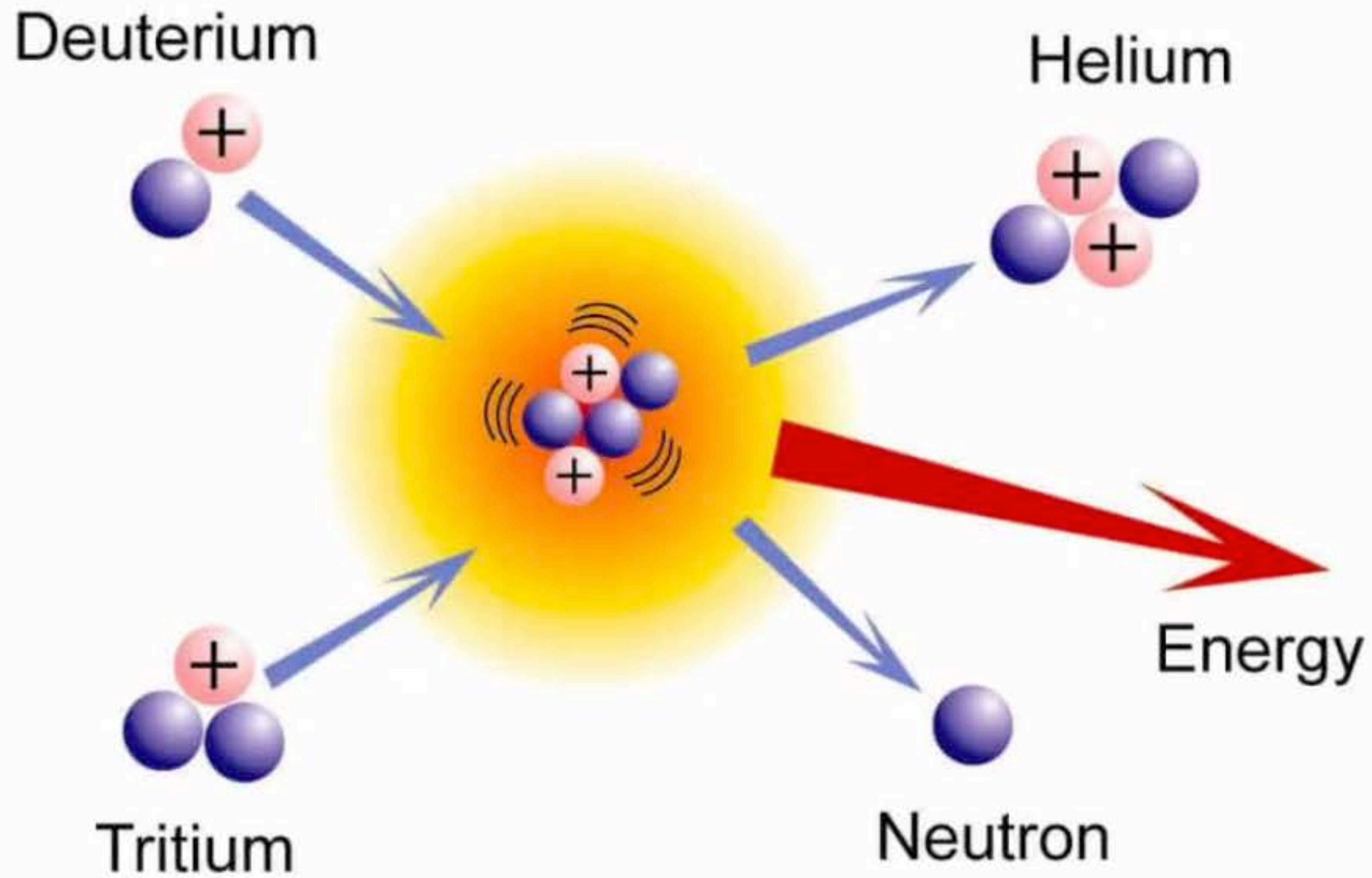


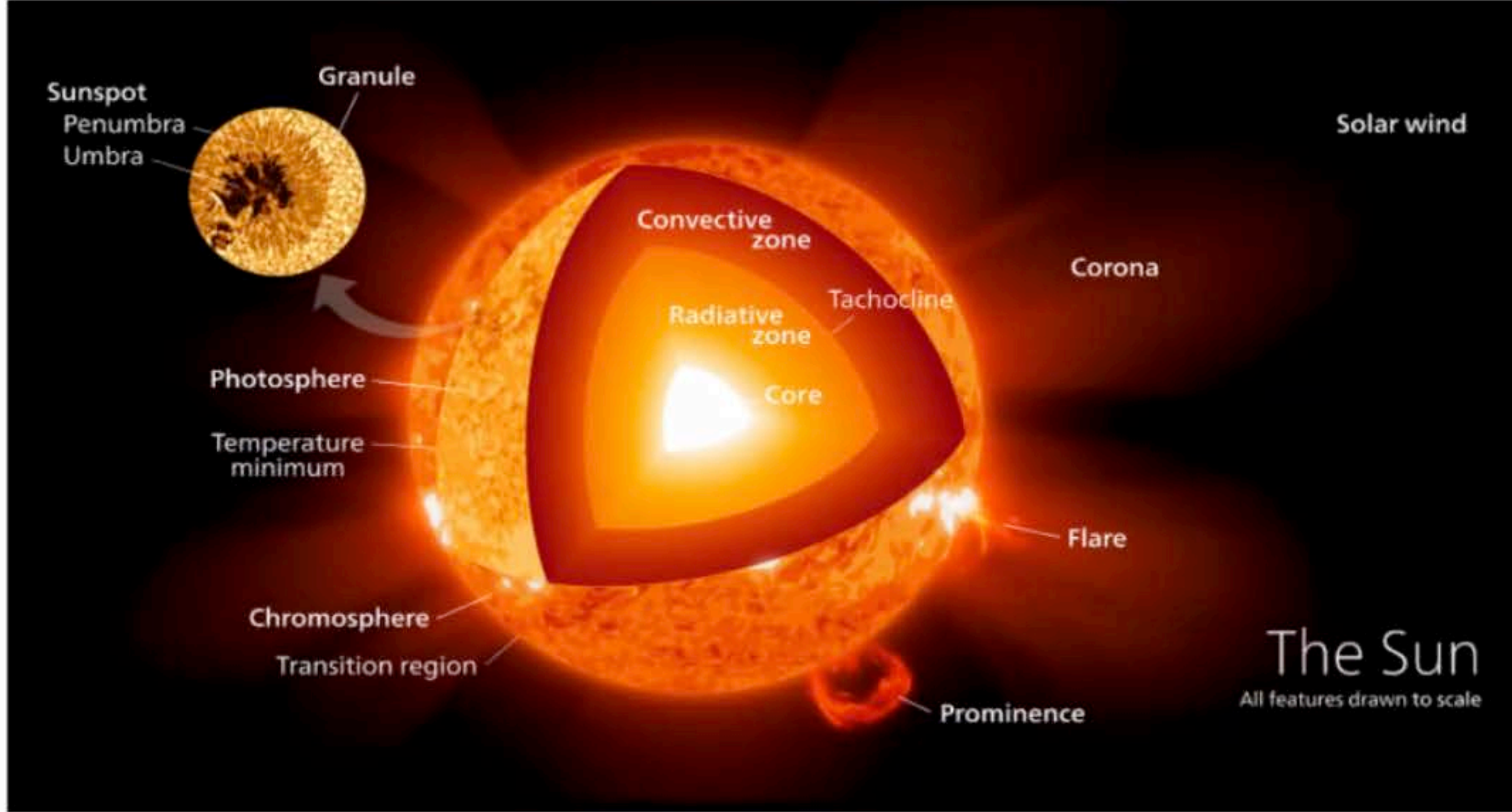


What is Fusion?





Literally, Solar Power

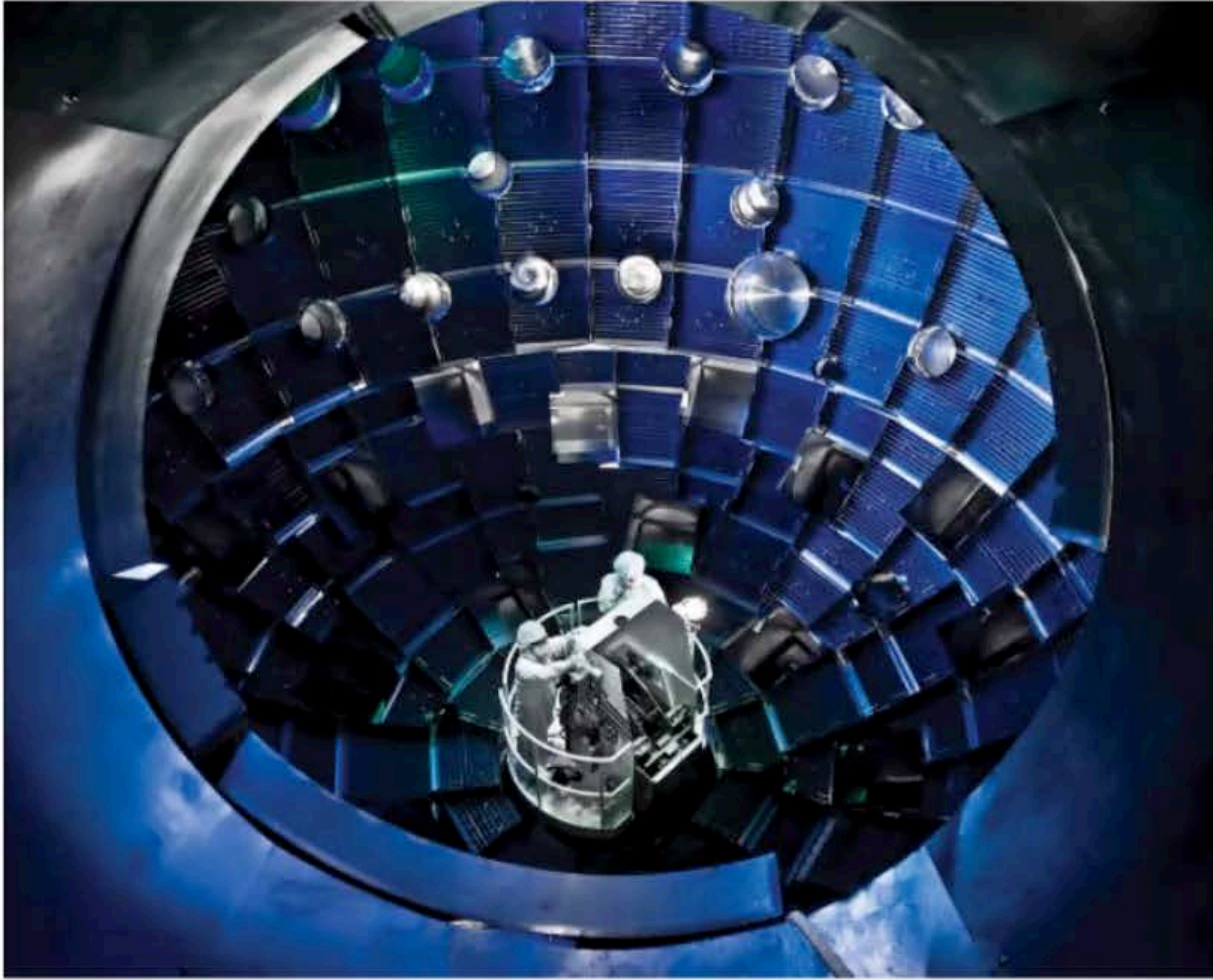
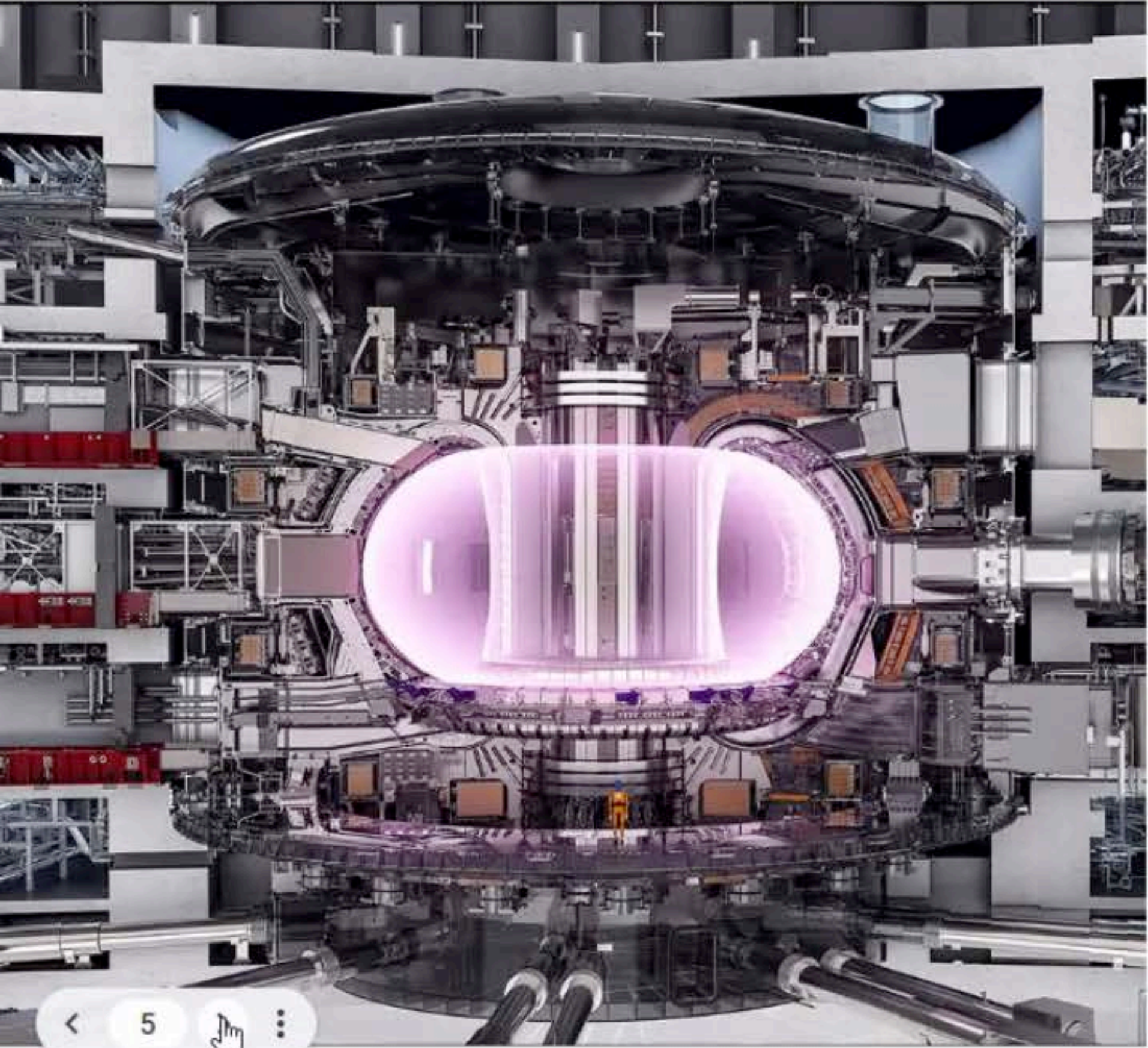




**Unfortunately,
it's hard to recreate
the core of the Sun...**



Magnets vs. Lasers





“Nuclear fusion is always twenty years away”

Nuclear fusion
Topic



+ Compare

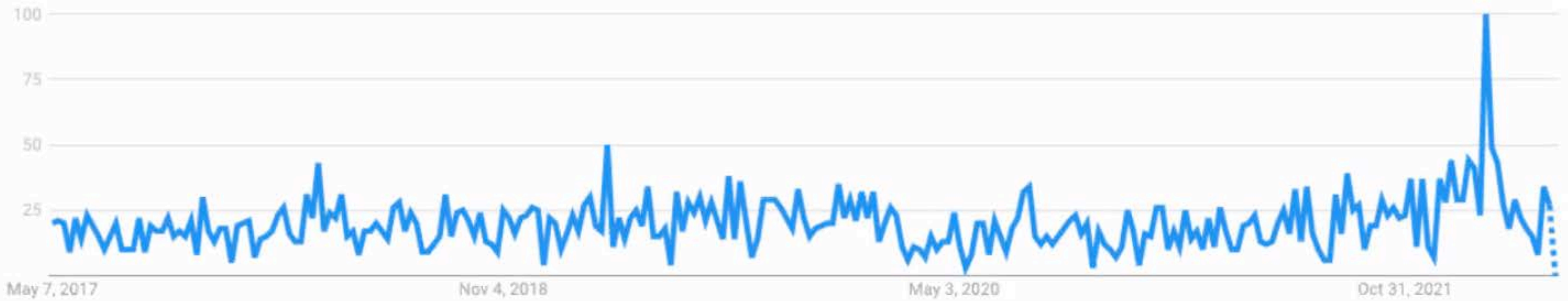
Worldwide ▾

Past 5 years ▾

All categories ▾

News Search ▾

Interest over time ?





How soon?

“[in order to reach zero net emissions by 2050], we need to be building plants, multiple, in the 2040s. And the first of a kind has to be built in the 2030s. Which means the physics problem has to be solved in the 2020s.”

– Nick Hawker, First Light Fusion



1 Megajoule

The amount of caloric energy in a candy bar

The amount of explosive energy in a hand grenade

Typical unit for expressing the output of fusion reactions

A watt is a joule per second, so a megawatt is a megajoule per second.



59 Megajoules

Current record for fusion output

“Researchers at the Joint European Torus (JET), a fusion experiment in Oxfordshire, generated 59 megajoules of heat – equivalent to about 14kg of TNT – during a five-second burst of fusion, more than doubling the previous record of 21.7 megajoules set in 1997 by the same facility.”

— The Guardian, February 2022



International Efforts

- International Thermonuclear Experimental Reactor (ITER) - France
 - Tokamak
 - Seeks to generate 500 MW of energy using 50 MW of energy

- National Ignition Facility (NIF) - Livermore California
 - Inertial Confinement

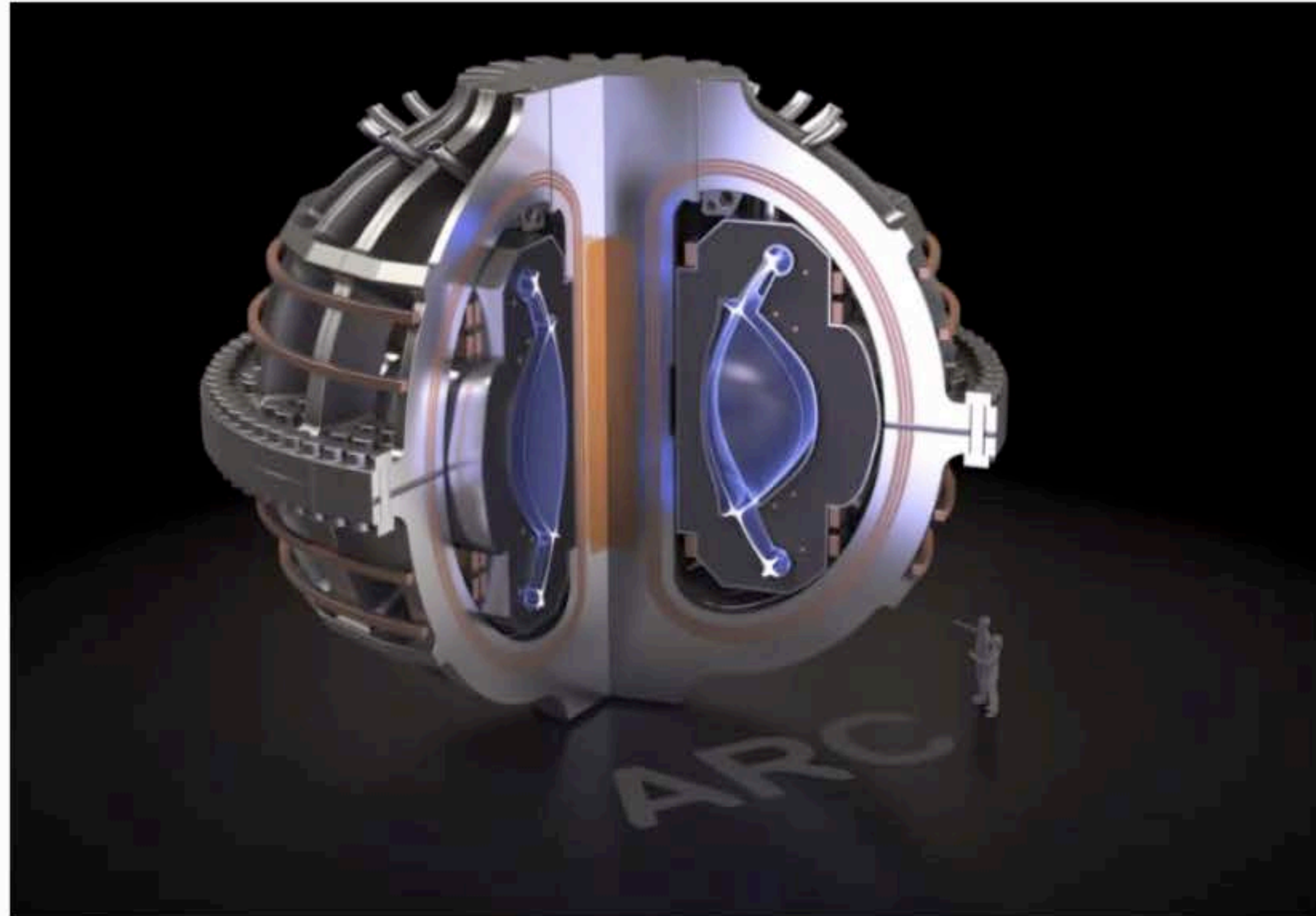


Private Players

- **Commonwealth Fusion**, US, \$2 billion
 - Smaller, more efficient tokamak using better magnets
- **Helion Energy**, US, \$577.8 million
 - Innovative plasma accelerator
- **General Fusion**, CAN, \$322.1 million
 - “Magnetized Target Fusion” (liquid metal, steam pistons)
- **First Light Fusion**, UK, \$107 million
 - “Projectile Fusion”
- **TAE Technologies**, USA
 - Innovative plasma accelerator, using boron
- **ZAP Energy**, USA
 - Sheared flow, no magnets required
- **Tokamak Energy**, UK
 - Spherical tokamak design with “high-temperature” magnets

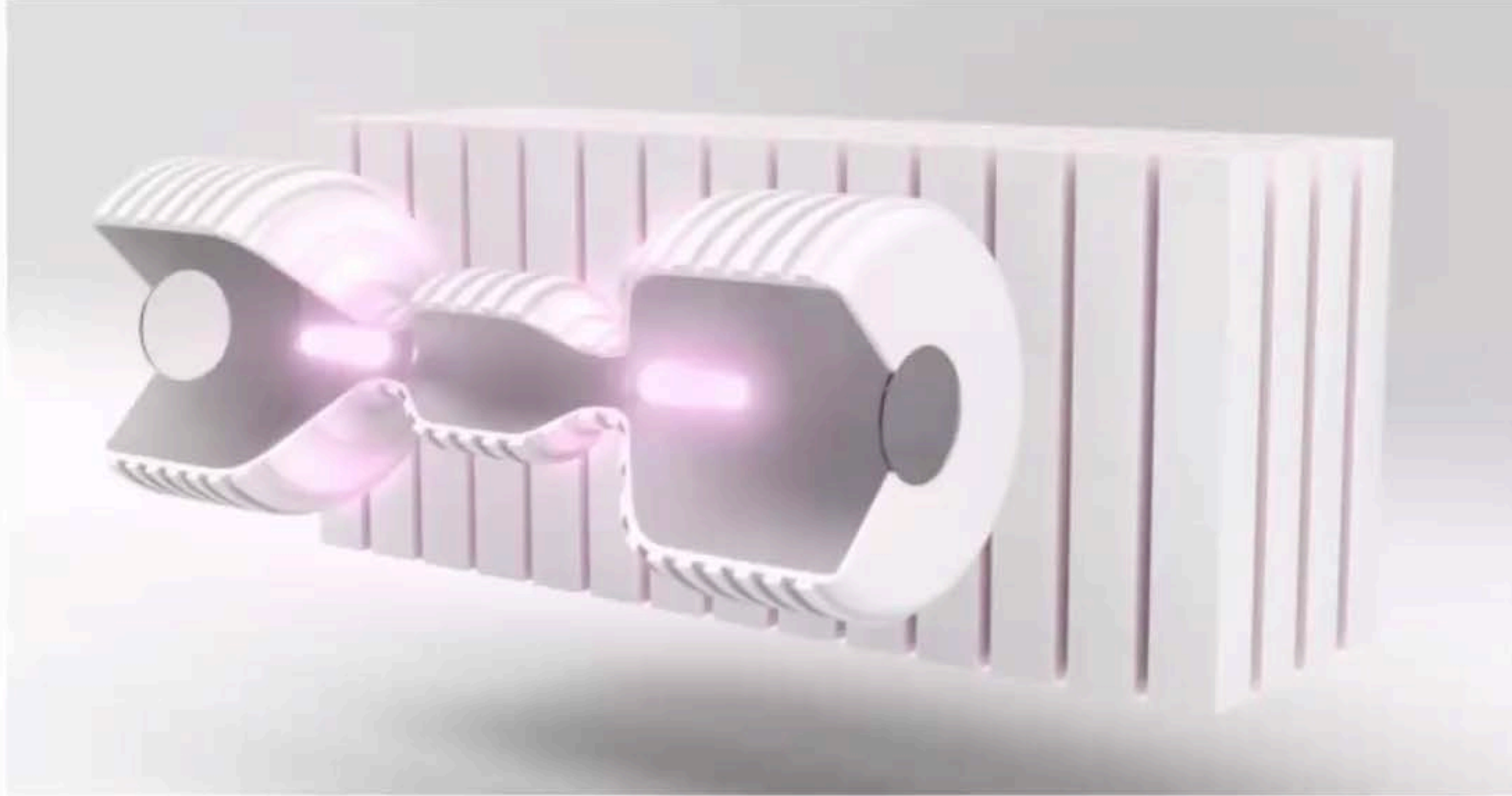


Commonwealth Fusion



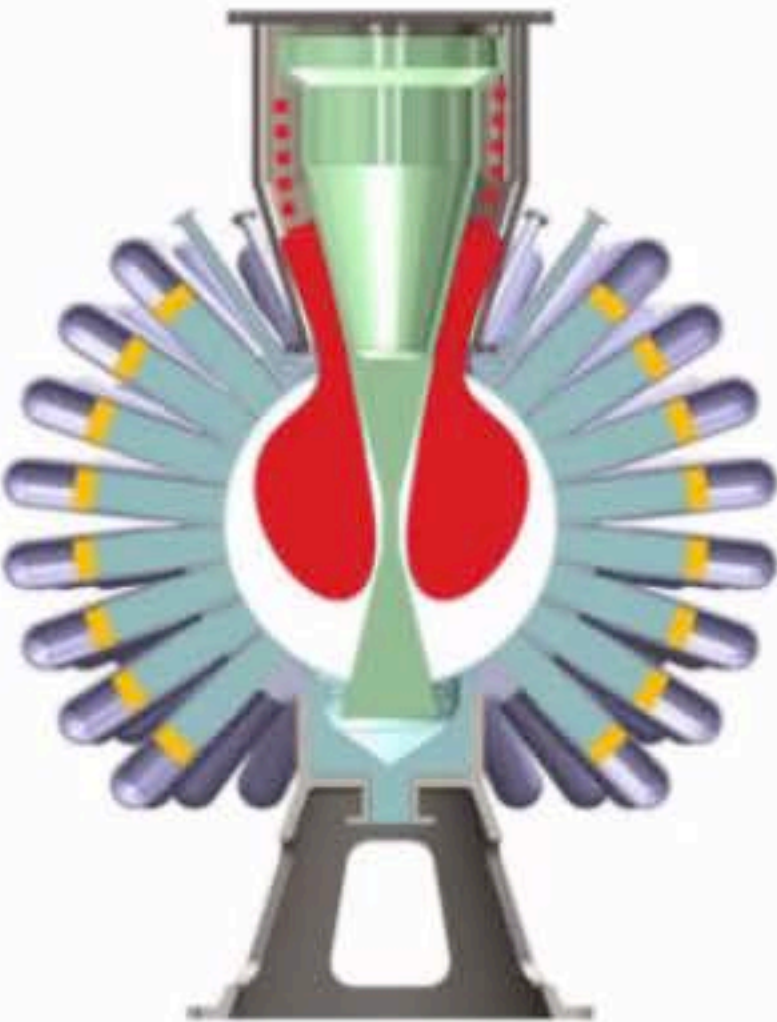


Helion Energy

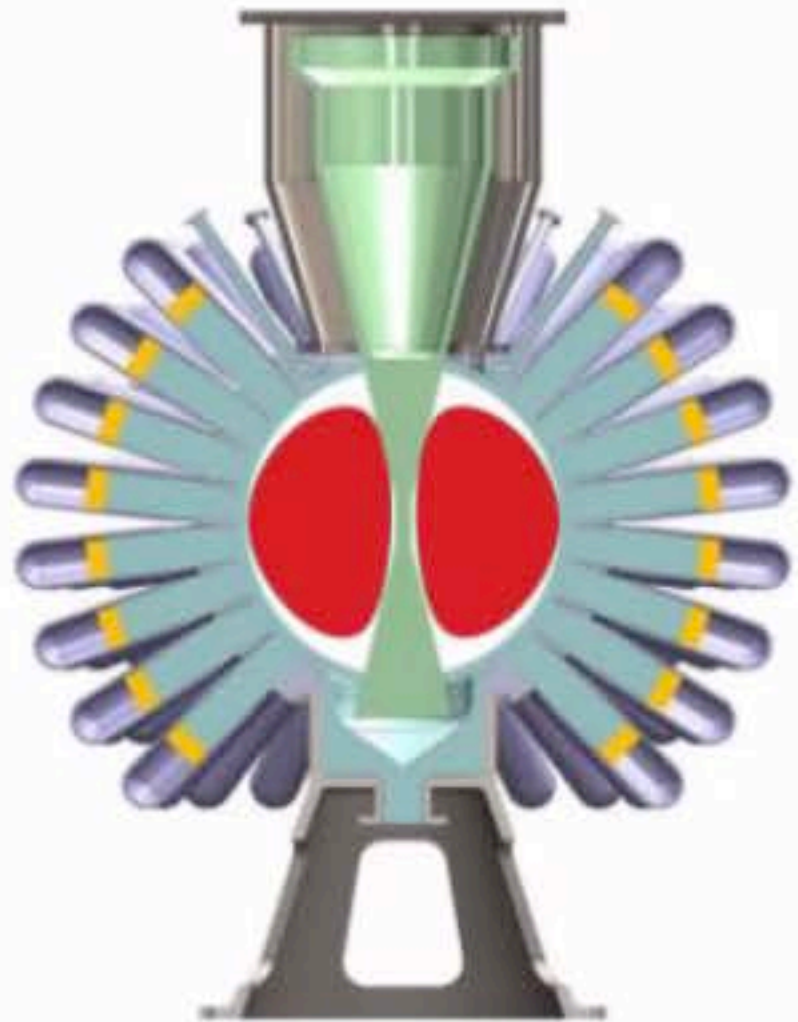




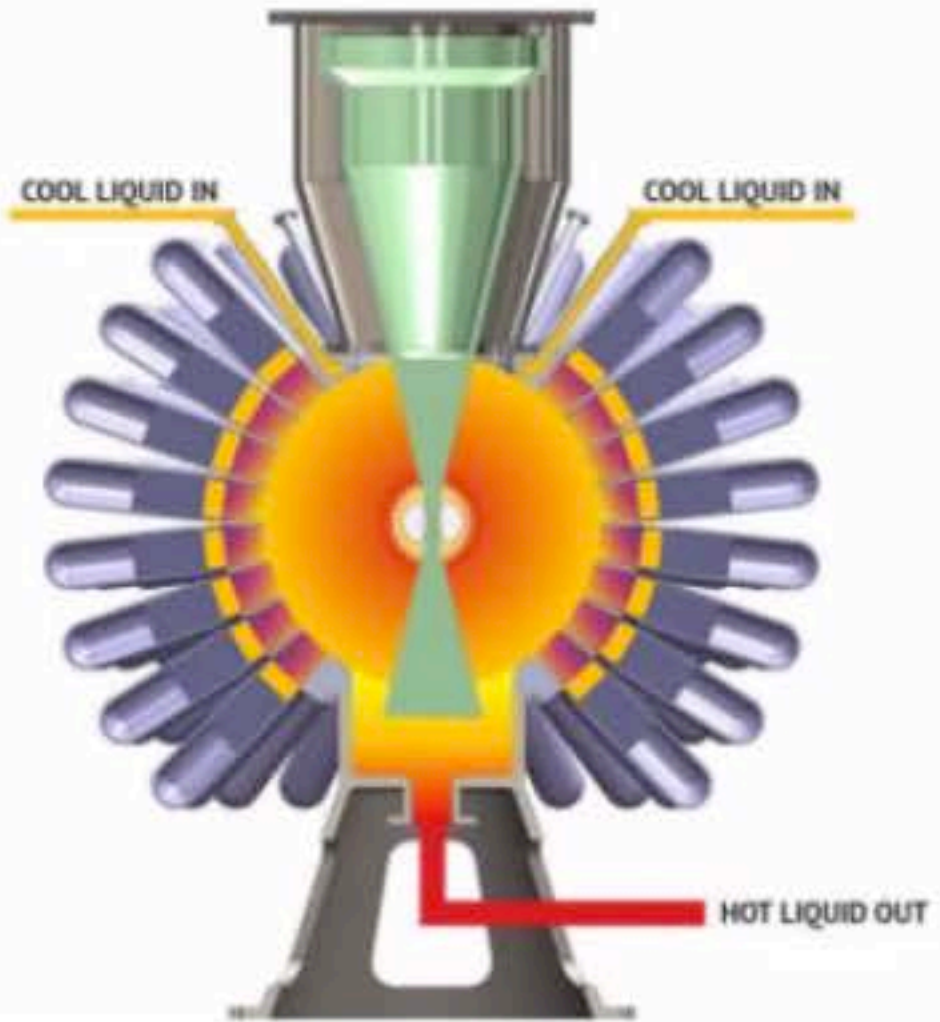
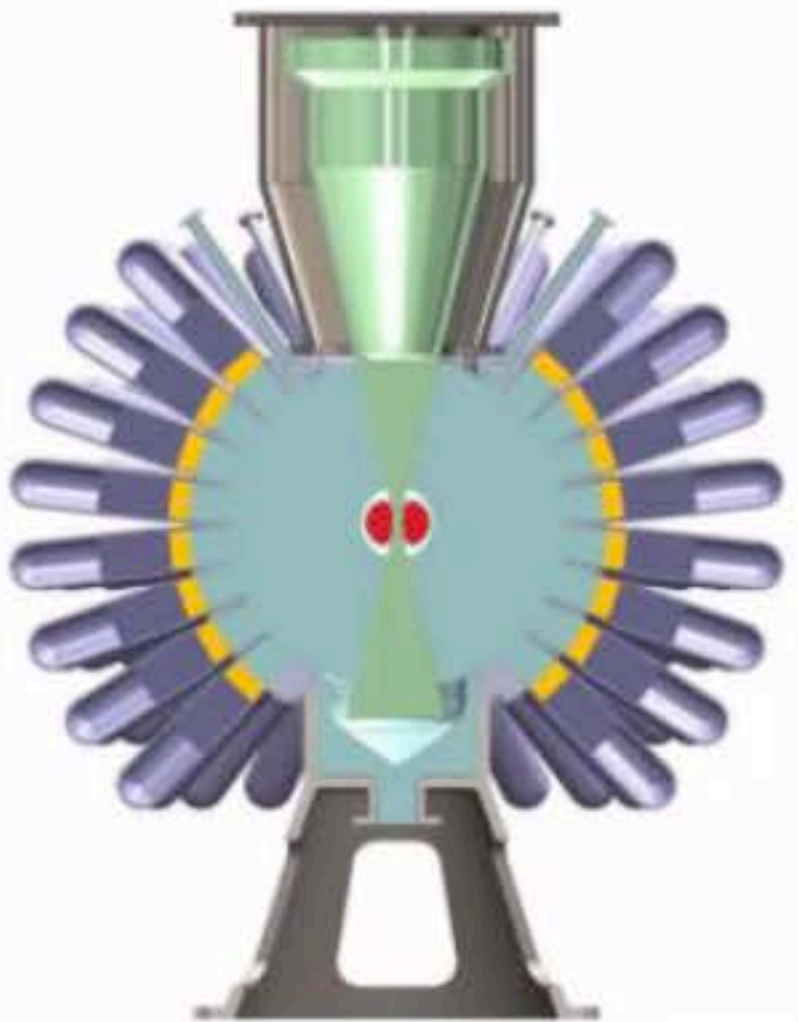
General Fusion



1. Inject Plasma Fuel



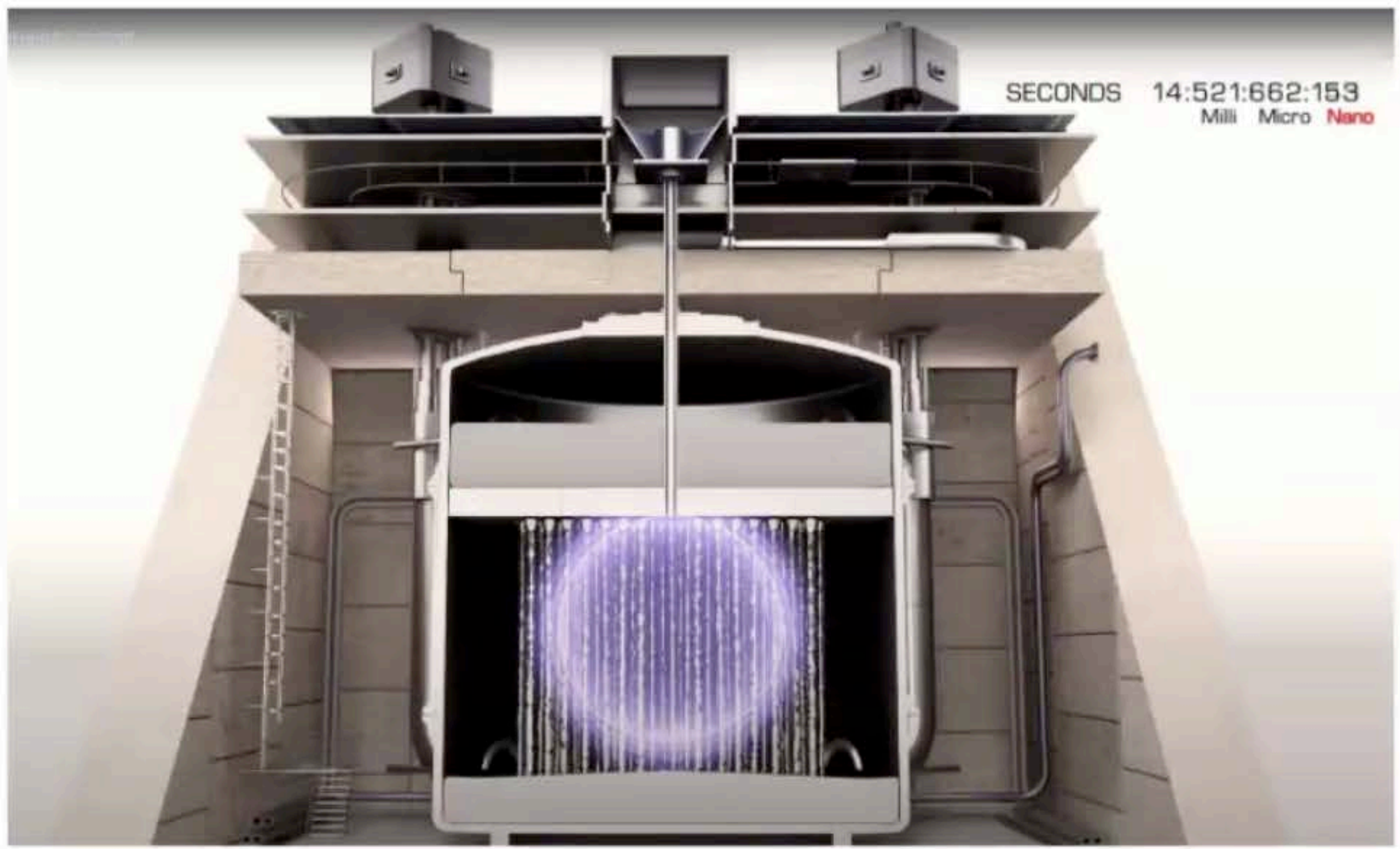
2. Compress Plasma Fuel



3. Extract Energy

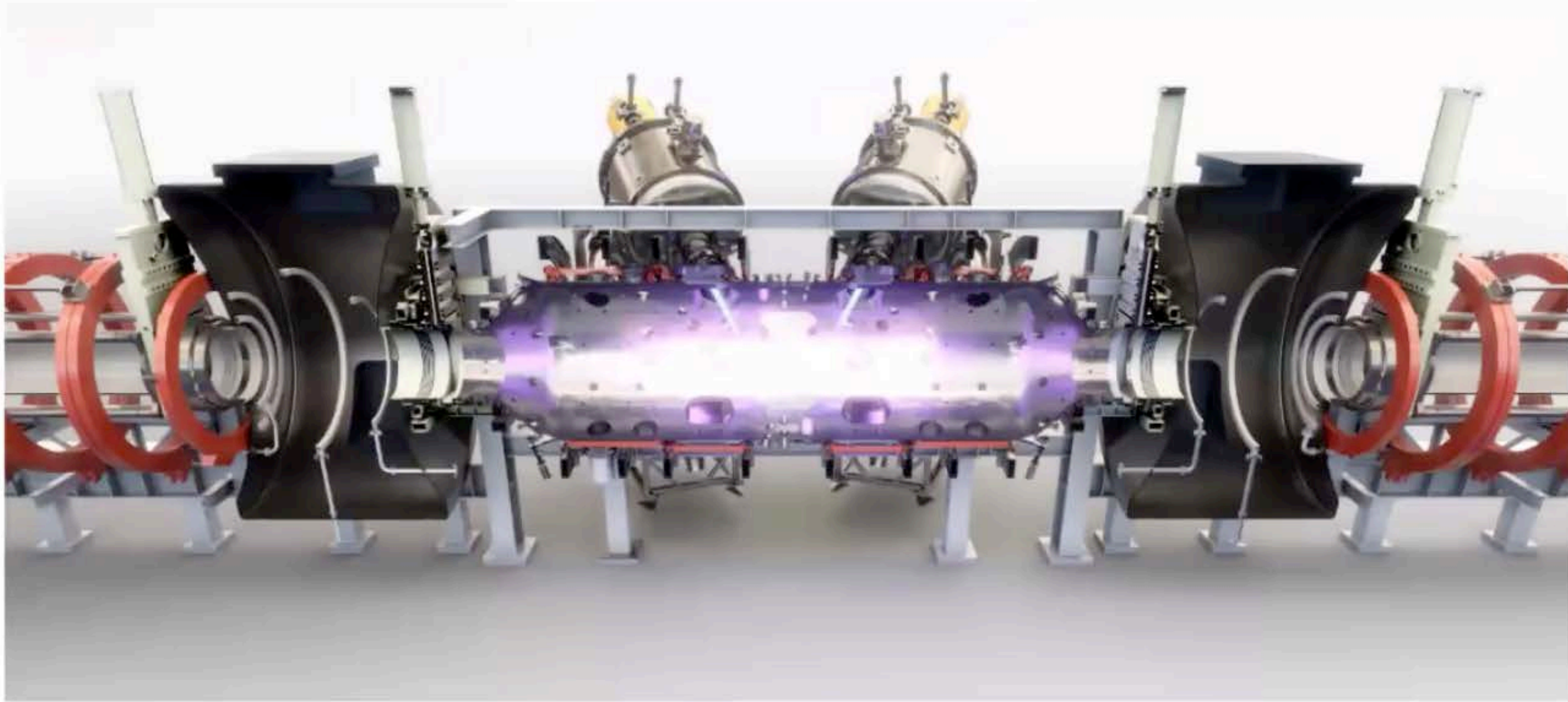


First Light Fusion



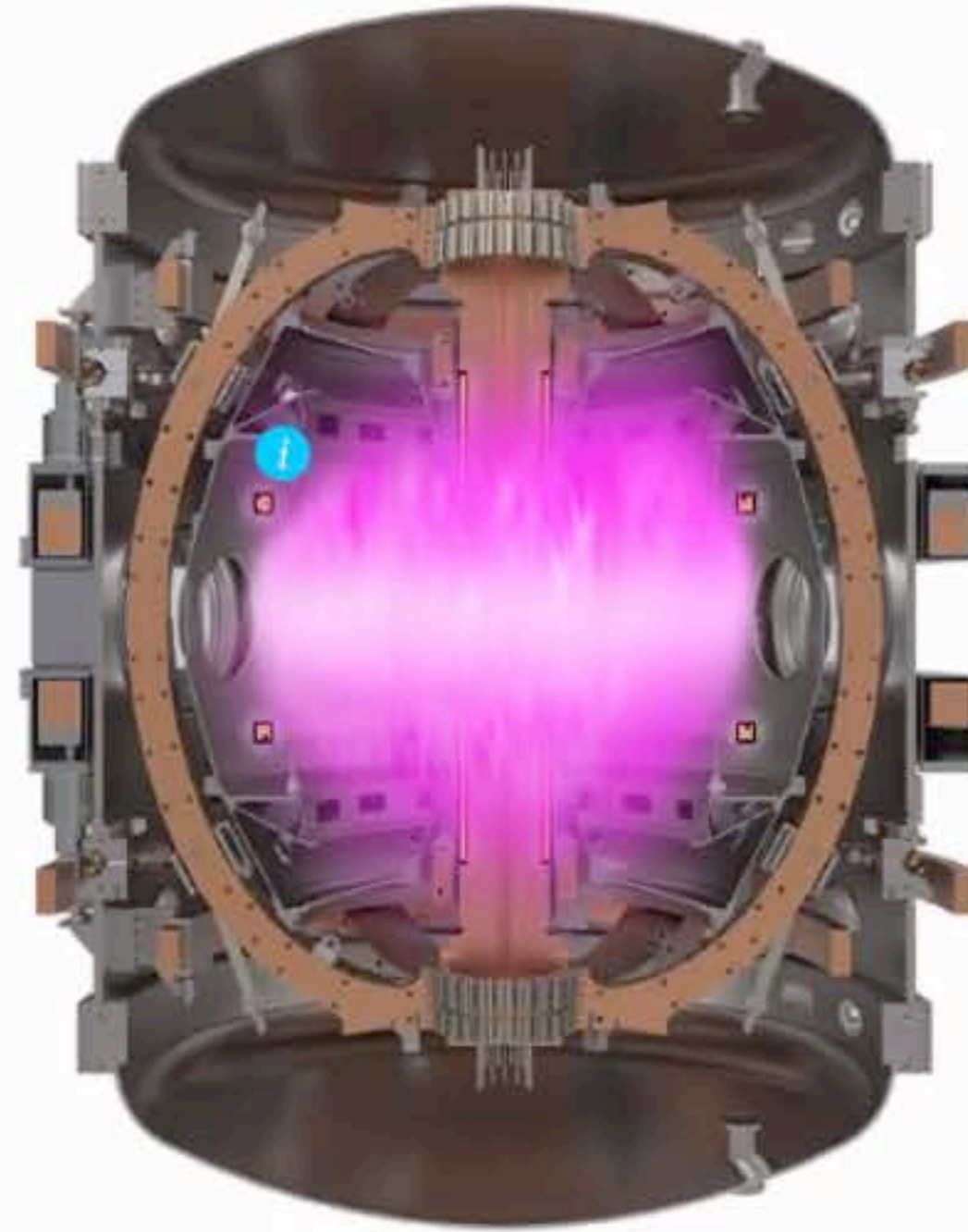


TAE Technologies





Tokamak Energy





Safety

The reaction produces inert helium gas

Radioactivity is low level and short-lived

Reaction is not a chain reaction (no explosions)

Biggest issue is neutron damage to surrounding elements





Milestones to watch for

Burning Plasma

the heat generated by the fusion reaction itself is the primary heat source for the creation/maintenance of plasma state

Breakeven ($Q = 1$)

Net Energy Output ($Q > 1$)

the reaction produces more energy than it takes to maintain it

$Q \geq 10$

The reaction produces 10x or more energy than it takes to maintain it



