

Welcome!

The program will begin soon.
You will not hear audio until we begin.



Fusion Energy and the Growing Fusion Industry

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&
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What is fusion energy?



What is fusion?



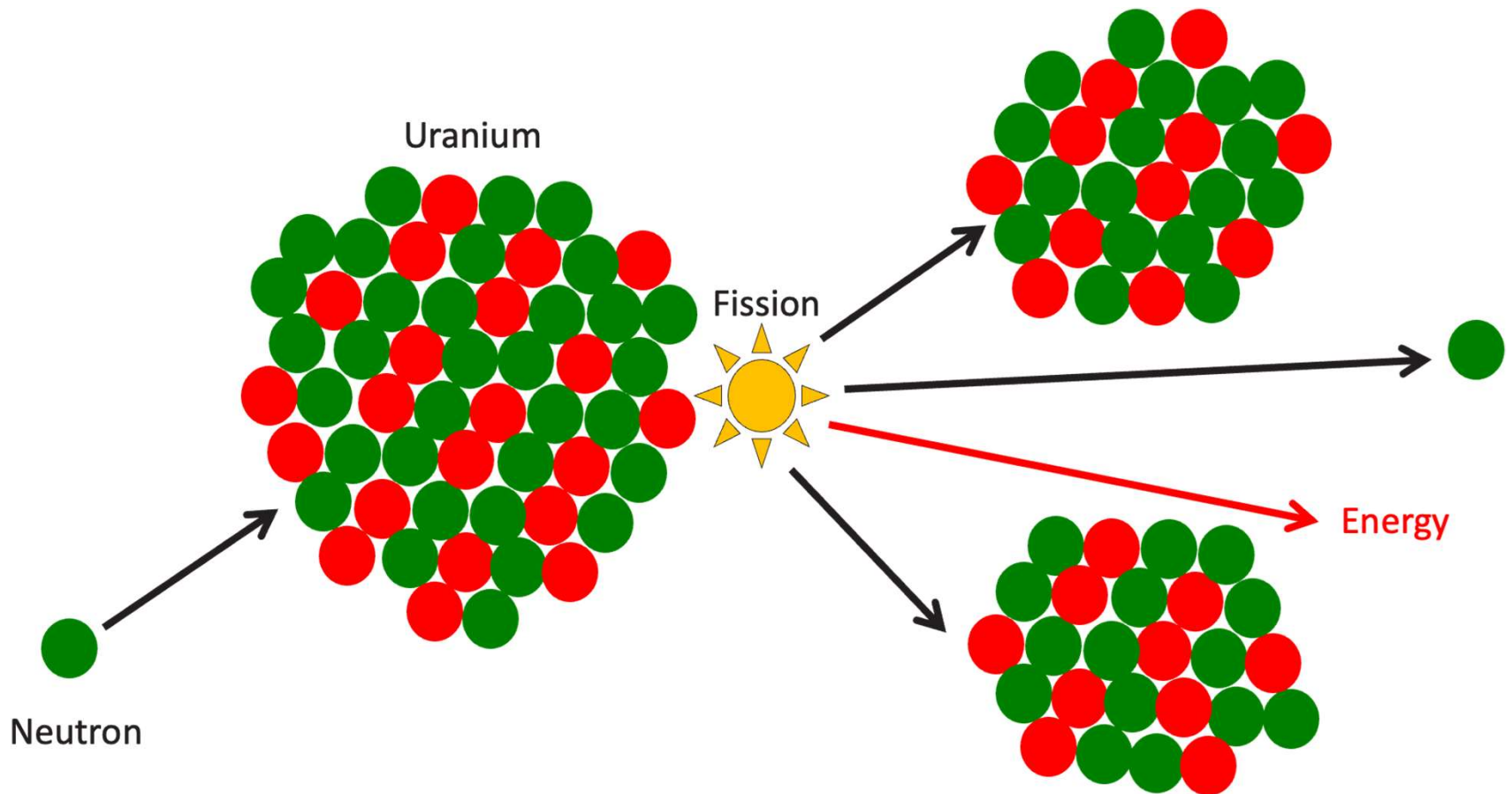
Proton



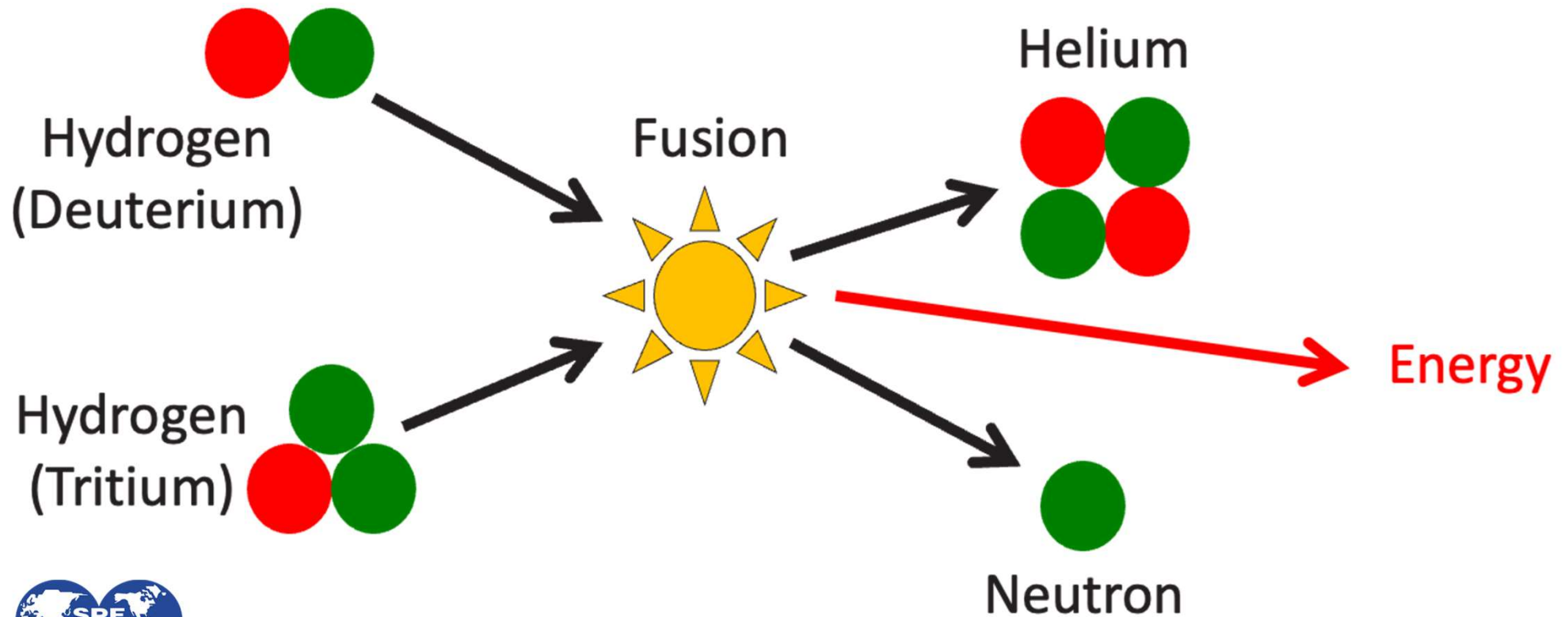
Neutron



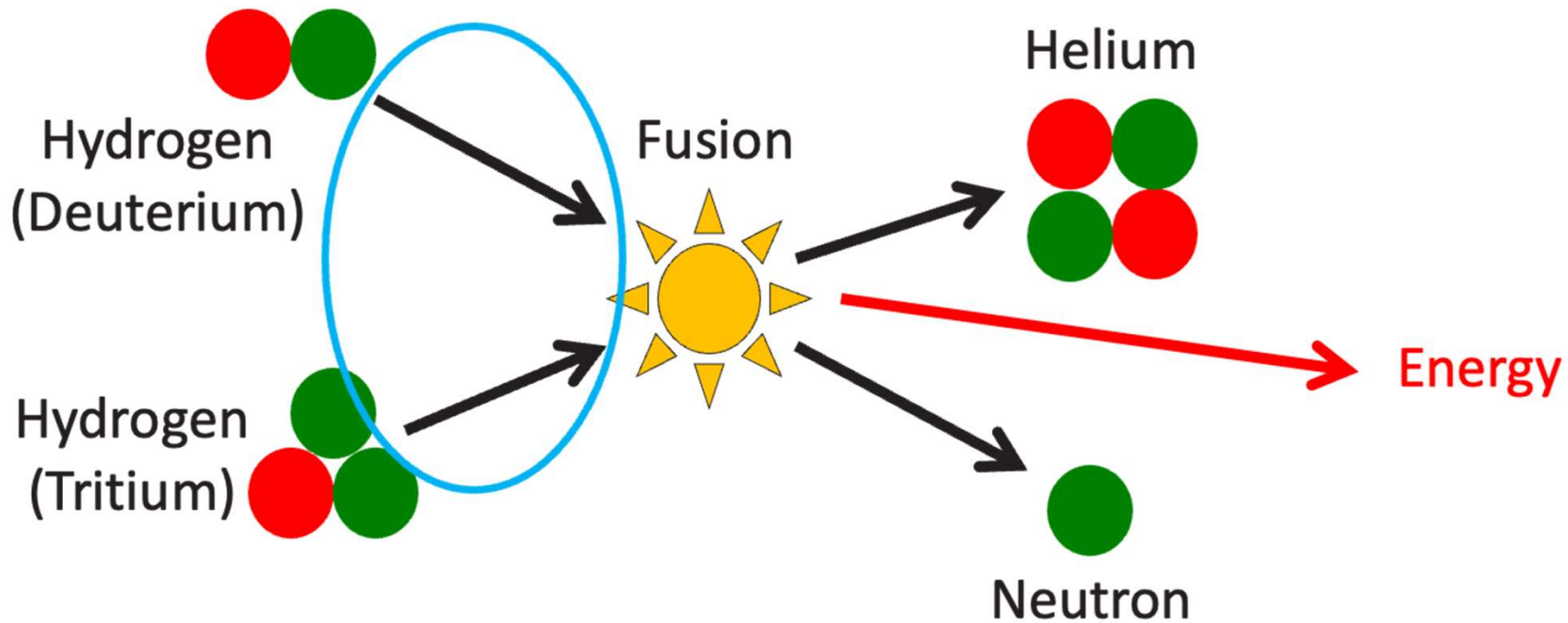
Let's start with fission – splitting atoms



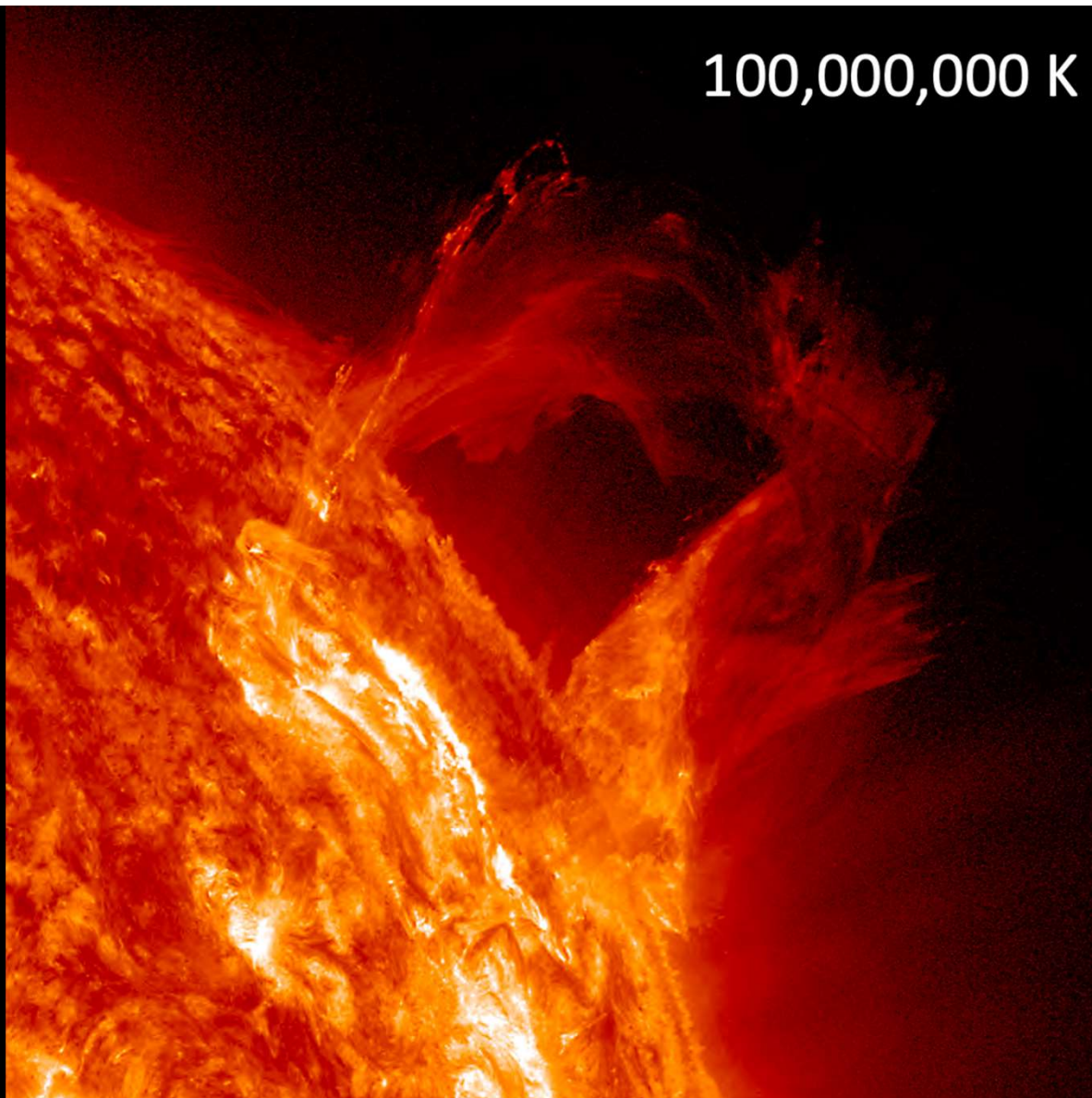
Fusion is the opposite – combining atoms



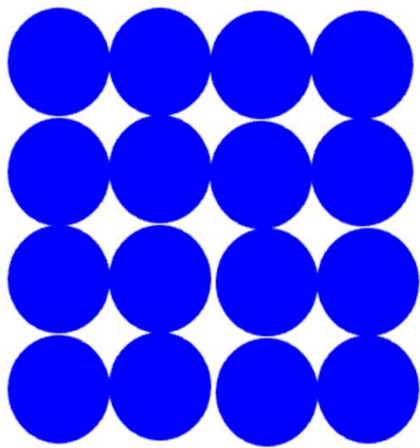
Fusion is the opposite – combining atoms



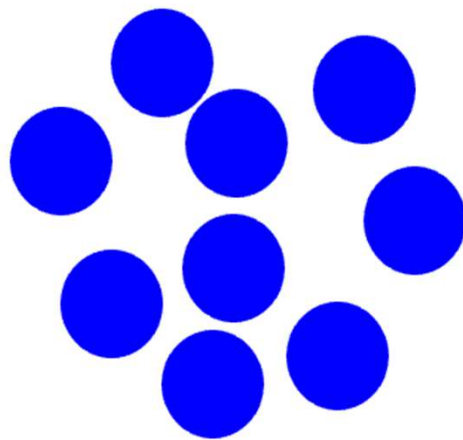
100,000,000 K = Plasma



What is a Plasma?

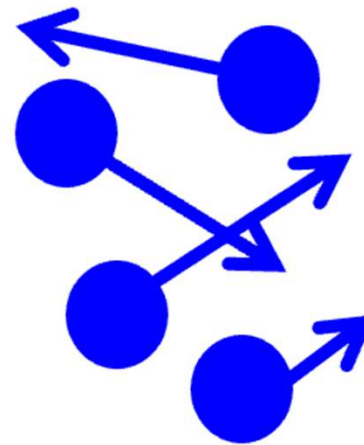


Solid



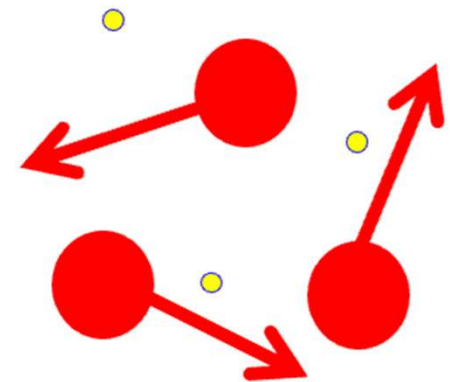
Liquid

273 K



Gas

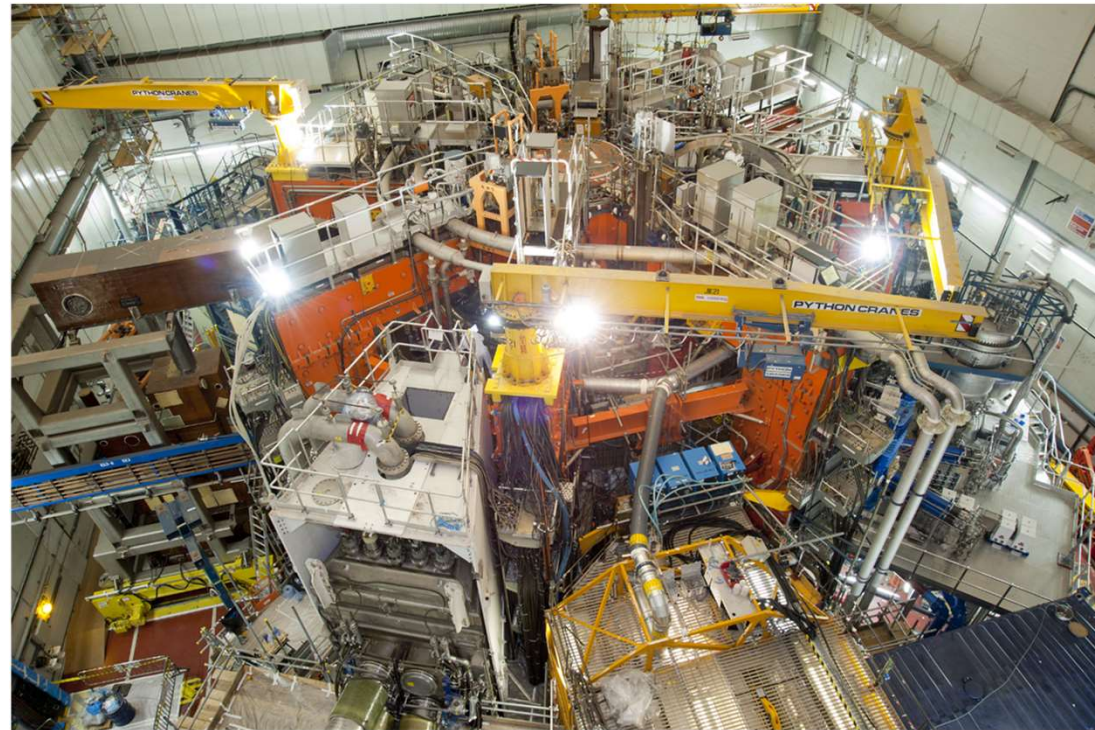
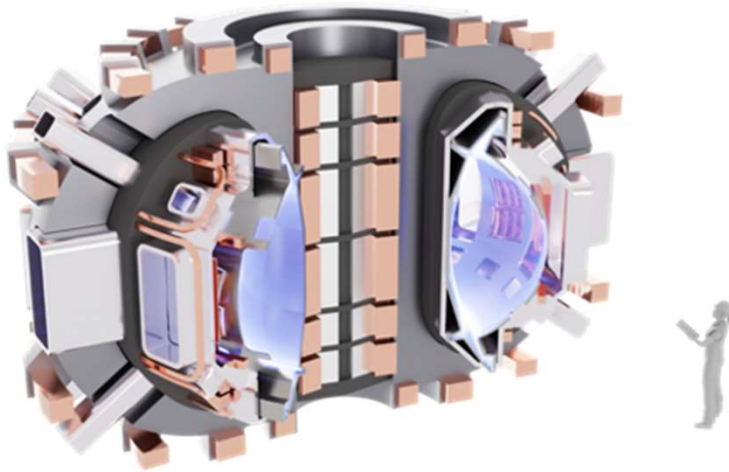
373 K



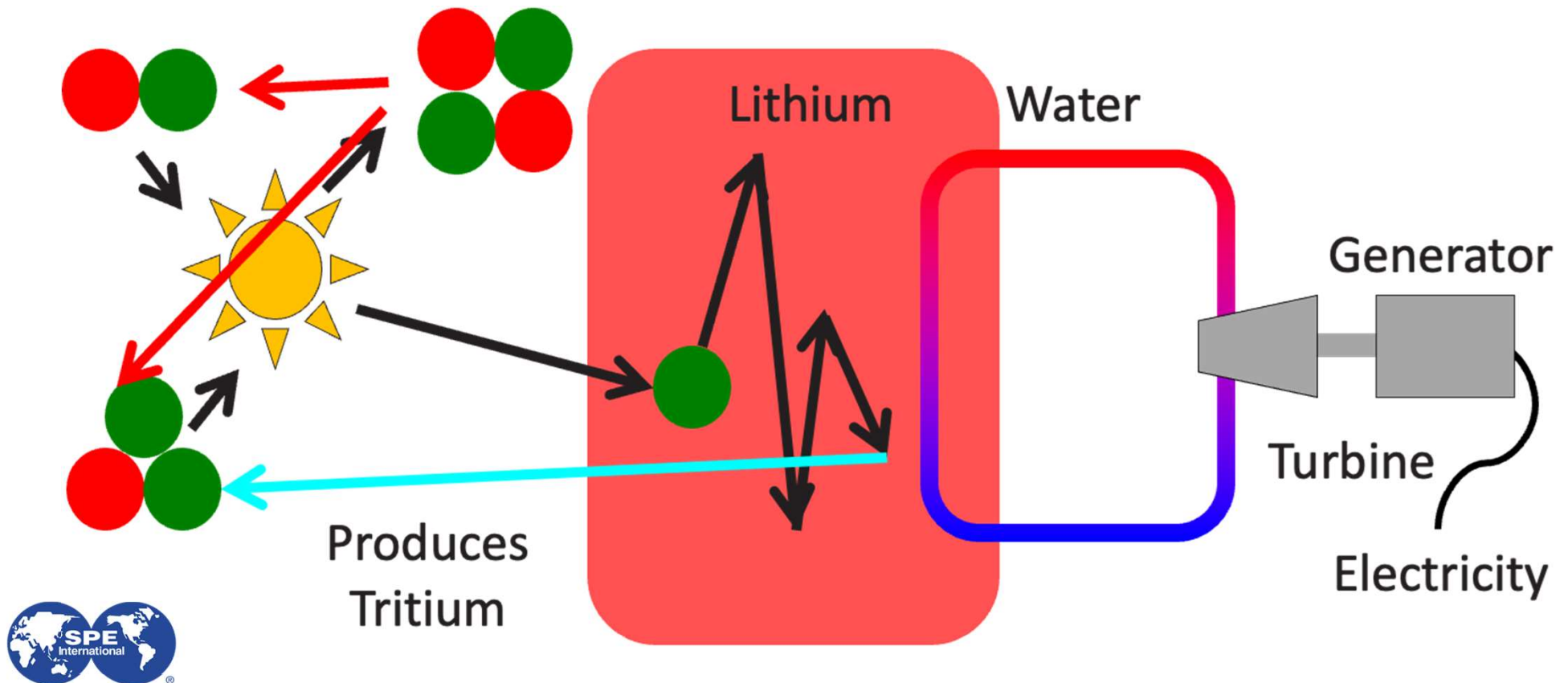
Plasma

~10,000 K

Tokamaks Hold and Heat Plasmas



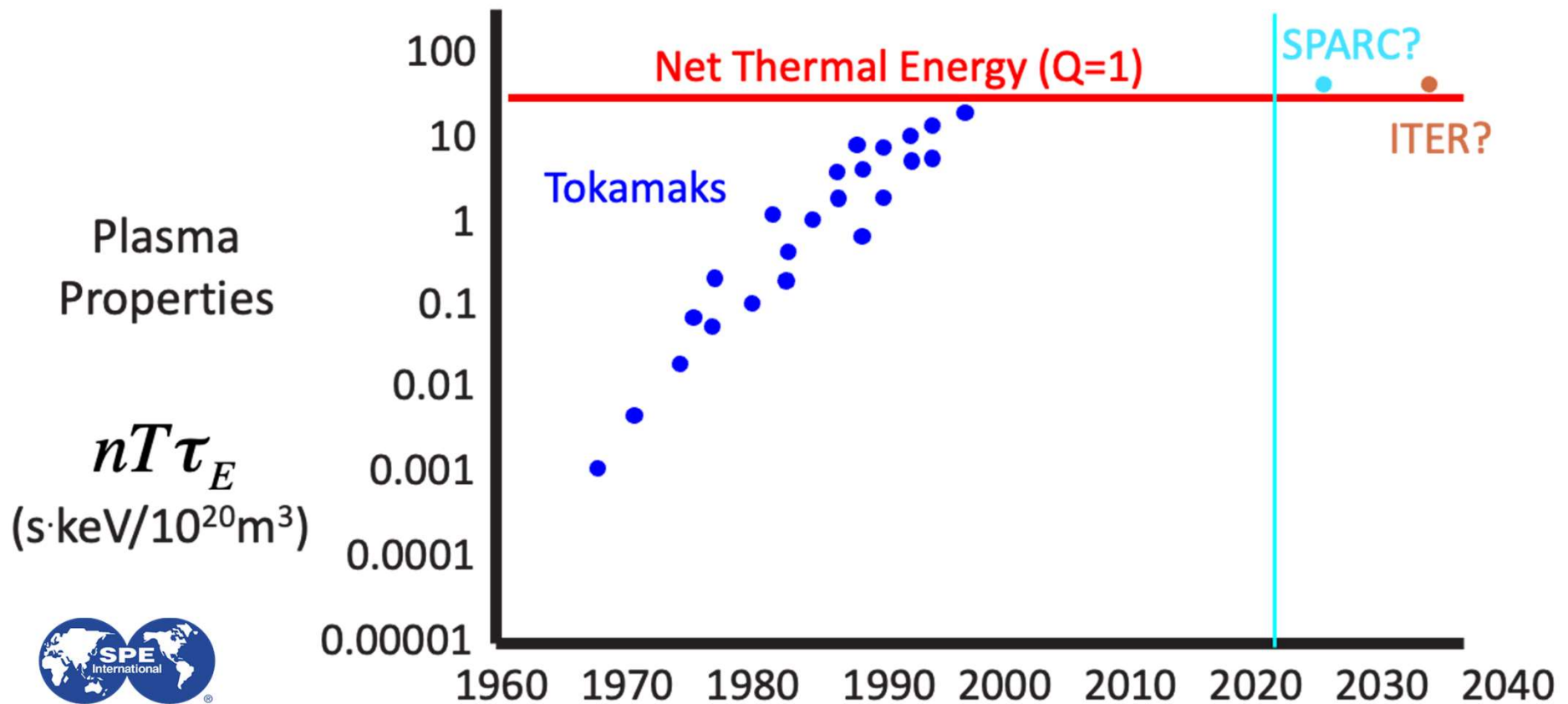
How do you turn neutrons into electricity?



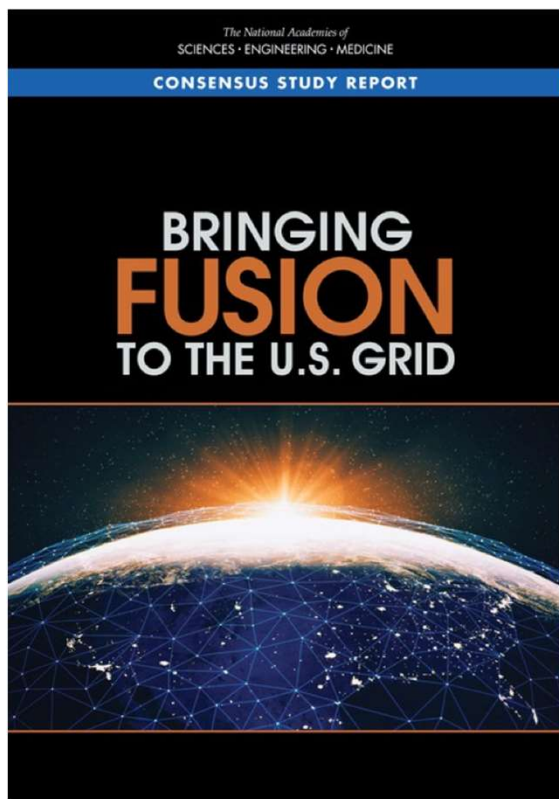
Where are we with fusion?



Fusion Progress



The US Government is Renewing Focus on Fusion



**DEPARTMENT OF ENERGY (DOE)
OFFICE OF SCIENCE (SC)
FUSION ENERGY SCIENCES (FES)**

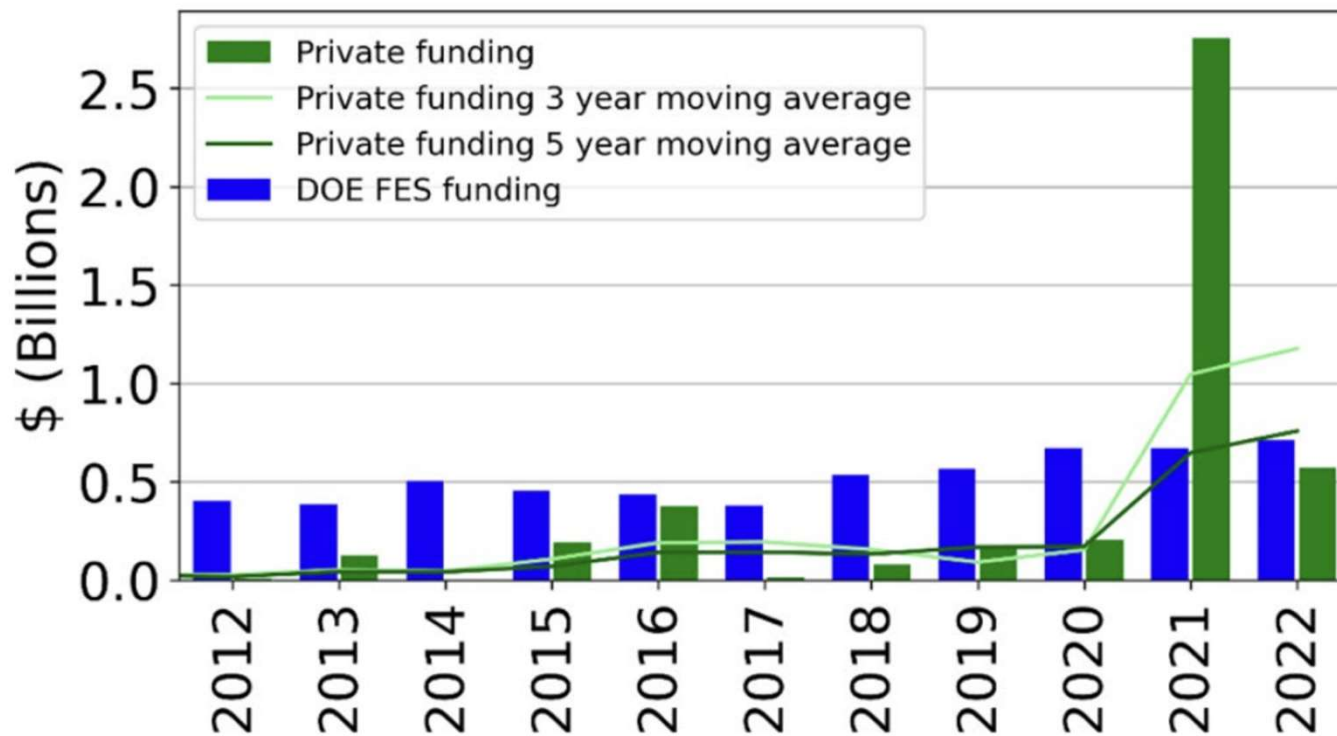


MILESTONE-BASED FUSION DEVELOPMENT PROGRAM

**FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER:
DE-FOA-0002809**

**FOA TYPE: INITIAL
CFDA NUMBER: 81.049**

Private Funding in Fusion is Increasing



S.C. Hsu, Journal of Fusion Energy, 2023

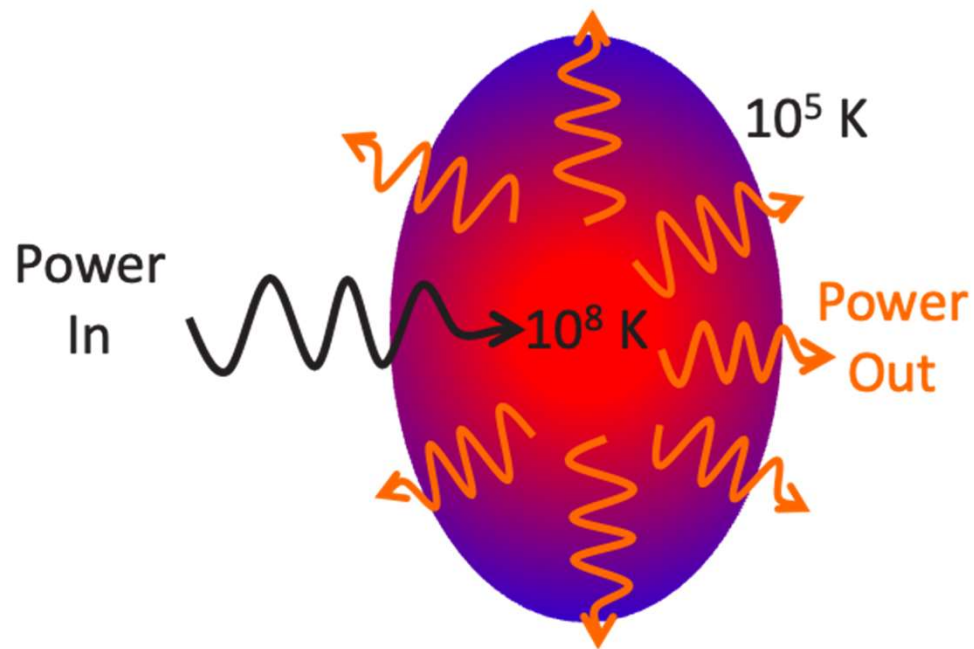
Companies are making concrete progress



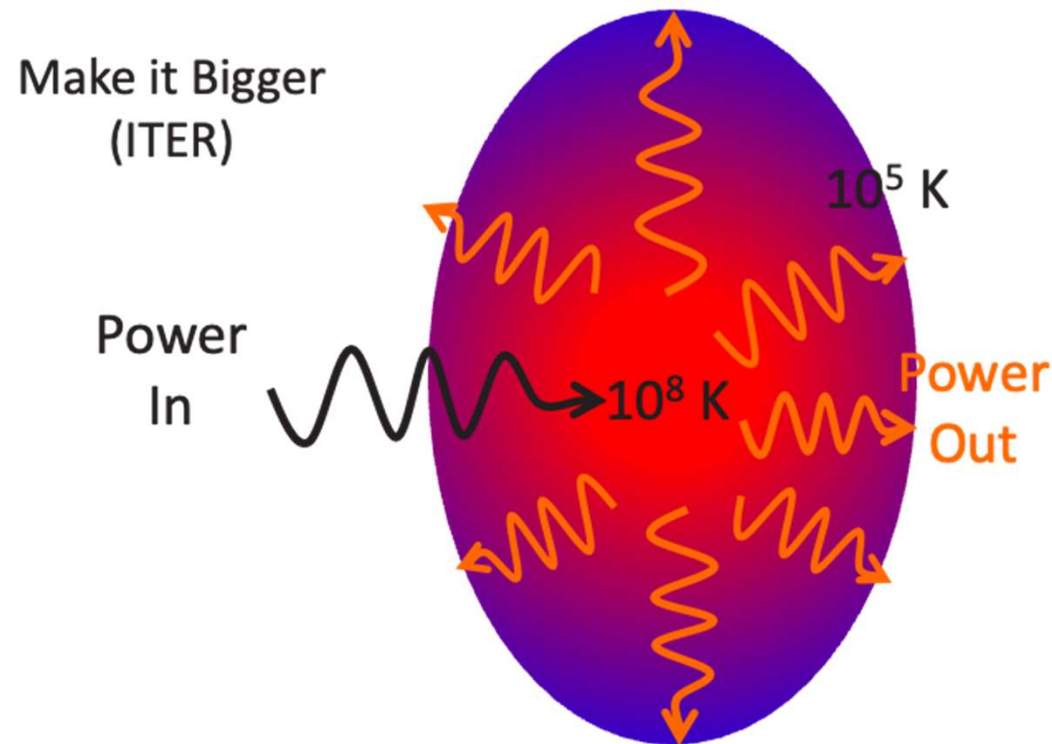
The high field approach to fusion



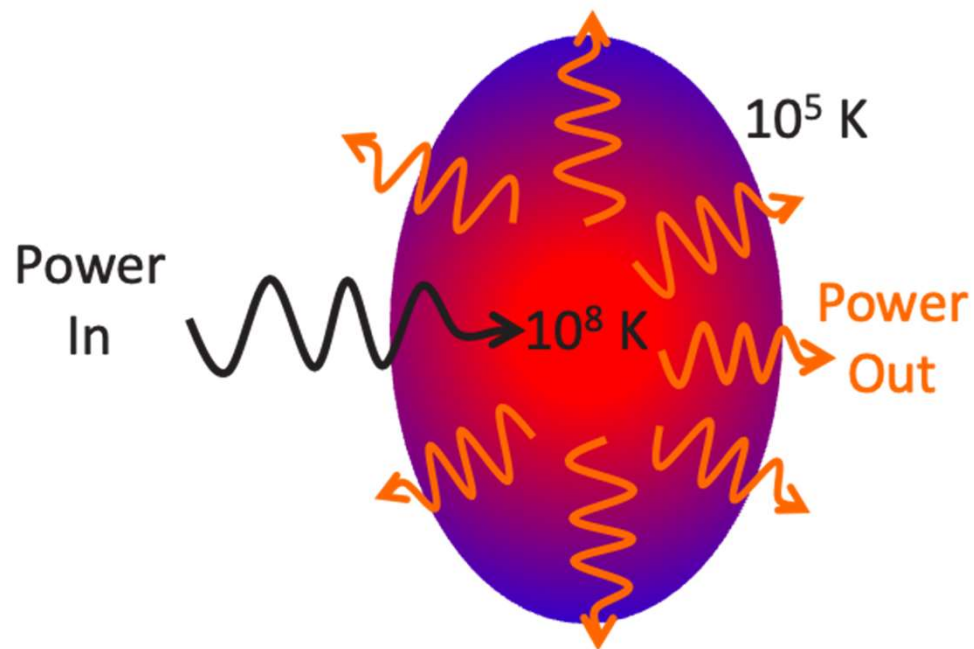
How can we make fusion go faster?



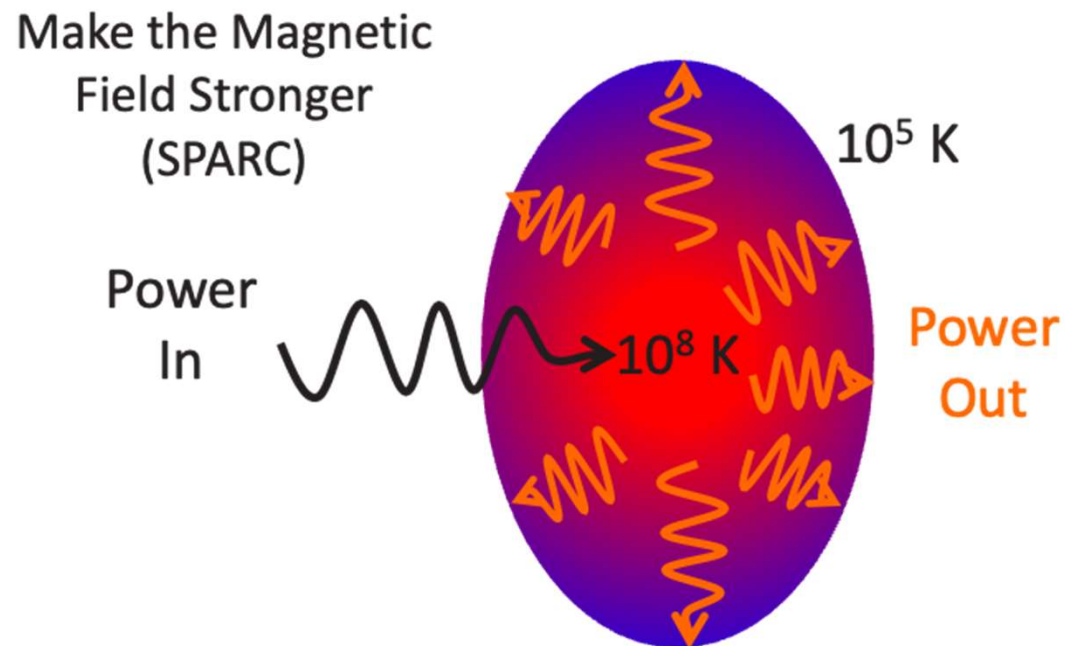
How can we make fusion go faster?



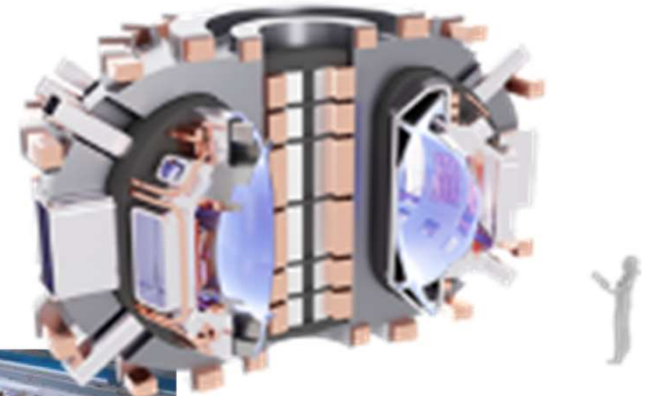
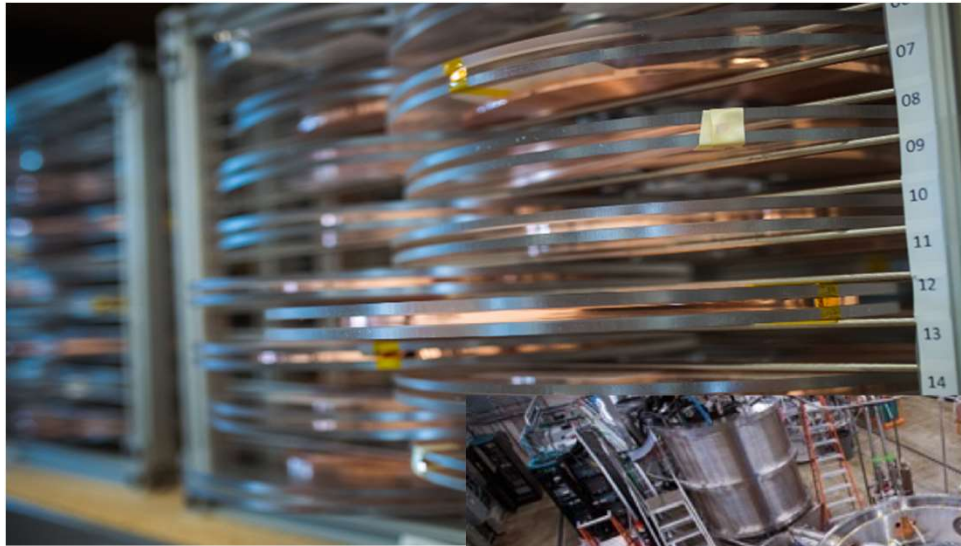
How can we make fusion go faster?



How can we make fusion go faster?



New magnets unlock smaller, faster fusion



Common Interests: Fusion & Industry



Large Component Manufacturing

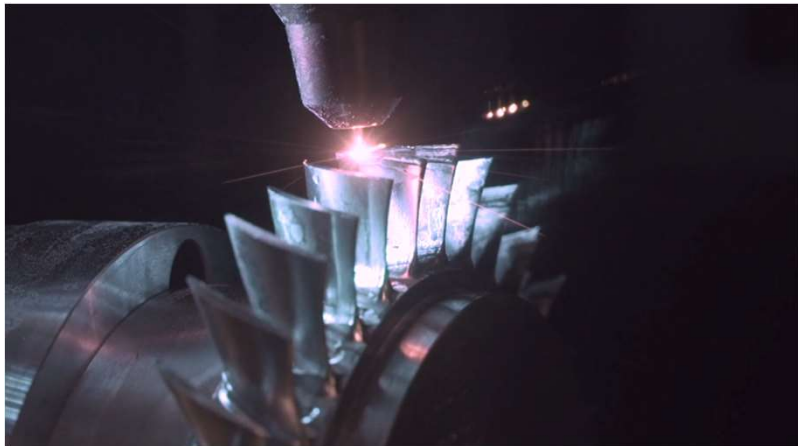
- Serviced by existing oil and gas component suppliers
- Similar size, higher precision & performance requirements



Advanced Manufacturing



- Additive + conventional manufacturing for complex parts
- Unique joining of dissimilar materials
- Automated high precision welding



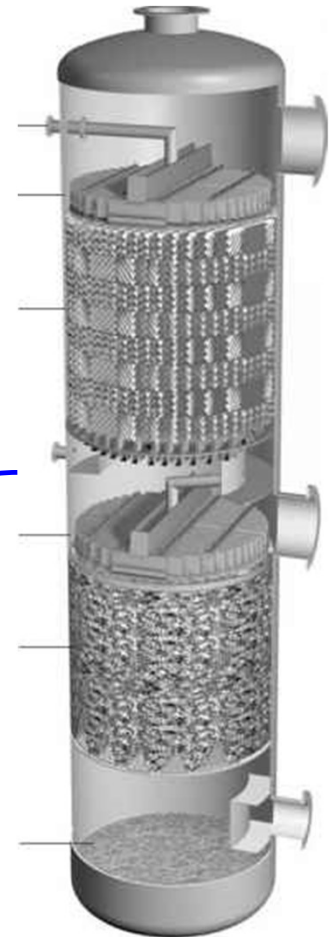
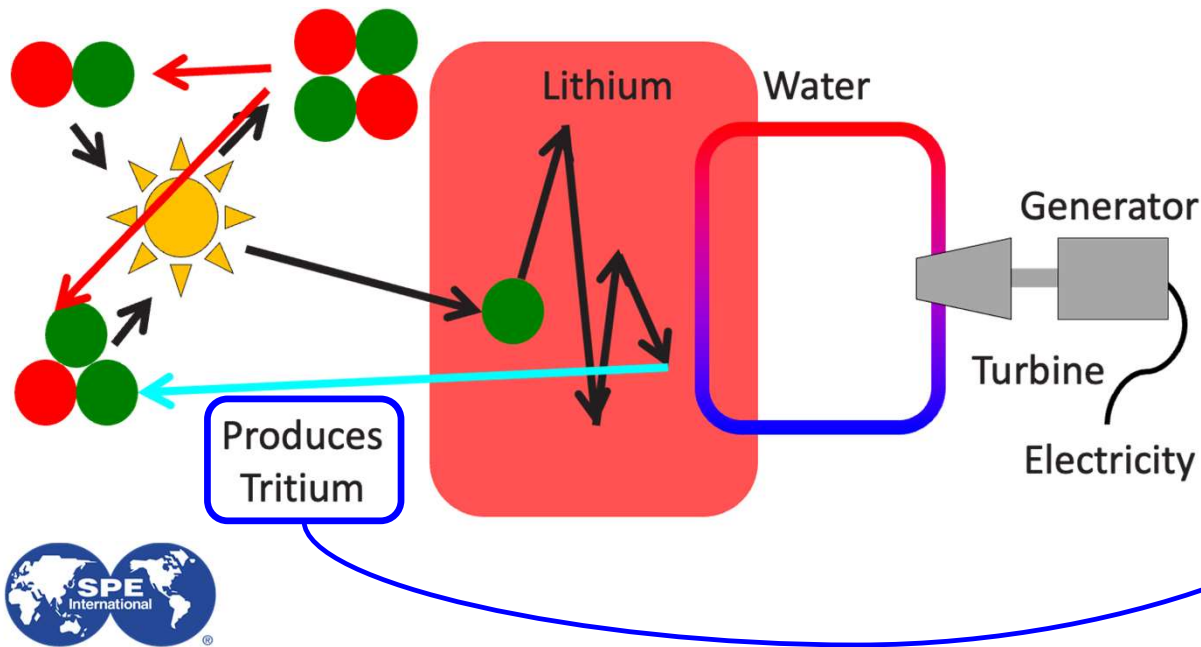
Cryogenic Systems

- Magnets must be kept at cryogenic temperatures
- -250°C operation with Helium vs. -160°C for LNG



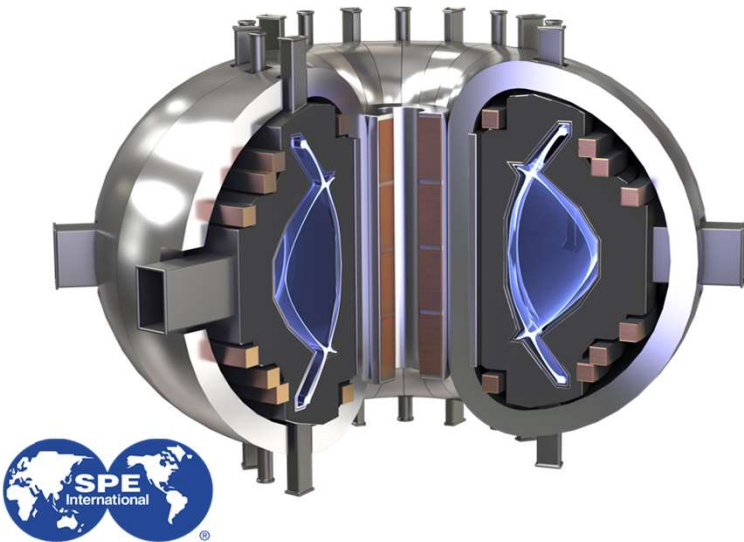
Tritium Extraction System

- Similar to packed stripper column and gas separators
- High extraction efficiencies required



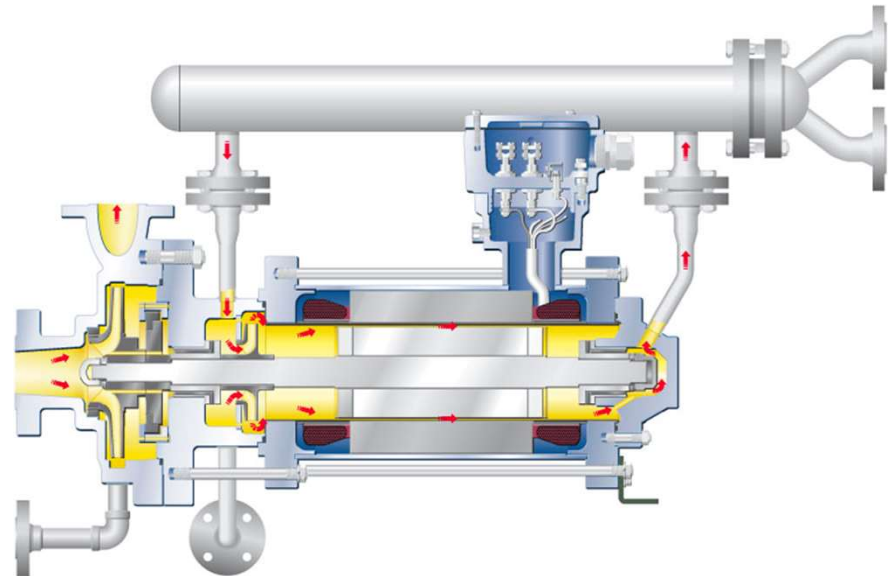
Molten Salt Blanket

- Similar to molten salt chemical reactor
- 630°C with fluorinated salts instead of 550°C with nitrates
- Corrosion mitigation and redox control



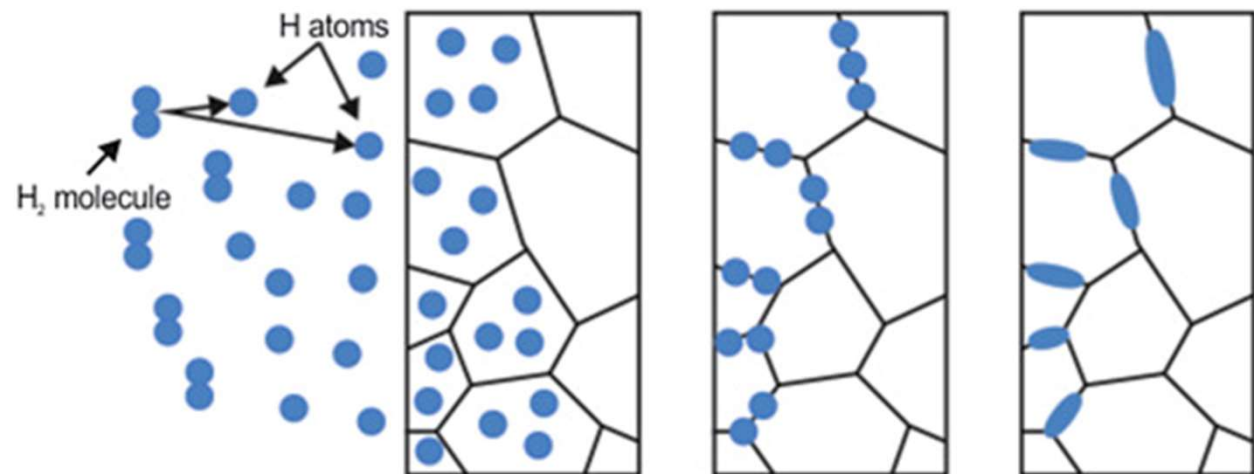
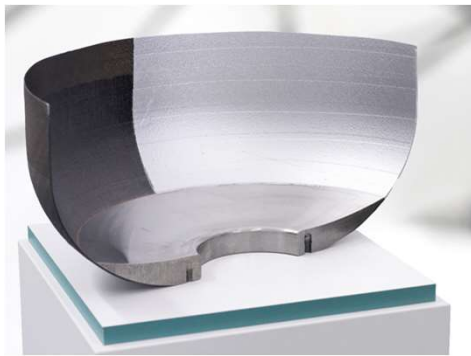
Molten Salt Pump

- Provide circulation for blanket liquid
- Specialized high temperature canned motor pumps



Hydrogen Compatible Materials

- Tritium and Deuterium are Hydrogen isotopes
- Hydrogen embrittlement
- Hydrogen permeation barriers
- Hydrogen engineering, codes and standards

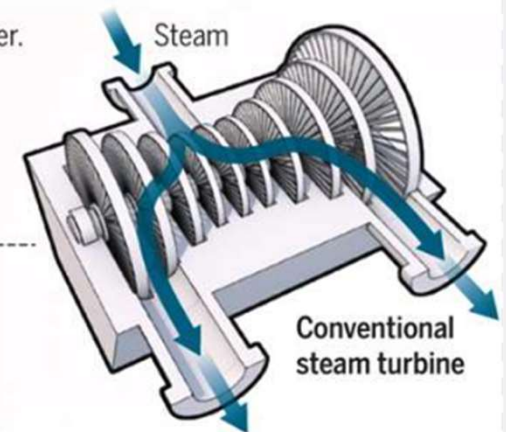
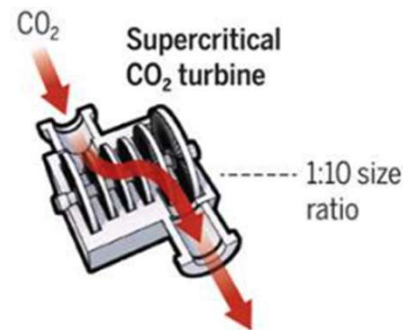


Electricity Production

- New high temperature steam turbines
- Compact supercritical-CO₂ systems



Smaller but more efficient
Both turbines can deliver 300 MW of power.



1:10 size ratio

Unit operations

Compact Heat Exchangers

- Minimize molten salt exposure area
- Maximizing thermal transfer to reduce surface area

