Innovations in fusion energy

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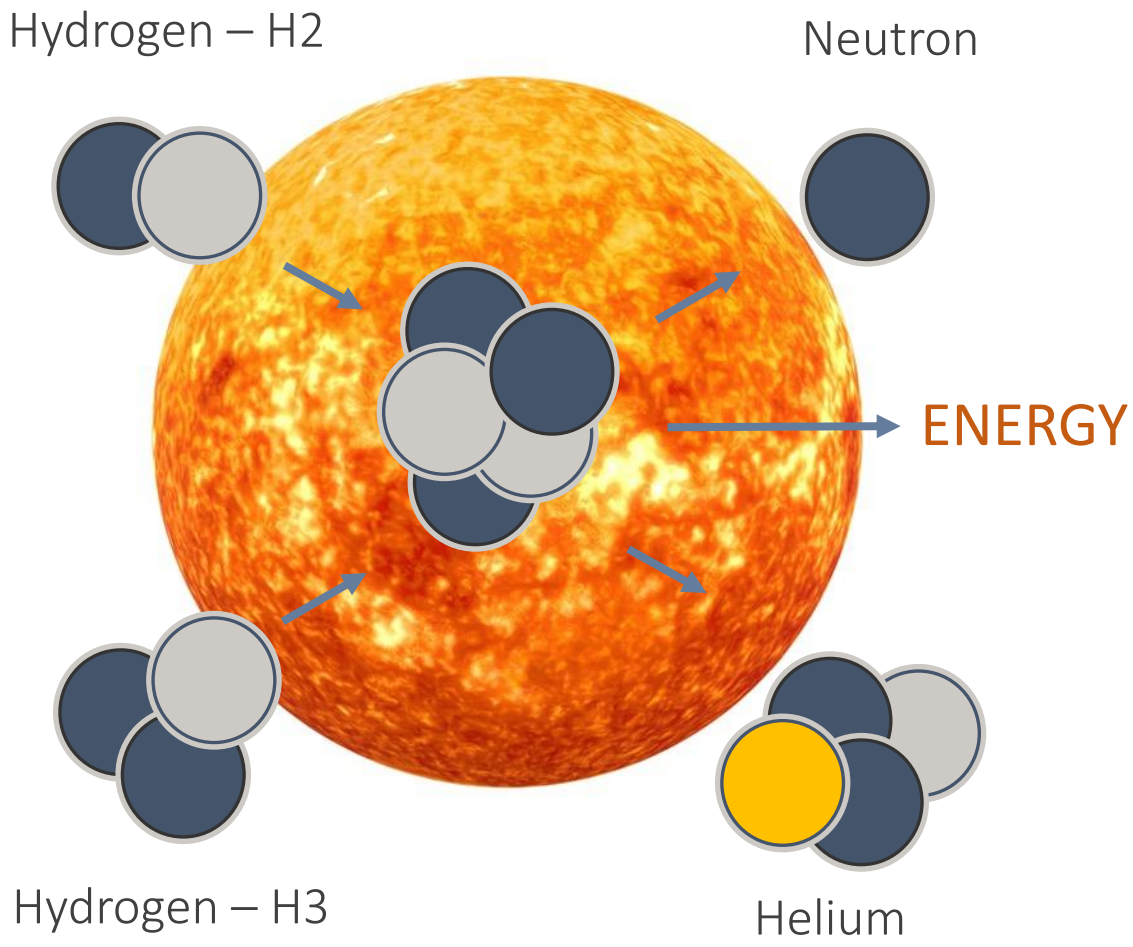
Fusion 101

- Fusion of hydrogen into helium is the process that happens in stars like our Sun.

- On earth with fuse heavy Hydrogen releasing enormous amounts of energy.
  - Effectively inexhaustible fuel
  - Intrinsically safe
  - High power density
  - On-demand

- Science tells us fusion can power the world with carbon-free energy
  - Can we engineer cost-effective delivery systems?

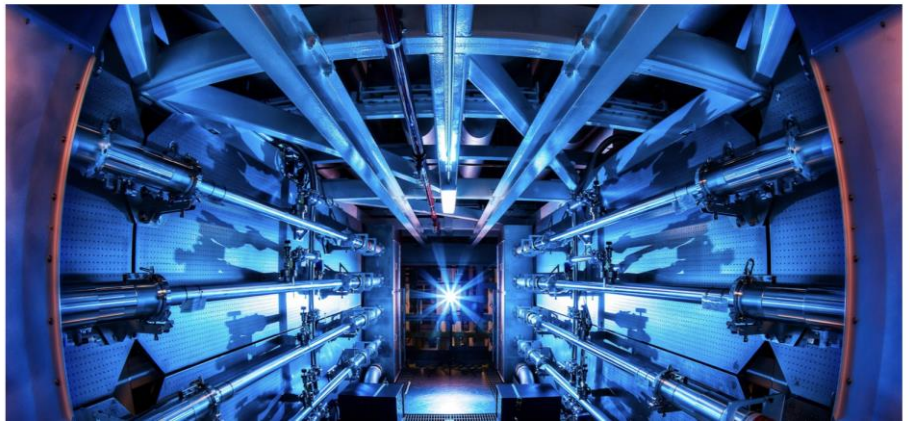


Fusion has had deep innovations and breakthroughs in last year

Fusion Breakthrough: At the Brink of Fusion Ignition at National Ignition Facility

TOPICS: American Physical Society Energy Fusion Energy Fusion Reactor Lawrence Livermore National Laboratory National Ignition Facility Popular

By AMERICAN PHYSICAL SOCIETY NOVEMBER 14, 2021

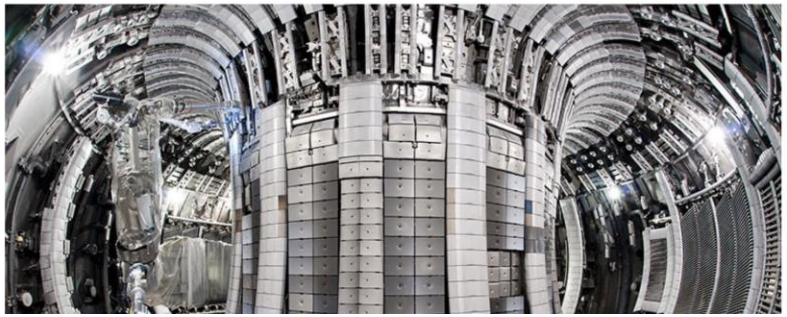


NEWS | 09 February 2022

Nuclear-fusion reactor smashes energy record

The experimental Joint European Torus has doubled the record for the amount of energy made from fusing atoms – the process that powers the Sun.

Elizabeth Gibney



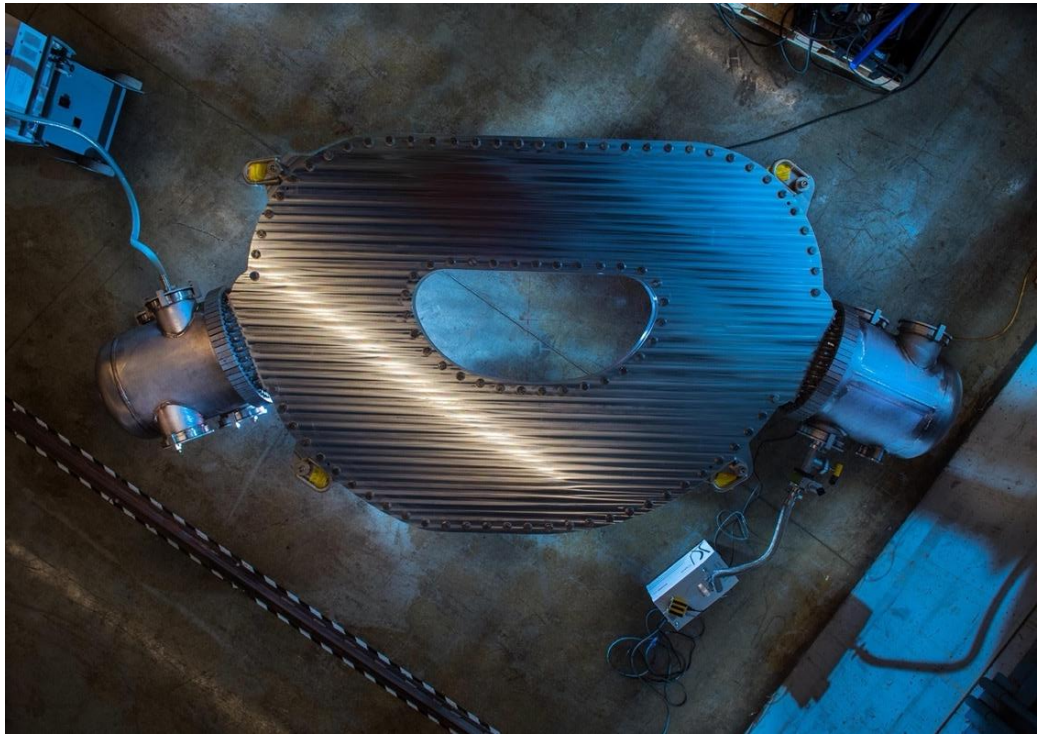
Disruptive superconductor magnet technology demonstrated 09/21 has fundamentally changed fusion commercial prospect

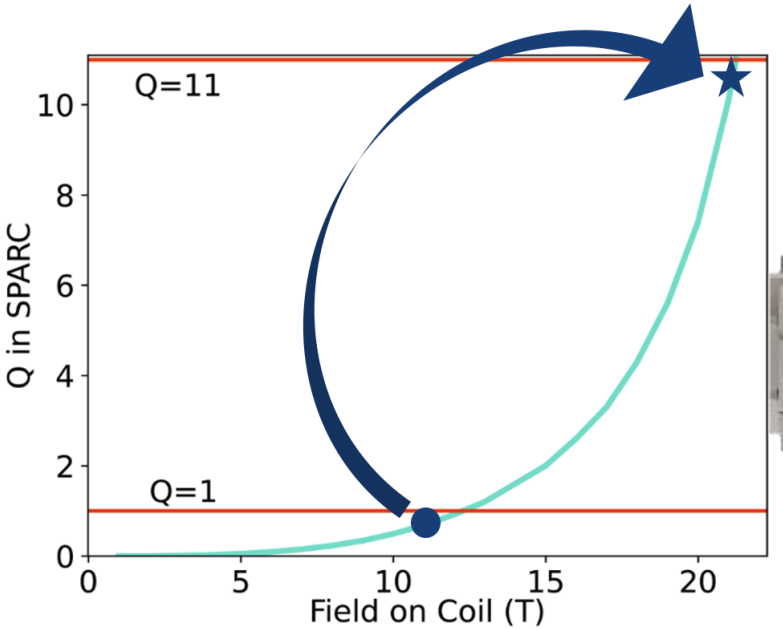
20 Tesla coil demonstrated by MIT-CFS teams

20-40x improvement in cost-per-watt!

While permitting a small, fast demo of fusion in mid-2020 called SPARC

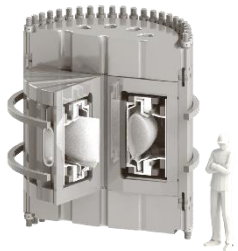
- Science vetted
- Most downloaded papers





The foundations laid for a rapid development and deployment of fusion energy to tackle climate change

COMPLETED:
Alcator C-Mod



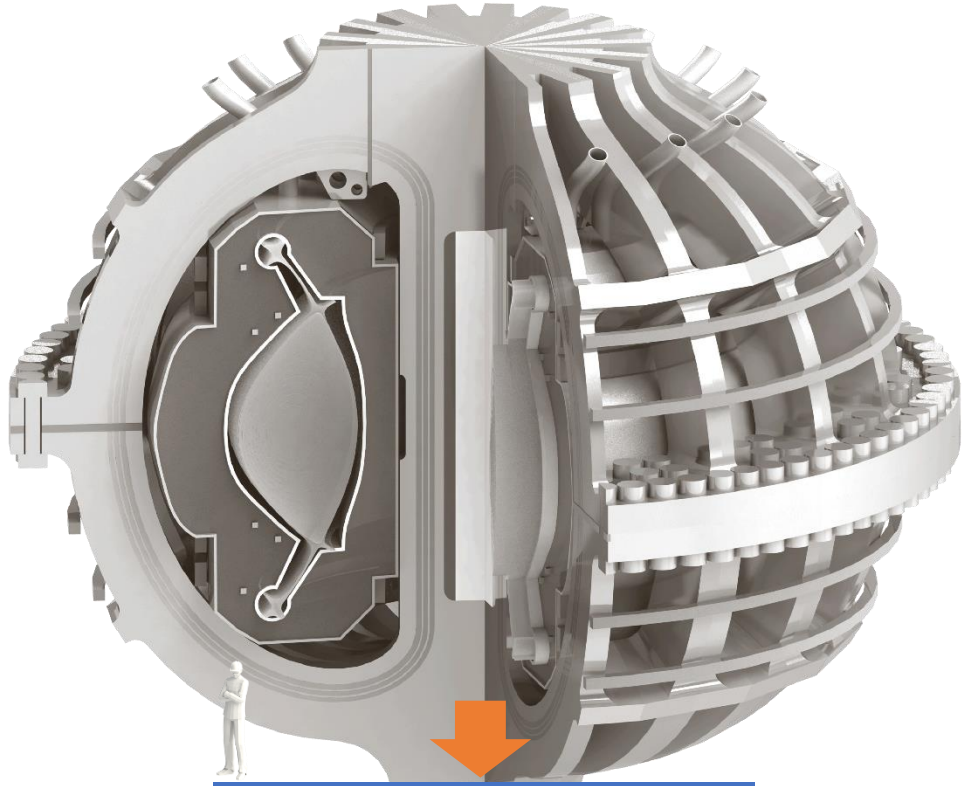
COMPLETED
TFMC demonstrated
September 5, 2021

FUNDED at 1.8 B$
December 1, 2021

CONSTRUCTION PLANNING UNDERWAY for 2025 LAUNCH
SPARC achieves net energy

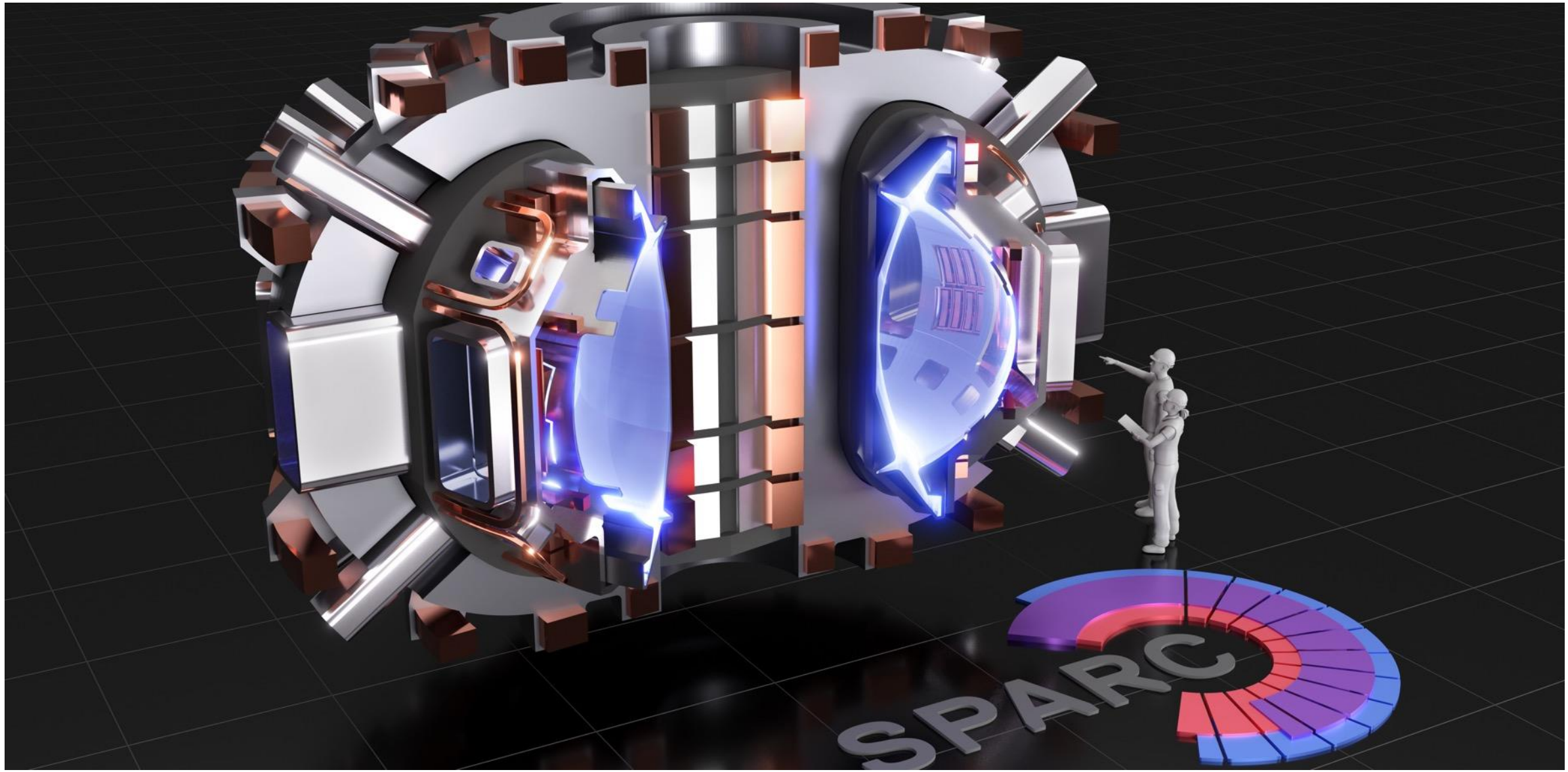
Net energy

Early 2030s
ARC fusion power on the grid



Carbon-free scalable commercial power

SPARC: world’s first commercially relevant fusion machine



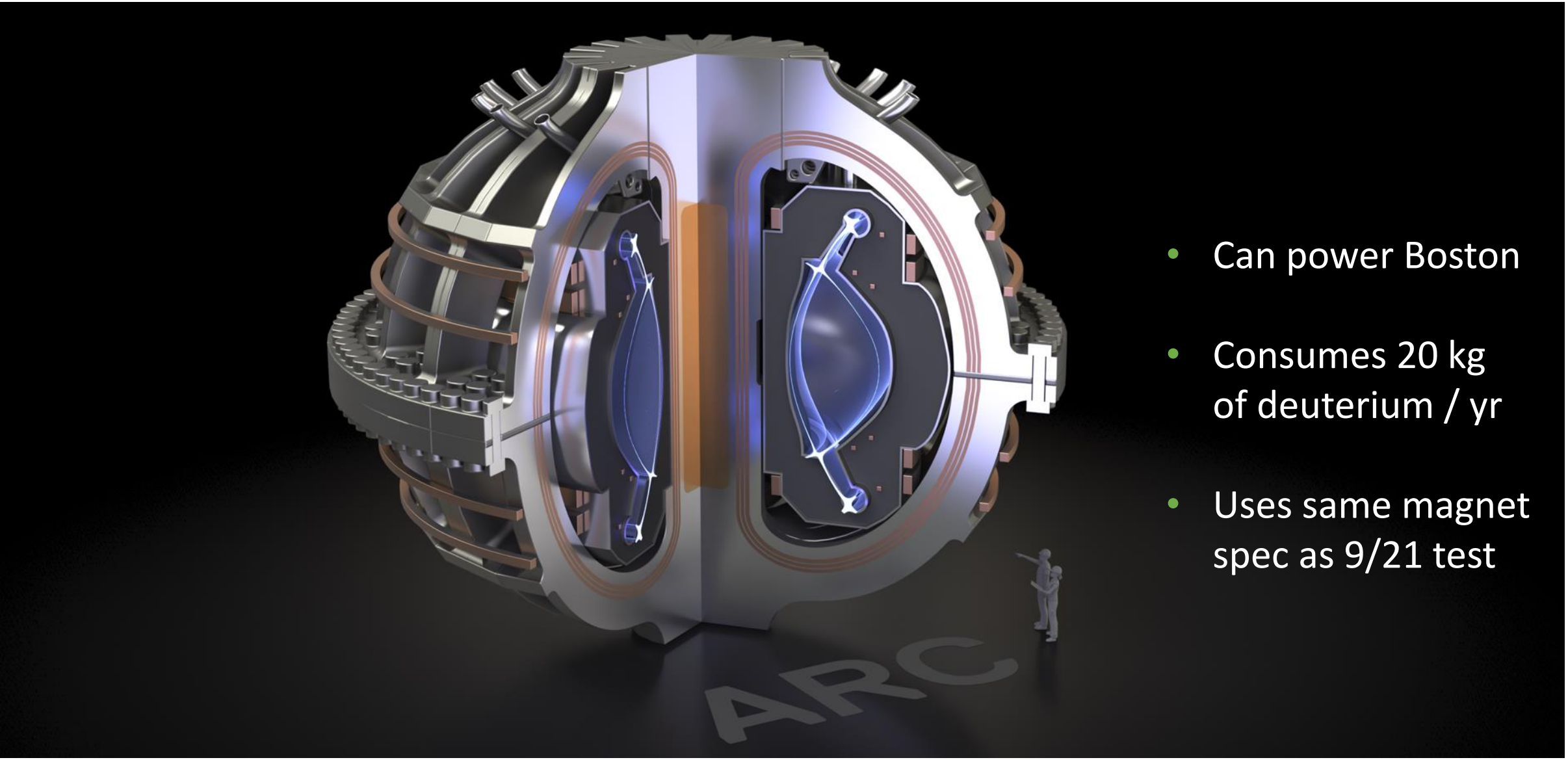
SPARC site ~ 45 minutes NW of Boston

Courtesy of Commonwealth Fusion Systems

Onset of 25+ companies attempting to demonstrate fusion science

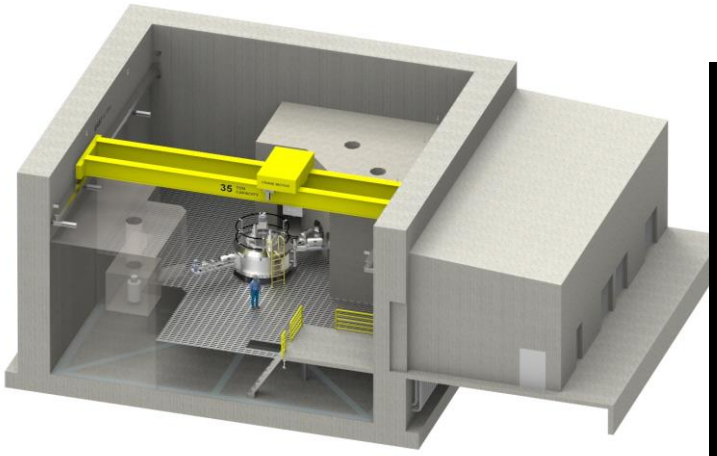
1. *Only a few of these will succeed science-wise*
2. *The investment ecosystem has severe dearth of fusion systems engineering and services*

ARC: World's First Fusion Power Plant

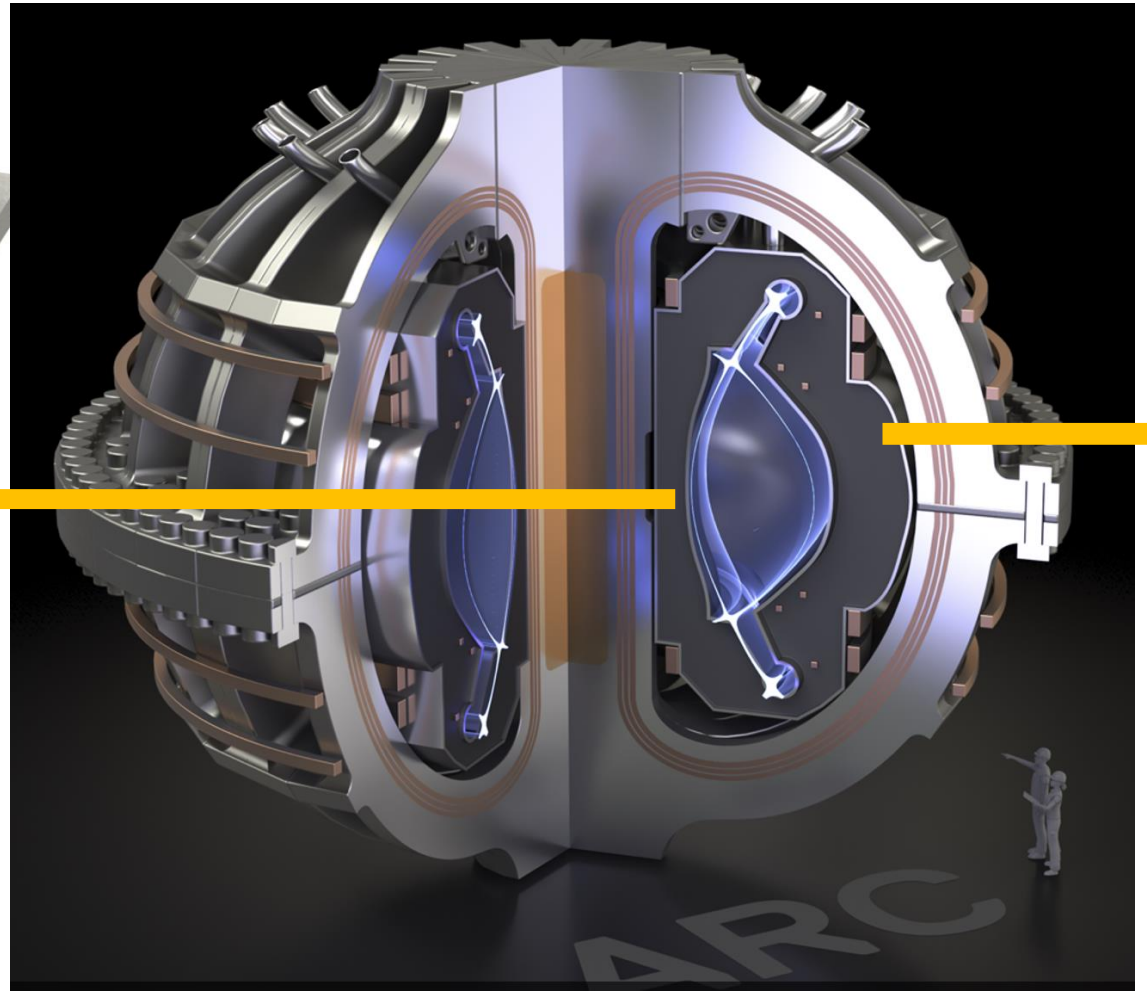


- Can power Boston
- Consumes 20 kg of deuterium / yr
- Uses same magnet spec as 9/21 test

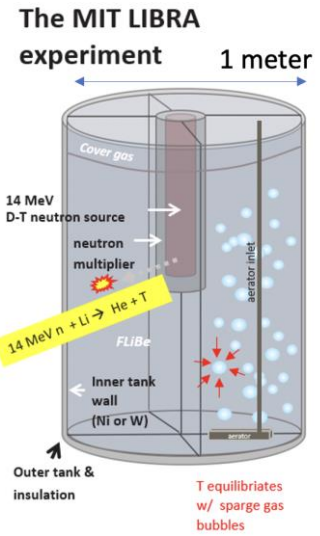
Next wave of innovations: focus on energy delivery



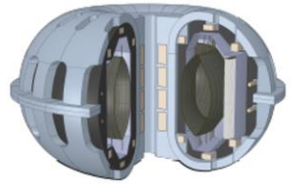
Rapid prototyping &
Testing of materials
in a fusion environment
To improve reliability

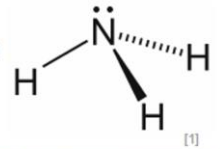


Heat and tritium recovery



Education and outreach innovations
Fusion needs many more people, and more diverse talent!





Energy products: Fusion → ammonia fuel

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