



Update from Commonwealth Fusion Systems

Robert Mumgaard, CEO
FPA 2022

- 1. CFS status**
- 2. Some observations**

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Since Last Year's FPA:

- 39 Gtons CO2 emitted for energy production
 - Most ever
- Climate impacts more evident:
 - Floods in Pakistan
 - Heat in Europe
 - Fires everywhere
 - Power outages in CA
- Market transition for sustainable energy better quantified:
 - \$100-200T of energy infrastructure
- More commitments to net zero by 2050
- Ukraine war highlights energy independence
 - Gas shocks
 - Geostrategic reshuffling
- The world needs fusion more and more --- **can we get it to them fast?**



Risk retirement in concrete steps

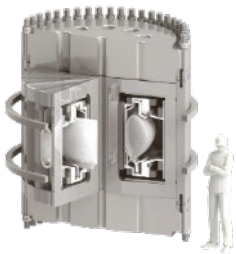


COMPLETED:
Proven science
Alcator C-Mod
\$200M

COMPLETED:
Demonstrate
Groundbreaking
HTS magnets at 20T

**CONSTRUCTION
UNDERWAY for 2025
FIRST PLASMA**
SPARC, $Q > 10$ burning
plasma
 $P_{\text{thermal}} > 100 \text{ MW}$

Early 2030s
Fusion power on the grid
ARC, $Q > 10$, $P_{\text{electric}} \sim 200 \text{ MW}$



FPP Phase 1a
Fully funded, sited, and under
construction



FPP Phase 1b-2
AND FOAK
Site search underway



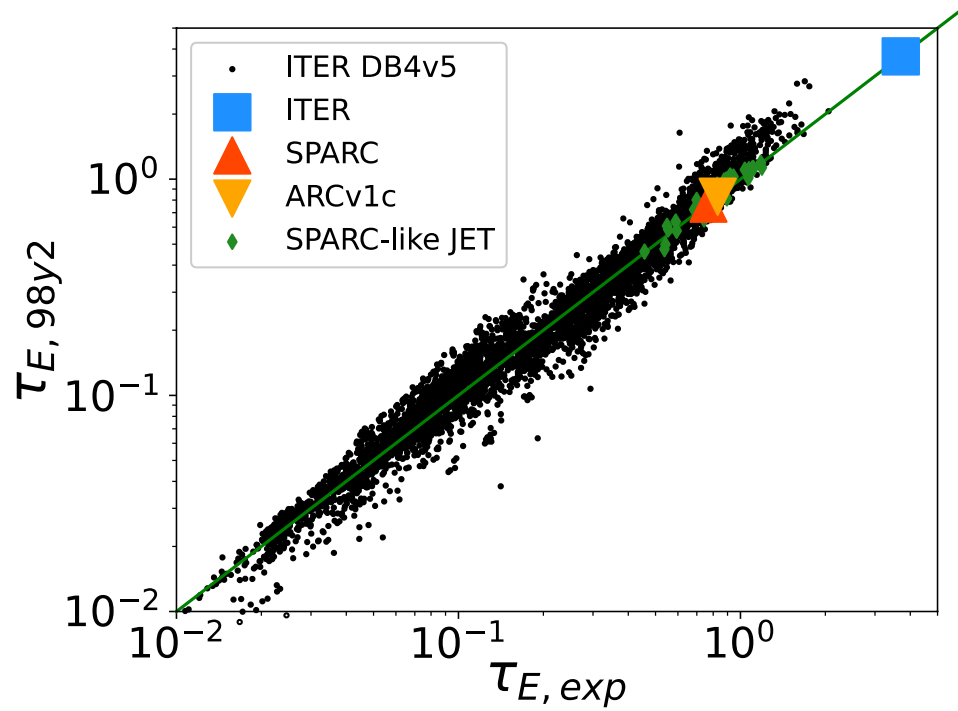
CFS team is growing

- 400 FTEs, ~1000 heads on the projects
- ~100 jobs posted

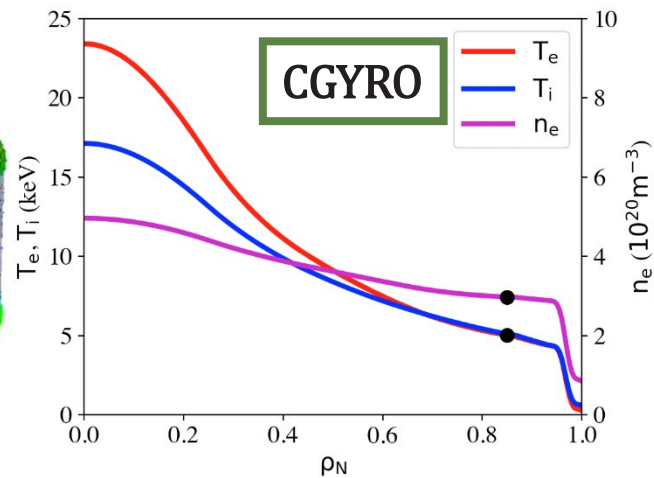
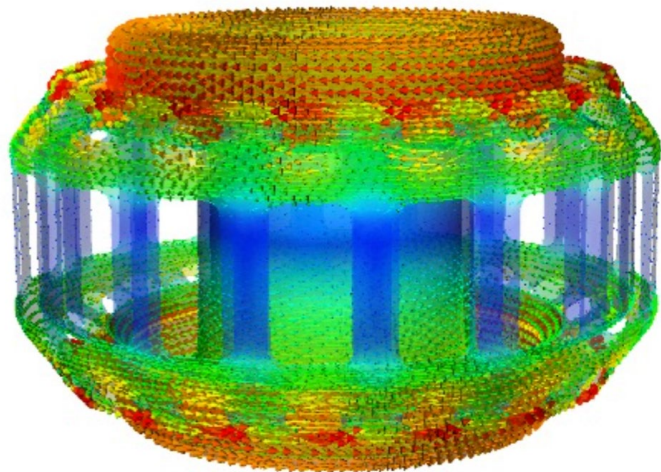




SPARC tokamak design is on track



World-wide network of collaborators



Magnet tech is looking good



November 3, 2021



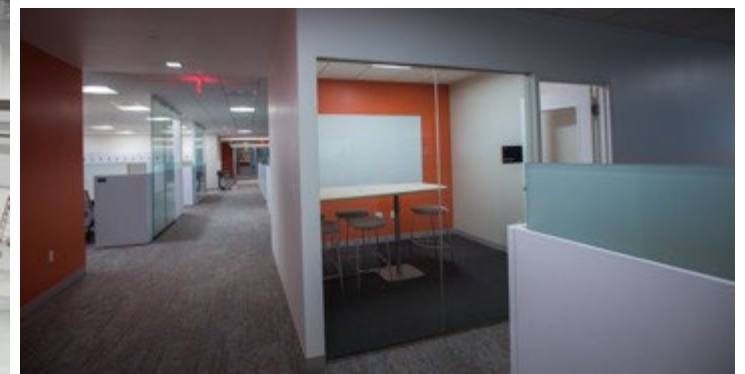
November 28, 2022



SPARC Magnet components in fab



SPARC Magnet serial production starting



SPARC construction is on track

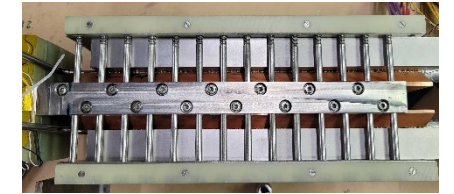
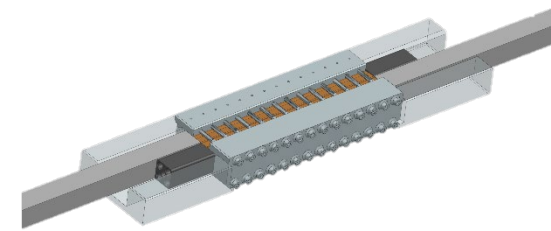
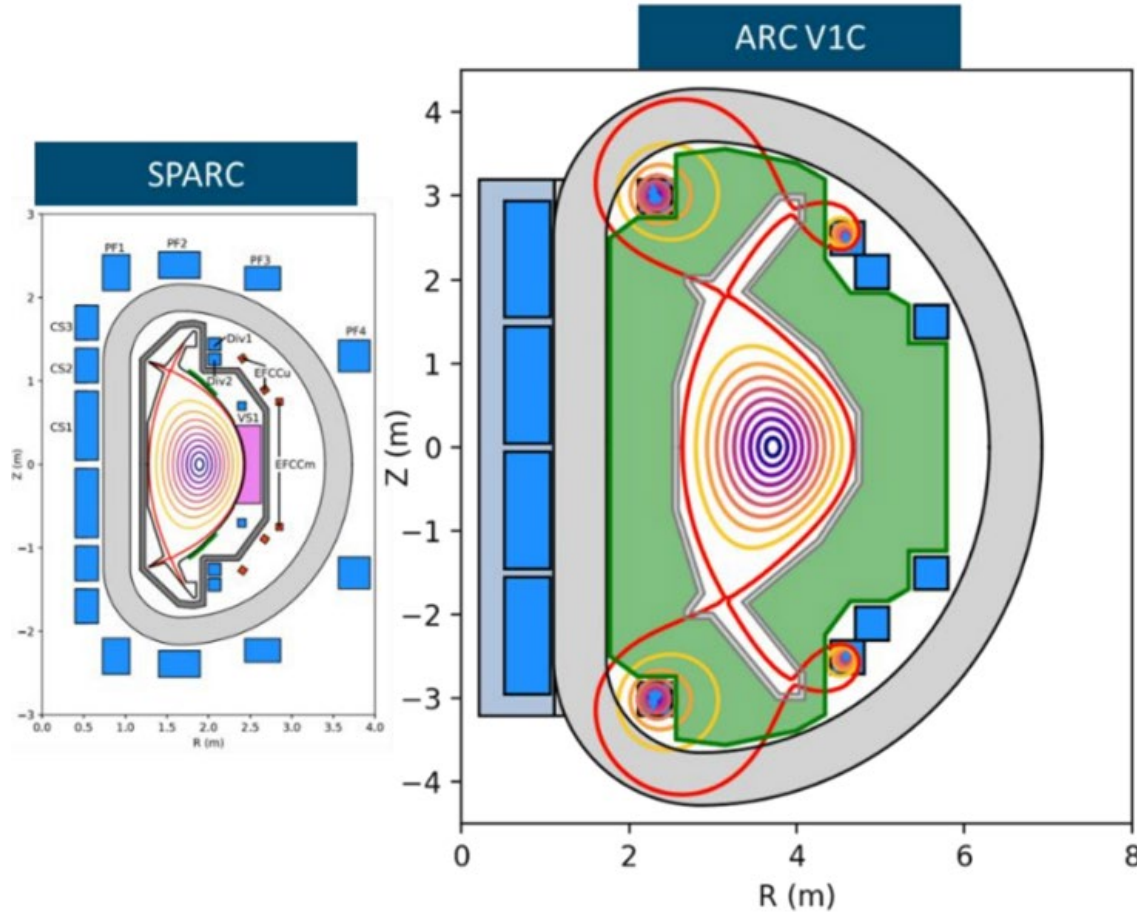


You can build things fast

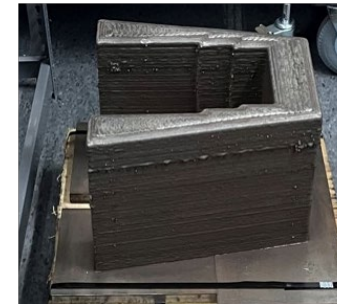




Ramping up ARC prototypes and siting now



Benchtop-scale superconducting joints that have been fabricated for SPARC magnets



Examples of intermediate-scale, additive manufacturing test articles produced in collaboration with industrial partners

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2. **Some observations**



What are some takeaways from our experience?

- Fusion is a product and people want it today
- Don't assume the future will look like the past in energy markets
- Economics rule everything and are brutal
- The world wants the DC-3, not the F-22
- Good engineers are better than great system codes
- Diversity and workforce from other industries not just fusion
- Go around obstacles, not always through them
- Find what you are good at, partner with what you're not
- If you've been doing the same thing for >10 years now is the time to change or else you'll be left behind



Fusion energy ecosystem scorecard for the year

What	Status	Direction	Comment
Interest			Ok, we got the attention, people care. We should all be cheering on each other.
Science			Better every month/shot. PPPs make the science more available. Still hard to work with ITER
Community plans			Its all written down and agreed to. But STILL NOT IMPLEMENTED. Get on with it.
Existing US facilities			When and where are we going to look at DIII-D and NSTX and reconcile with FESAC and NAS?
New US facilities			Still waiting for some starts! Where is the alignment with the plan?
US leadership			UK is kicking the US's butt with better coordination, better facilities, clearer roles.
US cohesion			Getting there between some elements. Labs need to figure out their role in the shifting ecosystem. What do we do with PPPL?
Market pull			Fusion is highly desirable, getting into the conversation about who is going to buy one.
Workforce			In high demand, salaries up ~30%, lots of grad students, need development programs.
Convening			Good convening forums started. How does FPA evolve to be effective in the ecosystem?
Regulation			UK looks appropriate, US in process and we'll know soon.
ITER			We should all be worried about how to navigate the delay. Tough questions are coming.



From Mumgaard talk at FPA 2021 – still relevant: What will it take for your organization to navigate transition?

Good things to have

- Climate relevant timelines and focus and partnerships
- Speed -- build-test-learn
- Capabilities demonstrated via hardware with solid execution
- Novel collaborations
 - Not just countries, but disciplines
 - Different types of organizations working together
- Commercialization pathway as a key input
- Initiatives and teams ready to do new things
- Organizational creativity and nimbleness
- A “default to action” strategy
- Expanding the pie mentality

Not so good things to keep

- A vague or unvoiced plan that lacks timelines, milestones
- A concrete plan that is not climate or energy transition relevant
- Scientific incrementalism
- Paper studies without hardware execution
- Technical spectacle via bigness, complexity, cathedral building
- Misunderstood roles for public/private – not knowing what you want to be when you grow up
- Rent seeking (cost plus etc.)
- Waiting for permission
- Focus on slicing the pie, trying to keep others down



Coming soon