Princeton Plasma Physics Laboratory and the Fusion Industry

Steve Cowley, Director

Fusion Innovation

National Academy of Sciences Study 12/2018

- First, the United States should remain an ITER partner as the most cost-effective way to gain experience with a burning plasma at the scale of a power plant.

- Second, the United States should start a national program of accompanying research and technology leading to the construction of a **compact pilot plant that produces electricity from fusion at the lowest possible capital cost.**

Mike Mauel and Melvin Shoet -- chairs

National Need – Commercial Fusion

- $1B private investment in fusion in 5 years. Injection of ideas and enthusiasm. Realizing the NAS vision requires working with private sector
- PPPL is working with the leading fusion companies – they are employing our graduates and using our diagnostics
- PPPL is supporting new FES program INFUSE to enable companies to benefit from the National Lab
- **Working to develop a public-private funded innovative concept at PPPL. <u>We are not going to simply watch others do it!</u>**

TRI ALPHA ENERGY
THE POWER OF INGENUITY

generalfusion

arpa·e

U.S. DEPARTMENT OF ENERGY

FUSION INDUSTRY ASSOCIATION

Ahmed Diallo
Deputy Director, INFUSE

INFUSE

COMMONWEALTH FUSION SYSTEMS

tokamak energy
a faster way to fusion

STELLAR ENERGY FOUNDATION

WE PPPL WANT TO DO MORE TO HELP INDUSTRY – HOW?

Supporting the Industry

- Facilitating fusion start-ups. What do they need to reduce costs, remove barriers and proceed fast?

- What can we, a national lab do for the fusion industry?

Supporting the Industry

National lab could provide: (PPPL capabilities)

- Physical facilities:
  - Electrical power: fast (2.2GJ - seconds) and slow power supplies (50MW steady).
  - Cryogenics: liquid helium (1kW @4.5K), nitrogen (11000 gallons) .
  - Cooling water. (MWs)
  - Radio frequency power: microwaves. (5-7MW @Mhz)
  - Diagnostics: lasers, x-rays, microwaves.
  - Tritium handling.
- Expertise, consultancy
  - Design engineering capability. (Virtual engineering)
  - Safety expertise. (Electrical, radiation)
  - Fusion science. (World class)
  - Modelling and high performance computing

Facility Needs Drive Long-Term Campus Plan

1 **Engineering Center (2018)**

2 **FLARE User Facility (2021)**

3 **Compact Permanent Magnet Stellarator (2023)**

<u>Home for new private ventures?</u>

4 **Future Liquid Lithium Lab (2023)**

5 **Princeton Plasma Innovation Center (PPIC) (2025)**

- Modern medium bay laboratories for large and precision research needs
- Remote Participation and Collaboration center external experiments
- State-of-the-art visualization center for leveraging Exascale computing

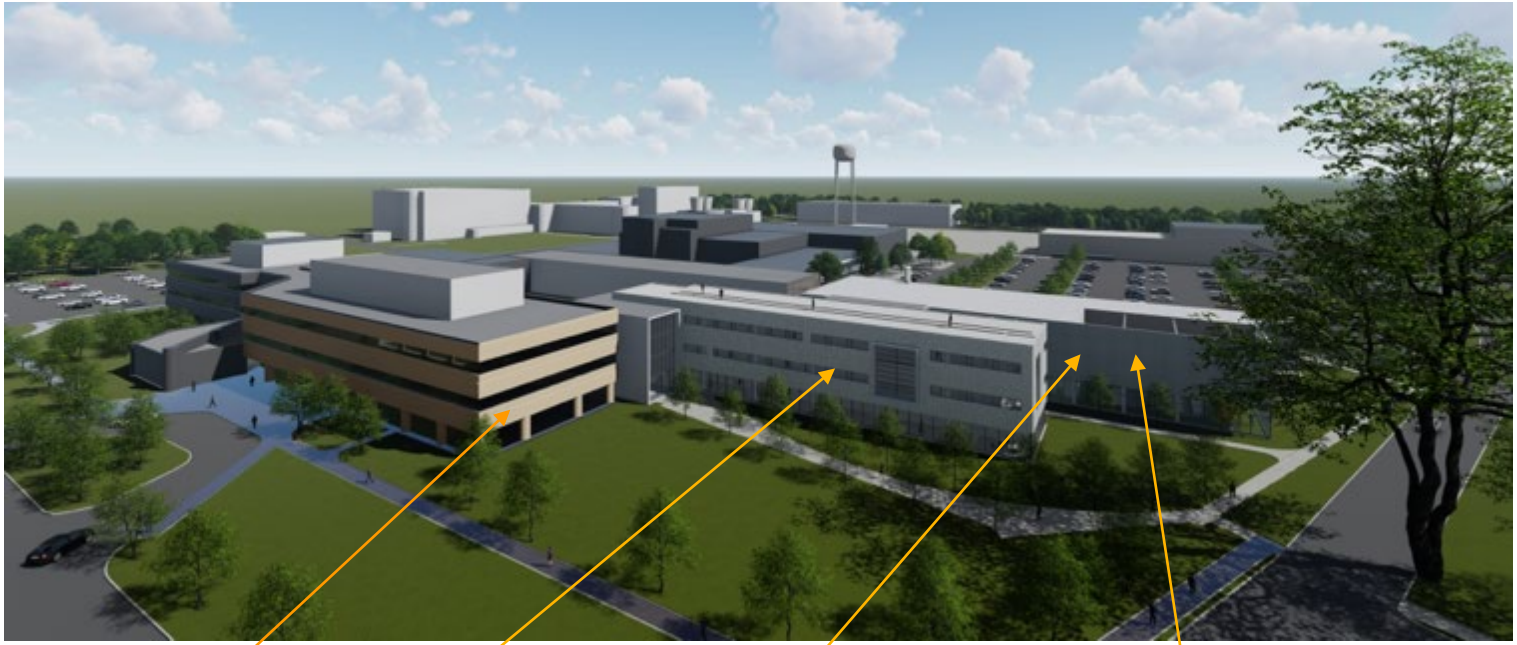
6 **Next large fusion experiment (2030) (Private Public Partnership?)**

New Computer Facilities

Princeton University to fund and manage new computer to enable high performance computing

- 1.5 petaflops
- 7 racks of Summit

Princeton Plasma IC Capabilities



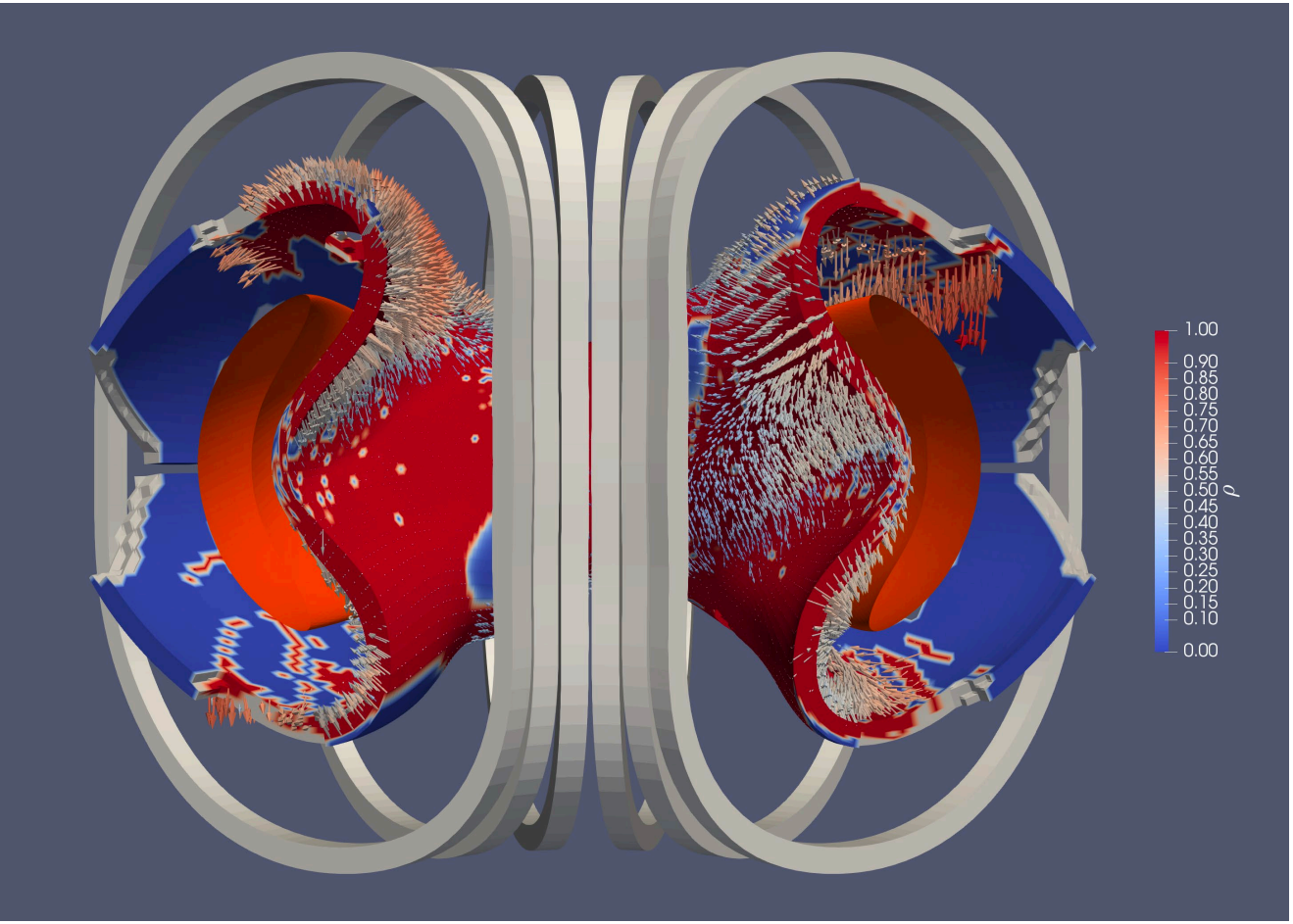
LSB West

Collaboration Space

Visualization and Remote Participation Room

Medium Bay Lab Space

Getting to Fusion Quickly



Optimizing physics on
high performance computers.
German breakthrough

Supported by
Simons Foundation

Driving simplicity in
engineering using new
Permanent magnets.

Game changing technology.

See poster by Zarnstorff

The end game

- Commercial Fusion will be delivered by private industry.
- Partnership with the public sector beginning.
- We need help to make that work optimally.

Thank you