Demonstration of low-density, high-performance operation of sustained spheromaks and favorable scalability toward compact, low-cost fusion power plants

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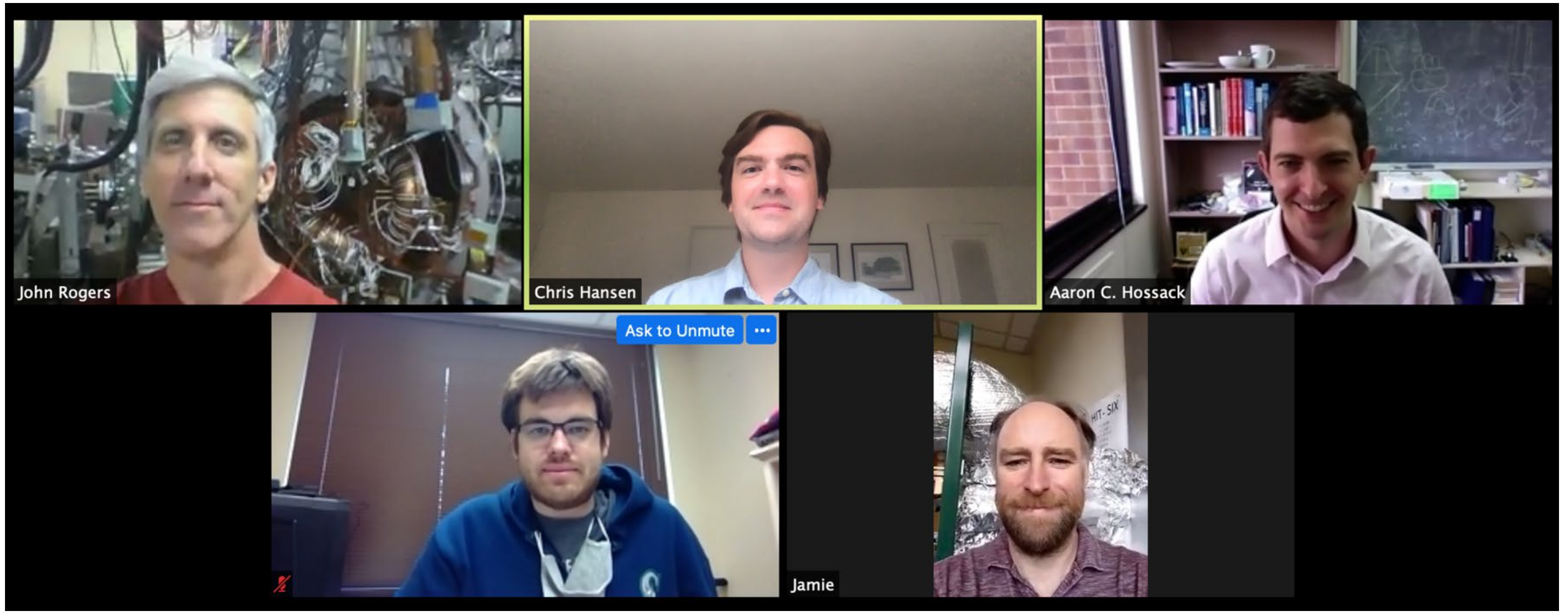
Team members and roles

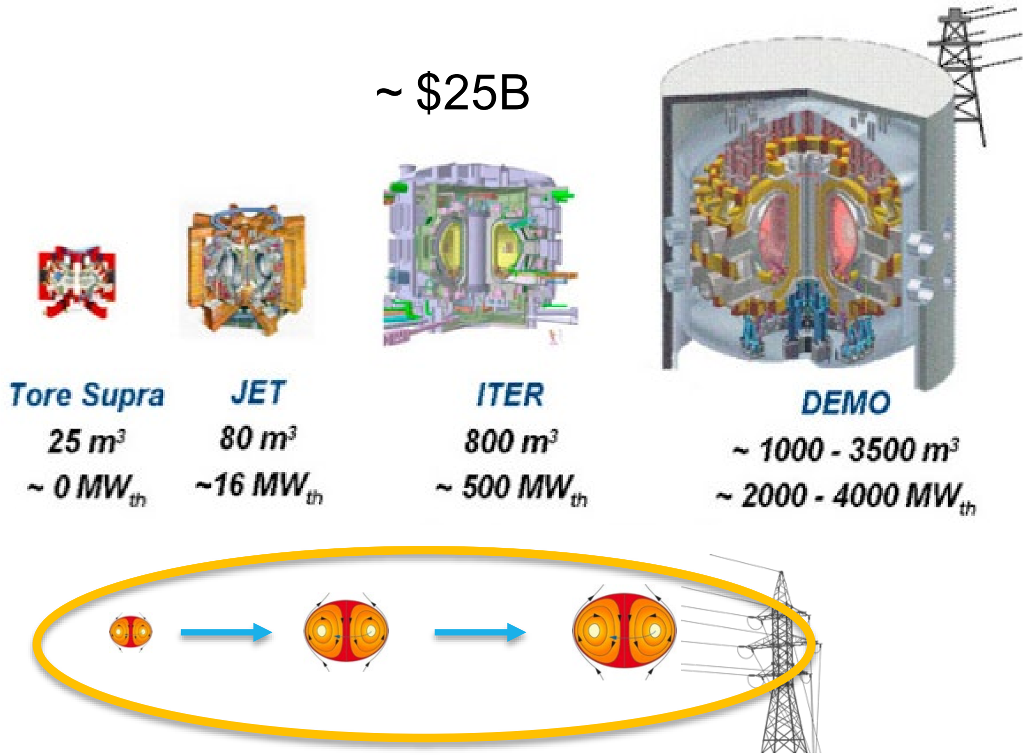
- Dr. Christopher Hansen, PI
- Dr. Aaron Hossack, Research Scientist
- Dr. Kyle Morgan, Research Scientist
- John Rogers, Lead Technician
- Jamie Coyne, Technician



Demonstrate efficient sustainment of compact spheromak plasmas with good energy confinement and reactor scalability

- Efficient sustainment of compact plasmas with good energy confinement
  - Improve on previous spheromaks using controlled 3D magnetic perturbations and inductive drivers
- Scalability of compact spheromak plasmas to economical fusion systems
  - Demonstrate compatibility of 3D drivers with path to reactor design points and requirements

- Lower both the development cost and final cost of fusion power generation

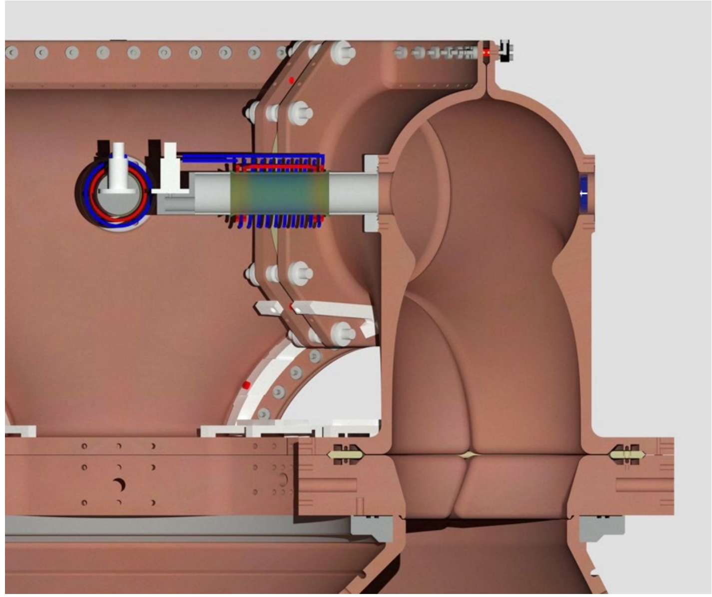


Compact, lower cost, faster!

Improve control of plasma density in experimental prototype (HIT-SIU) to demonstrate plasma heating/confinement

- Prior prototypes had limited density control requiring increasing power in time to “outrun” increasing density
- Significant improvements will be made through a new pre-ionized fueling system and modifications to passive density control components
- Control of plasma density allows time for plasma to heat and better use of available driver power

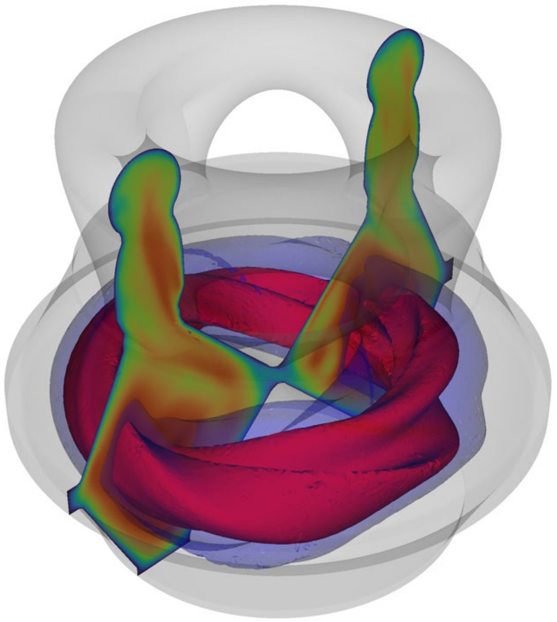
- Key risks:
  - Possibility of increased wall interactions near new fueling
  - Interference of driver circuits with pre-ionization system

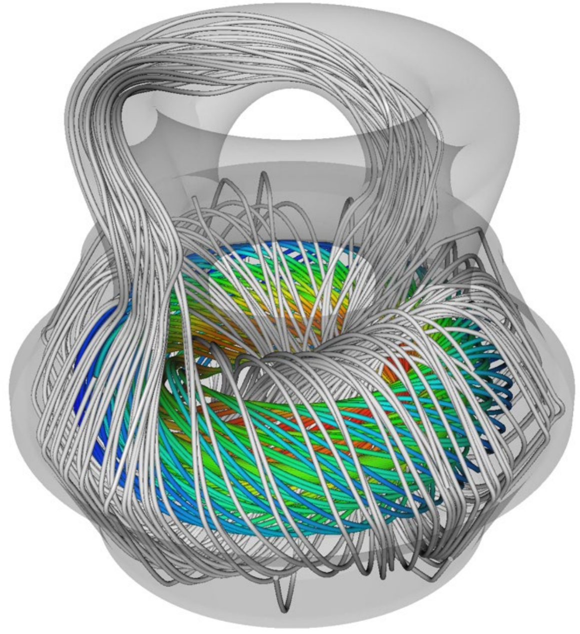


Develop computational models to predict performance of future design points and demonstrate reactor-scale configurations

- Develop "blueprint to plasma" model for predicting the performance and behavior of inductively driven spheromak plasmas
  - 3D extended MHD simulations with plasma-coupled circuits (PSI-Tet)
- Demonstrate self-consistent 3D driven equilibria from prototype to reactor scale
  - Large spheromak plasma current is driven by a small injector current
  - Details of driver/spheromak connection are important

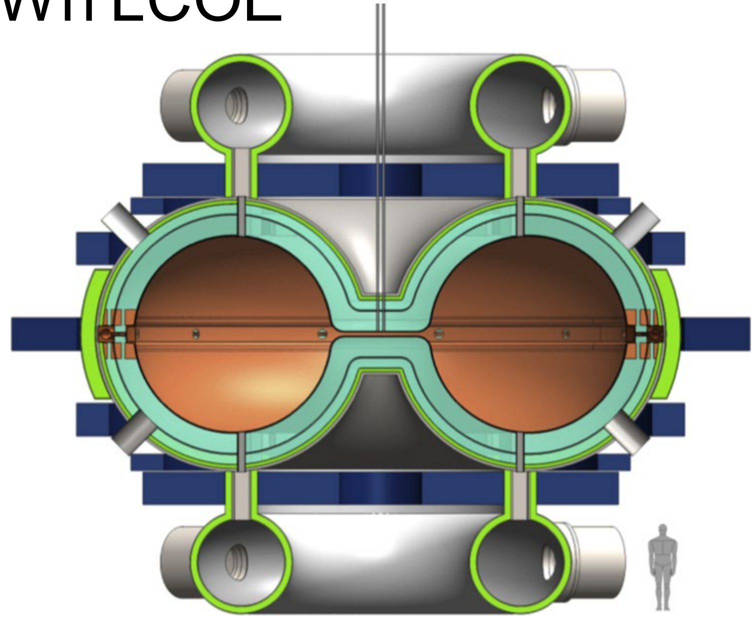
- Key risks:
  - xMHD may not contain all physics for "blueprint to plasma" model
  - Do equilibria exist at reactor scale with practical drivers?





Aim to demonstrate sufficient confinement during sustainment to exceed 100 eV and theoretical scalability toward a reactor

- Improvements to the small-scale prototype (HIT-SIU) designed to enable definitive demonstration of plasma heating during spheromak sustainment
  - Major barrier to all previous spheromak-based concepts
- Computationally explore scalability of concept to inform development path
  - Next-step experiments, high-fidelity from startup to flattop
  - Reactor scale, target plasma states to inform scoping/design
- Working closely with CTFusion to develop and refine low-cost fusion system designs, targeting:
  - Net-gain demonstration ~$100M
  - Commercial reactor 100-1,000MW @ < 5 ¢/kWh LCOE



Thank you for your attention

Questions?