Plasma-Jet Driven Magneto-Inertial Fusion (PJMIF)

BETHE Kickoff Virtual Workshop

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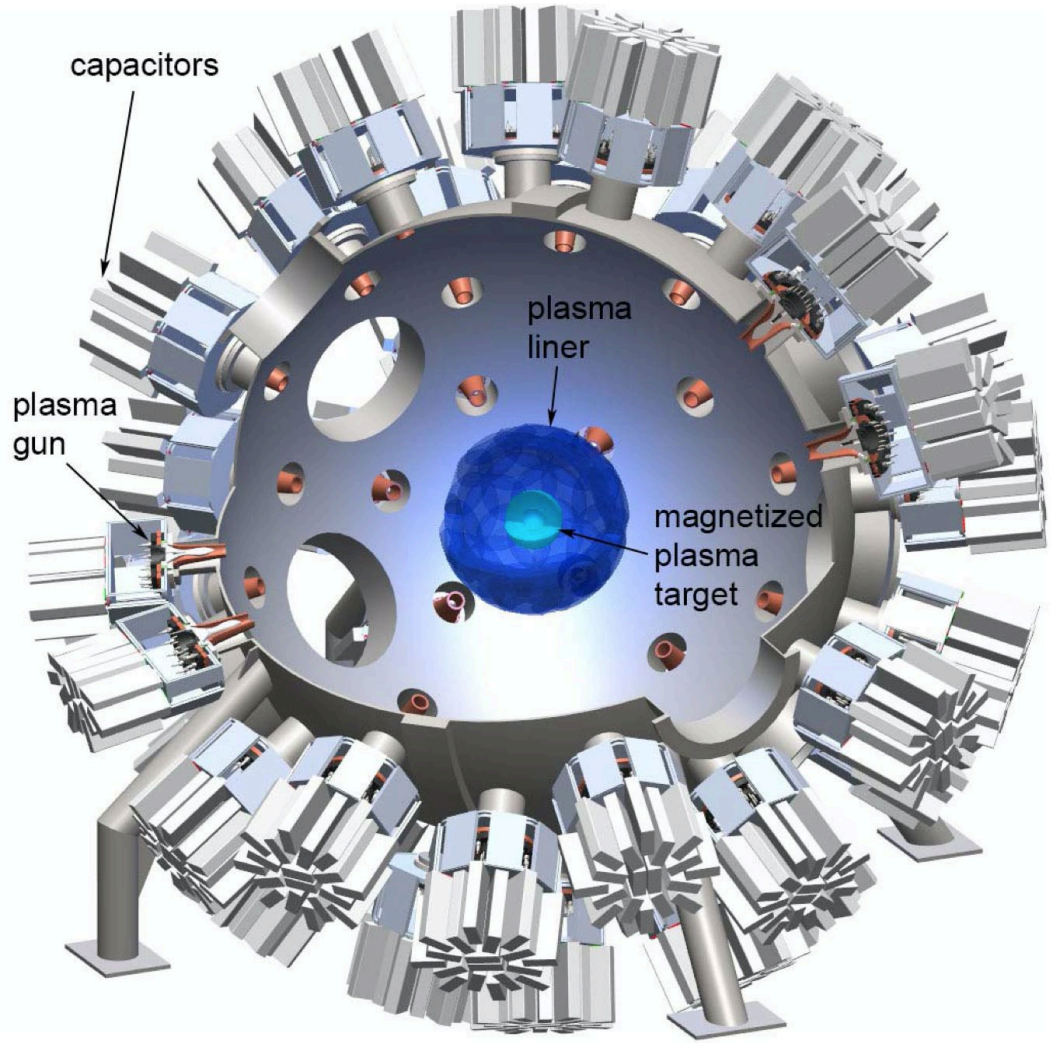
F. Douglas Witherspoon, HyperJet Fusion Corporation
Jason Cassibry, University of Alabama in Huntsville
Mark Gilmore, University of New Mexico

Team members and roles

- PLX @ Los Alamos National Laboratory, NM:
  - Integrated experiments
  - Sam Langendorf
  - Tom Byvank
  - John Dunn
  - New postdoc + students
- HyperJet Fusion Corporation, VA:
  - Plasma gun development
  - F. Douglas Witherspoon
  - Edward Cruz
  - Andrew Case
  - Marco Luna
  - Robert Becker
  - Adam Cook
- University of New Mexico:
  - Diagnostics
  - Mark Gilmore
  - New postdoc
  - New masters student
- University of Alabama in Huntsville:
  - Unstructured simulations
  - Jason Cassibry
  - Sumontro Sinha
  - Aalap Vyas
  - Bennett Hasner
- The BETHE capability teams:
  - Fluid and kinetic modeling and simulation
  - Machine learning

High-level motivation and goals of the project (speak directly to the goals of your project's technical category)

- Category A: Fusion concept team
- Explore an innovative alternative path to fusion power: Plasma-jet driven magneto-inertial fusion (PJMIF)
  - MIF + Spherical compression
  - Efficient high-velocity driver
  - High-beta target vs. MHD instability
  - Attractive reactor development path



Major tasks (and technical risks), milestones, and desired project outcomes

- Formation of novel high-beta (beta >> 1) magnetized target plasma compatible with spherical compression, e.g. tangled field →
  - Modeling: fluid and kinetic investigation of target formation and compression
  - Experiment: colliding magnetized jets to demonstrate standoff target
  - Risks: can we form such targets, and will they perform as well as we expect?
- Liner optimization
- Integrated Experiments

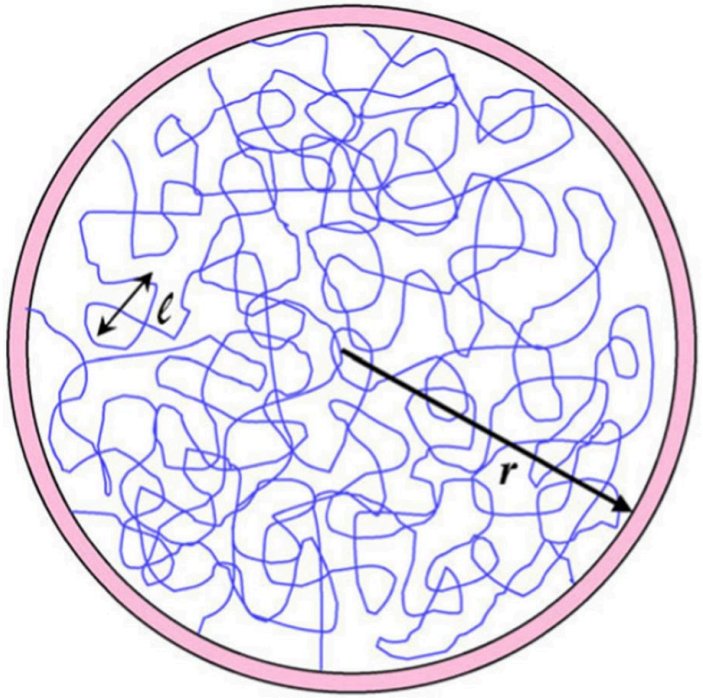


Fig. 1 Illustration adapted from [34] of a hypothetical spherical plasma target with highly tangled, open magnetic field lines with correlation length $\ell \ll$ radius r

Ryutov et al., F.S.T. 2009

Key techno-economic metrics of the project (and, if applicable, its commercial fusion-energy application)

- Attractive fusion core: Liner and target are line-replaceable, no repetitive hardware destruction → low cost of electricity
- First wall "standoff" distance from the fusion plasma → component lifetime
- Pulsed concept: amenable to load-following via shot rep-rate
- Low cost, modular components (plasma guns), easy to scale, no exotic new technologies required