Experimental and Computational Study of Power-Generating Magnetic Nozzles for Pulsed Fusion Propulsion

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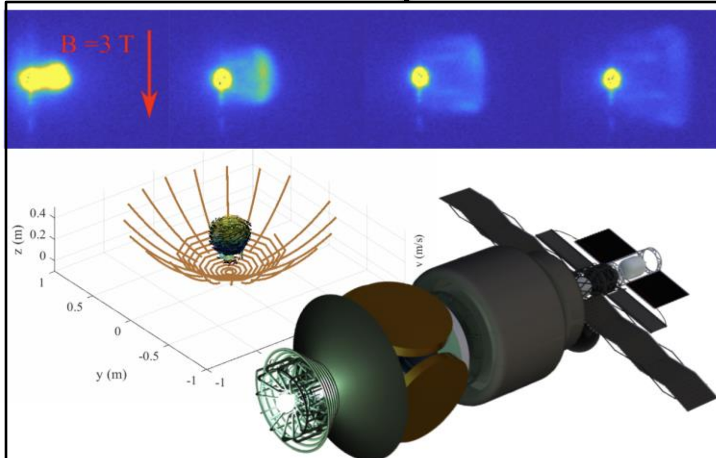
Research Objectives

- The first effort to test integrated power-generating magnetic nozzles (PGMN) for pulsed fusion propulsion.
- Develop data-backed scaling relations for PGMN to conduct more accurate propulsion system designs
- No experimental data on PGMNs currently exist. Currently power-generation and magnetic nozzle studied as separate
  - Starting TRL 2 – the concept of PGMN exist, but no experimental data
  - Ending TRL 3 – conduct first experiments and modeling on integrated PGMN

Approach

- Combined experimental and computational for feedback.
- Laser-induced plasma testbed for pulsed fusion reaction.
- Design, model, test different magnetic nozzle topologies and plasma flux compression generator designs to measure plasma behavior, thrust, Isp, and power generated.
- Experiment provide initial conditions and validation results for computational model, model provides new topologies to test and scale-up relations.
- Using data-backed scaling, conduct improved pulsed fusion propulsion vehicle study using PuFF as baseline.



Rendering of pulsed fusion propulsion vehicle with PGMN, model of plasma expansion in PGMN, and experimental data of plasma retardation and expansion in strong magnetic field.

Potential Impact

- Provide first experimental and validated computational results for PGMN technology.
- PGMN is enabling technology for pulsed fusion propulsion for future Mars and deep space exploration.
- The more accurate experimental data backed scaling relations will greatly improve future mission studies and system designs for fusion propulsion.
- Study of plasma interaction with magnetic fields, plasma flux compression generators, and laser-plasmas can contribute to other fusion technologies, plasma propulsion, and pulsed power technologies.