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Updates to the Laser Gate Experiment for Increasing Preheat Energy Coupling Efficiency in Magnetized Liner Inertial Fusion (MagLIF)*

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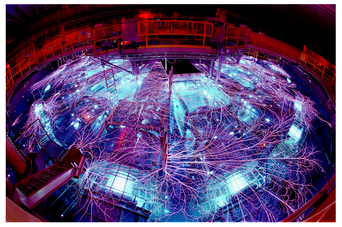
Fourth Year LRGF

Motivation

- Achieve ignition for clean energy and stockpile stewardship applications
- Magnetized Liner Inertial Fusion (MagLIF) is a pulsed power version of inertial confinement fusion (ICF) studied at Sandia's Z Machine

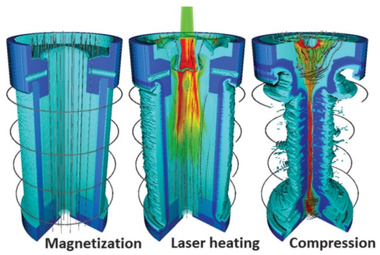


Z Machine at Sandia[1]

- Losses in fusion gain from laser energy absorption, and fuel-window mix originating at the Laser Entrance Hole (LEH)
- Mitigate losses and fuel-window mix to increase yield for MagLIF

Background

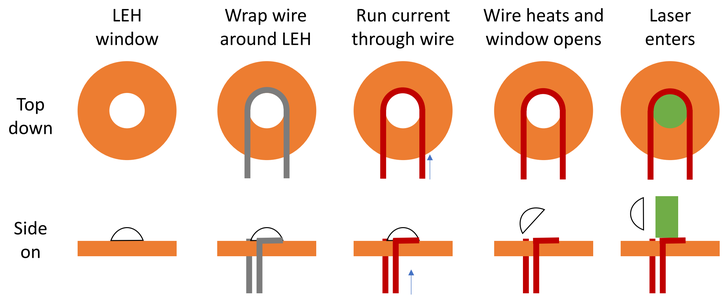
- 3 stages of MagLIF:
  - Magnetization
  - Laser heating
  - Compression
- LEH window keeps fuel inside of target until laser heating stage



MagLIF stages[3]

- Need to remove LEH window from path between laser and fuel
- Weaken LEH window and it opens out and away from laser path

Laser Gate Concept

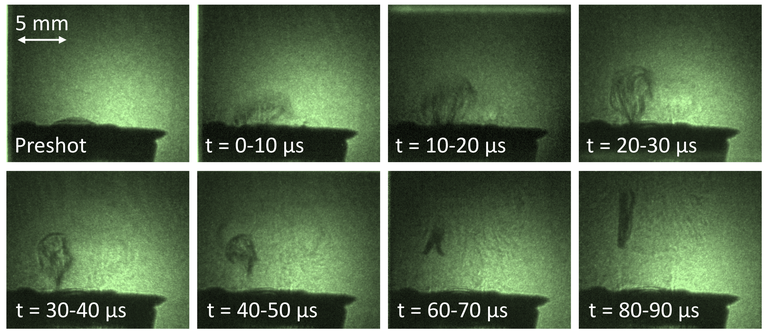


- To eliminate fuel window mix and laser plasma interactions (LPI)
- Remove window early in time as proposed by Steve Slutz

Objectives

- Reduce possible LPI losses by removing window early in time[2]
- Image LEH window opening to verify pulsed method
- Study fuel escaping from target (Schlieren Photography)
- Work to integrate to preheat studies at Sandia (eventually Z)

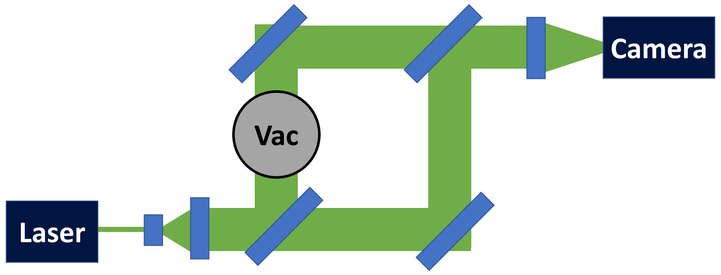
Laser Backlit Opening[4]



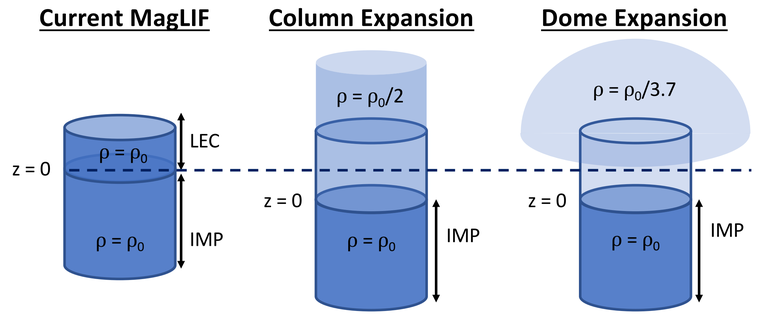
- Filmed on fast framing camera with laser backlight
- Window opening out of laser path on order of expected time scale
- Window rides along edge of escaping gas column

Interferometry Setup

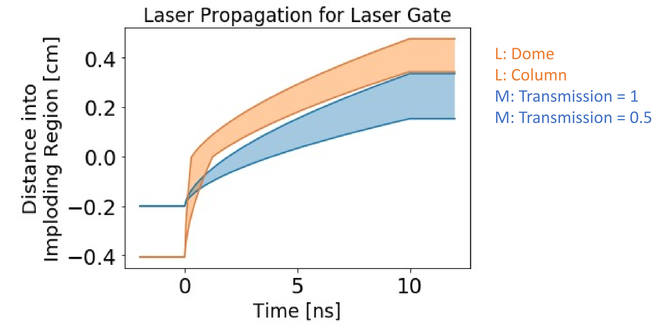
- Coded analysis with Abel inversion to back out density values
- Current vacuum chamber setup with interferometry
  - Determine current threshold needs
  - Study opening dynamics in vacuum
  - Calculate density of escaping gas



Modeling Laser Energy Deposition



Laser Gate Performance



- Preliminary results show "dome" expansion density
- Hope to measure deeper/better deposition for Laser Gate

Conclusions

- Imaged window opening
- Proved Laser Gate concept
- Built interferometer test stand

Future Work

- Current threshold studies
- Interferometry studies
- Integrated MagLIF shots

References

[1] Image taken from www.sandia.gov/z-machine
[2] S. A. Slutz, et al., Phys. Plasmas **24**, 012704 (2017); S. A. Slutz, personal communication (2017)
[3] M. R. Gomez et al., PRL **113**, 155003 (2014)
[4] S. M. Miller et al., RSI **91**, 063507 (2020)

Acknowledgments

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