第３回「高エネルギー電磁ビームに誘起される放電
とその工学的応用」研究会
於　六ヶ所核融合研究所
２０１７年９月１３・１４日

多孔熱交換型レーザー推進機を用いた超小規模打ち上げシステムの実現性解析

Feasibility study of very-small-scale launch systems using porous heat-exchanger laser propulsion

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Alternative: Laser – why ?

Laser vs Microwave (MW)

Focusing capability

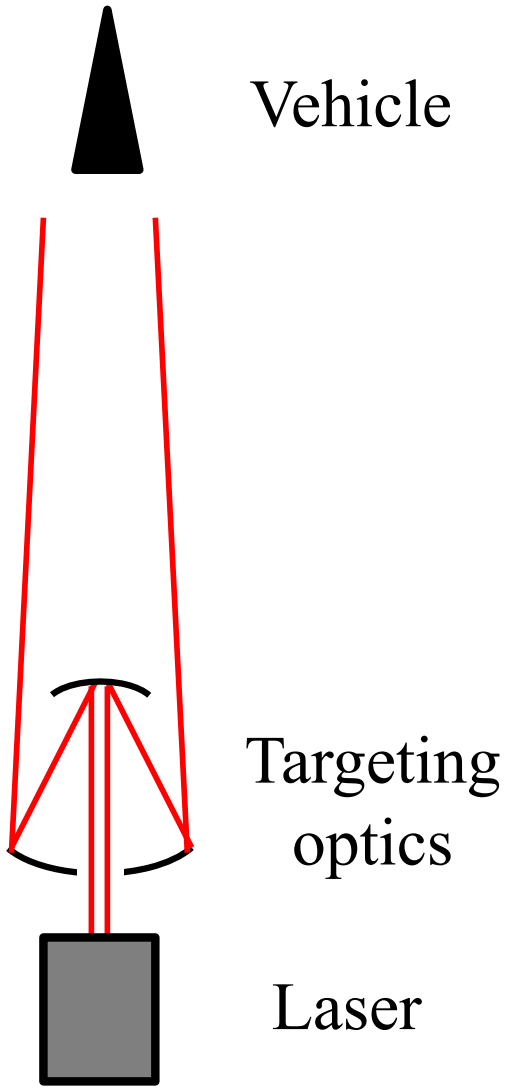
- Compact vehicle

- Weight, Front area

MW (2.45GHz) : $\lambda \sim 1$cm

Laser (Nd:YAG): $\lambda \sim 1\mu$m

Laser - Smaller spot

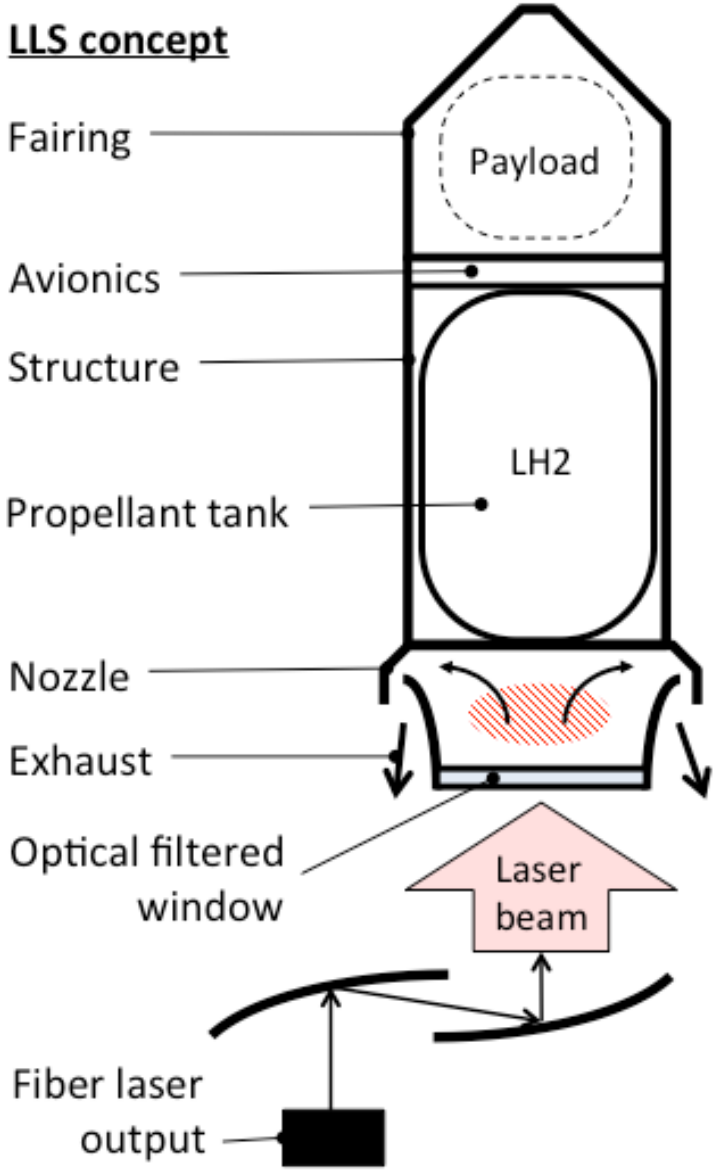


100kw-Laser Launch System (LLS)

100g payload

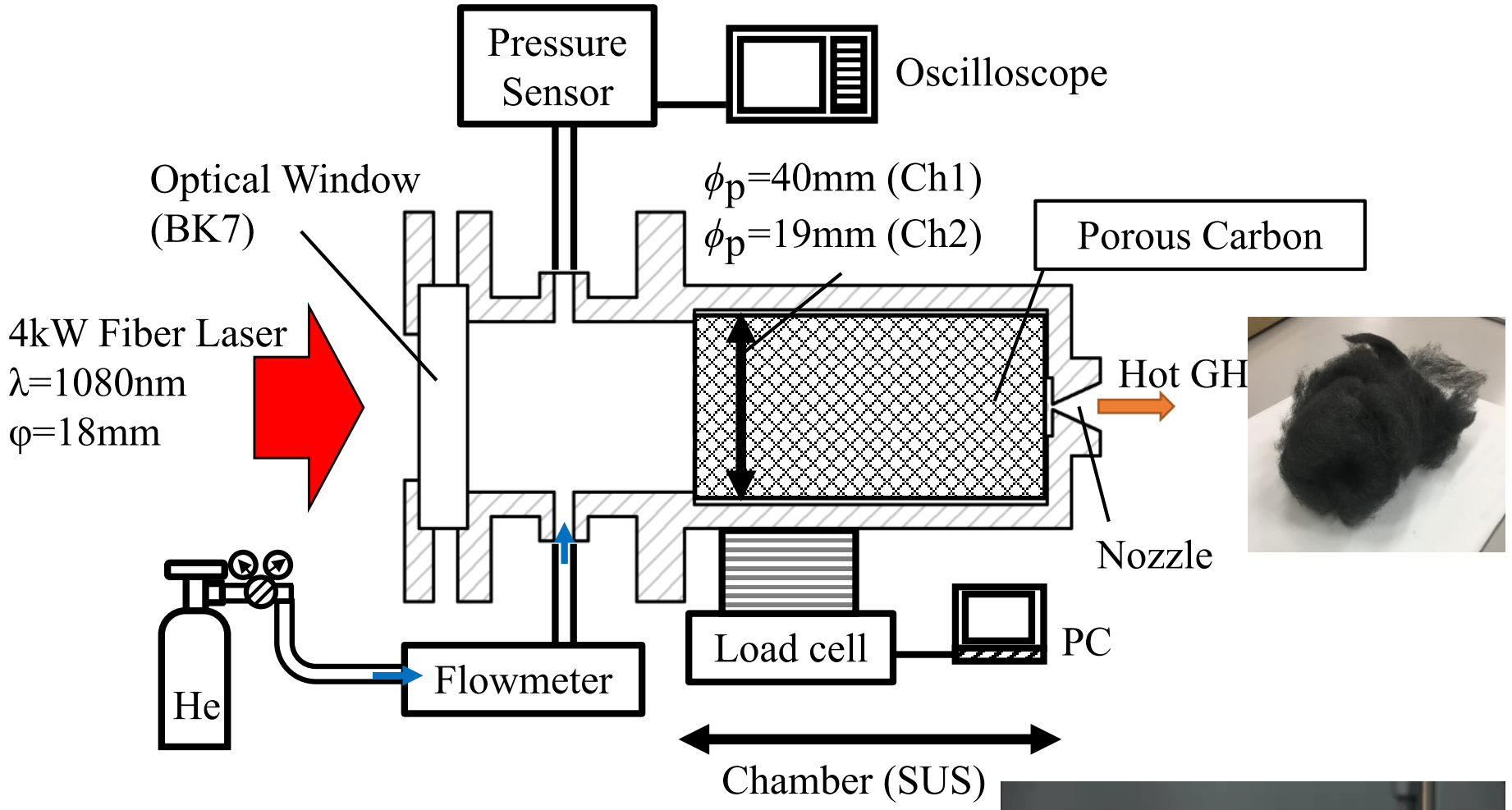
1kg vehicle (sub-meter size)

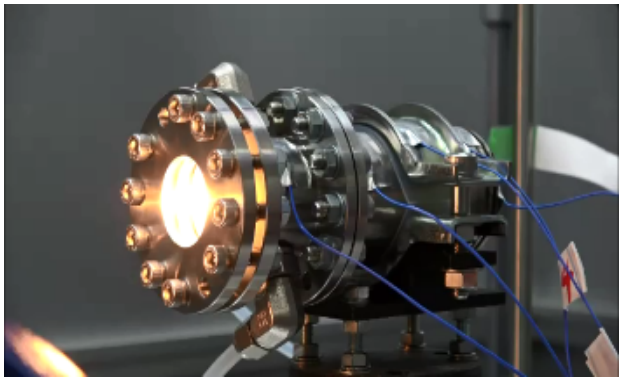
100 kw laser



Element	*Task*
Guidance & Control	• Trajectory plan • Beam riding • Actuator • Light weight
Structure	• Light weight • Strength
Propellant tank	• Sizing • Light weight • Cryogenic
Engine	• Principle < LSP / PHX • Nozzle flow • Nozzle cooling • Pump • Optical confinement
Collimation optics	• Optical design • Cooling • Air turbulence • Exhaust interference

New LHX Engine Model #1





Summary

1. New concept of Porous Laser / Heat exchanger Rocket is proposed. The model thruster has been tested using 4kW fiber laser in NADEX Inc..

2. GHe was heated upto 1500K, which corresponds to the specific impulse in vacuum at 407 s.

3. Radiation from porous heat exchanger is found major factor that reduce the thermal efficiency. New design to suppress the radiative loss is necessary.

2017 Target

Objective

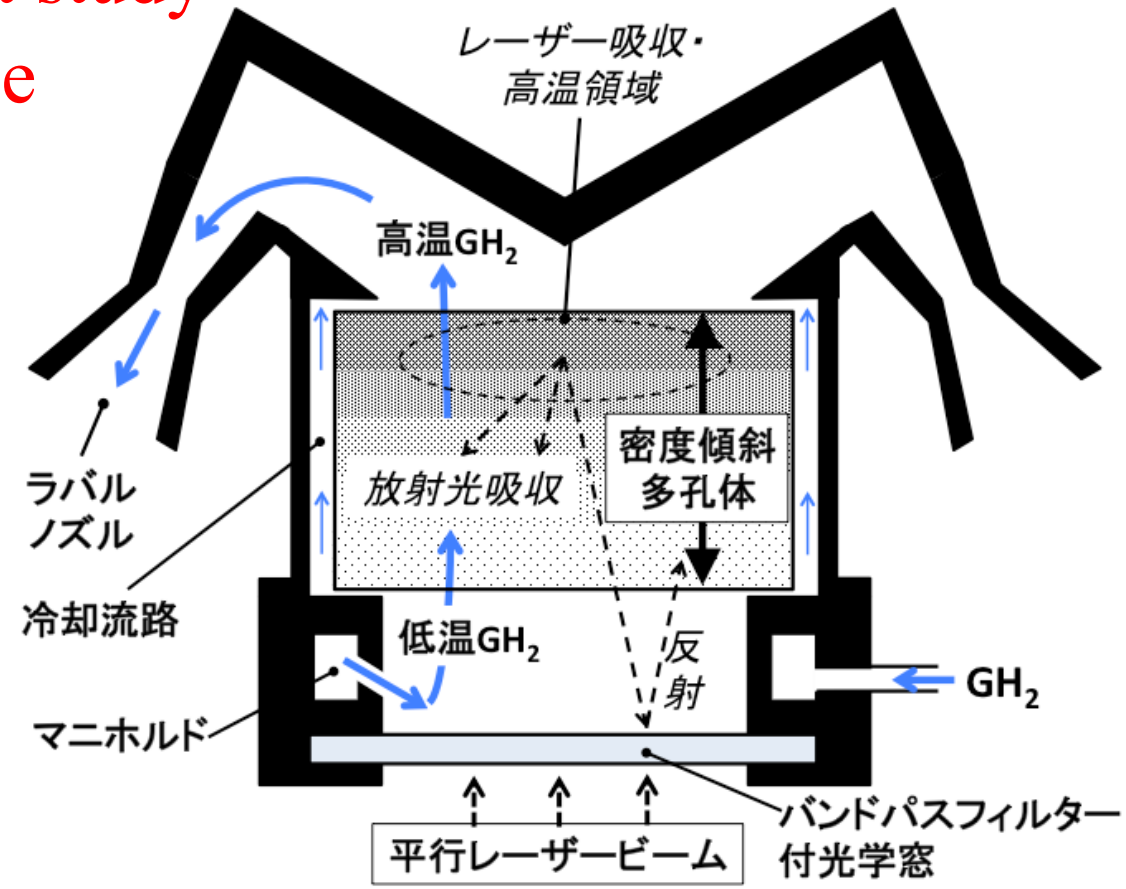
- Launch system concept study
- Propulsion performance

Subject

- Temperature to 3000K
- Radiation confinement
- Cooling design

Method

- **Concept study WG**
- **Laser Experiments**
- Thermo-Fluid-Radiation simulation in porous media



Plan to 2020

2019: Indoor launch

- Light-weight rocket design

2020: Outdoor launch

- Record break (>100m)
- Beam control
- Safety assessment