NASA Field Test

Physical Sciences Inc.

VG10-119-1

- Mauna Kea, Hawaii
- Lunar analog test site
- January 27 – February 10, 2010 (PSI on site)
- Sintering performed January 29 – 31

Sintering a joint effort of PSI and NORCAT

- PSI Solar Concentrator
- NORCAT X-Y-Zed Stage

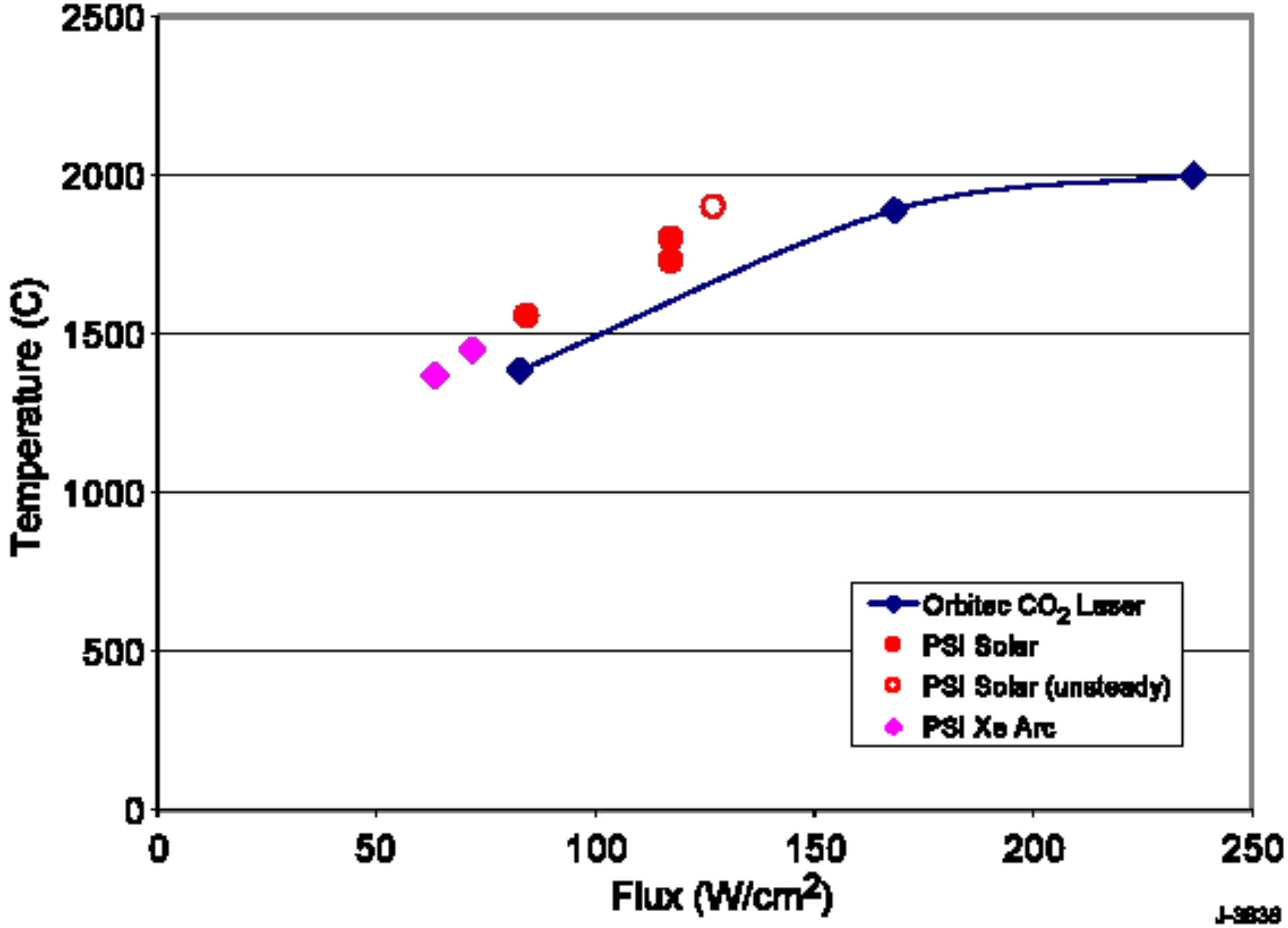
Goals

- Demonstrate sintering of native tephra
- Produce a sintered 'test patch' for thruster firing

Background

- **Sintered regolith can be used for load bearing and dust mitigation**
  - Roads
  - Foundations
  - Walkways
  - Berms
- **Solar power is a cheap, abundant resource in space**
  - Concentrators are cheaper and lighter weight than photovoltaics
- **The optical waveguide (OW) technology is used to mechanically de-couple the output from the concentrator optics**
- **This effort parallels work done by Hintze at KSC**

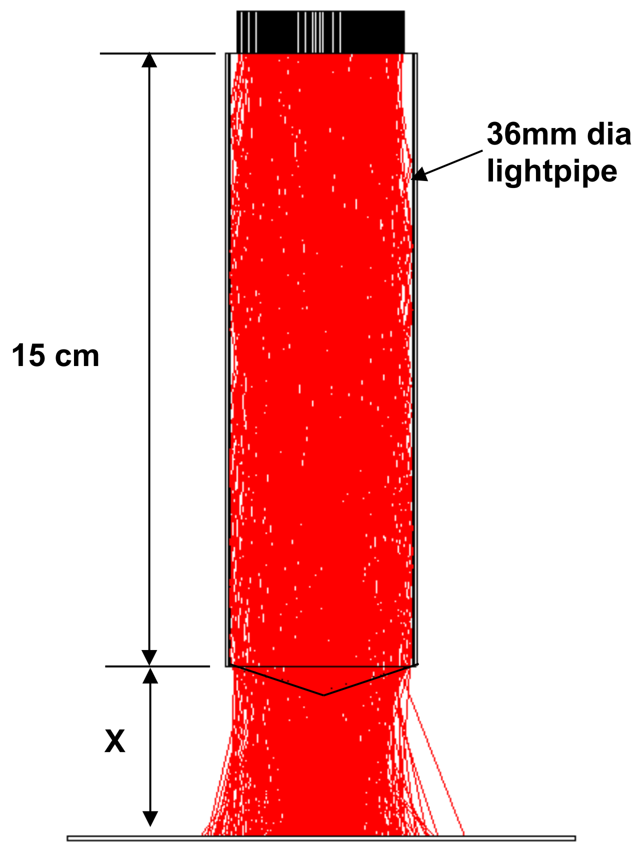
Surface Temperature of JSC-1 Melt

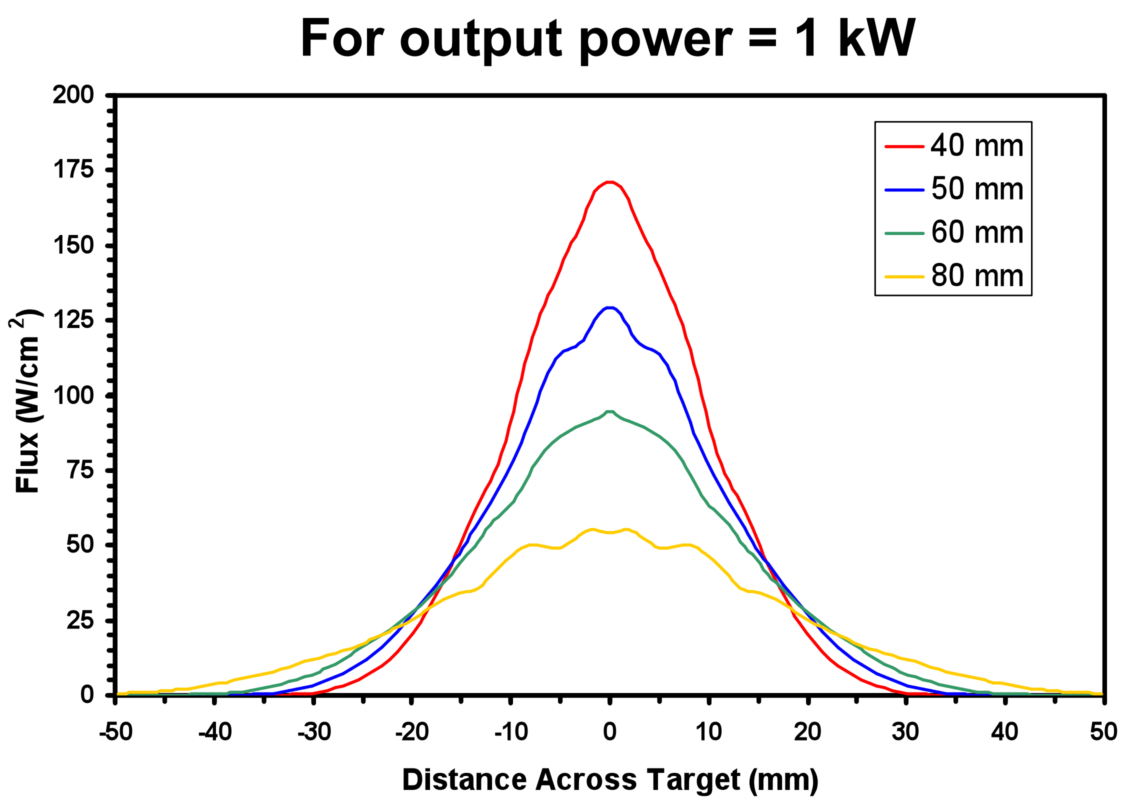


Temperature measured by Type C (W 5% Re - W 26% Re) thermocouples

Ray-Tracing for Sintering Rod

Note: Rod Length 15 cm is for ray-tracing, not actual hardware





Solar Thermal System Diagram

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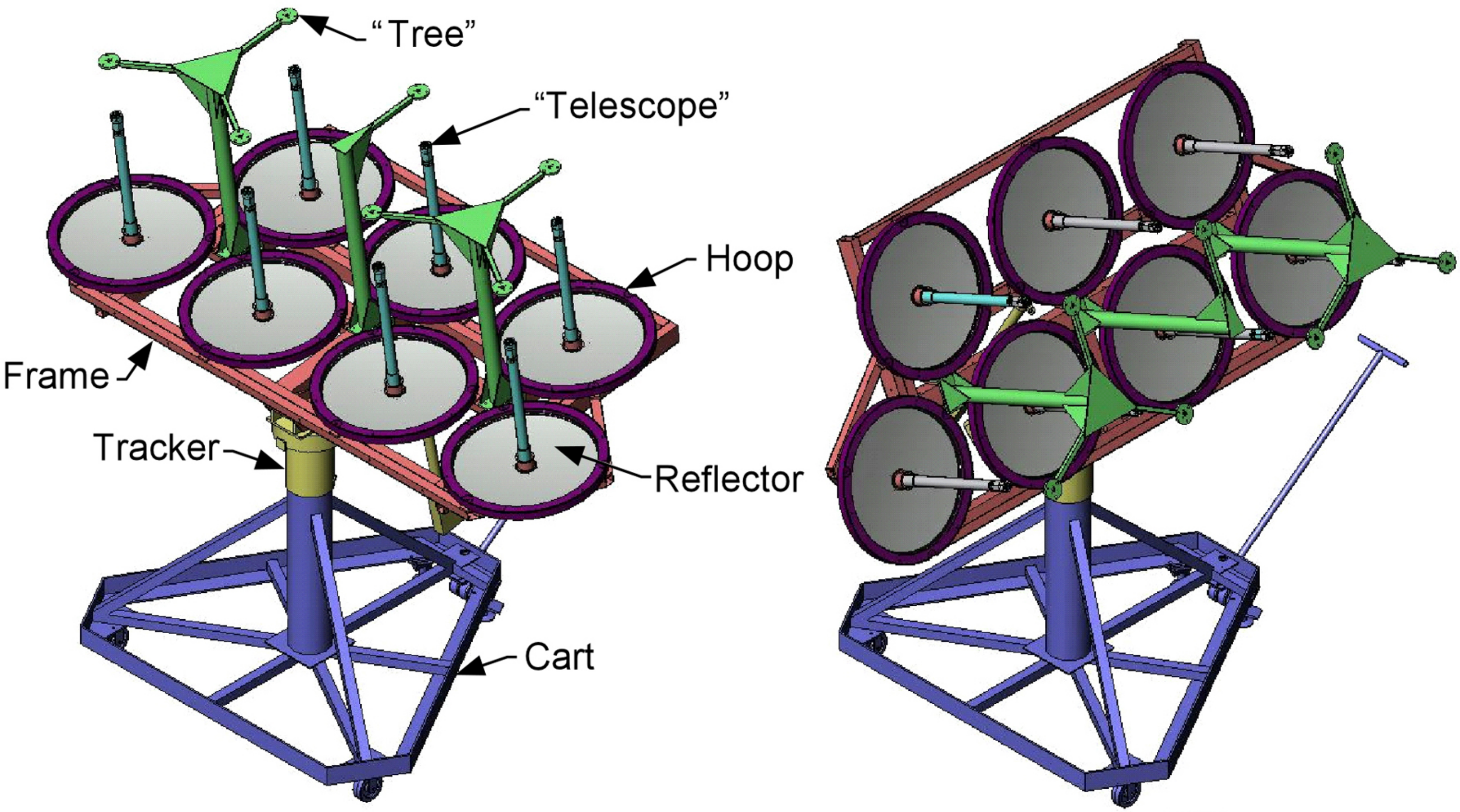

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Concentrator During Sintering, Mauna Kea HI

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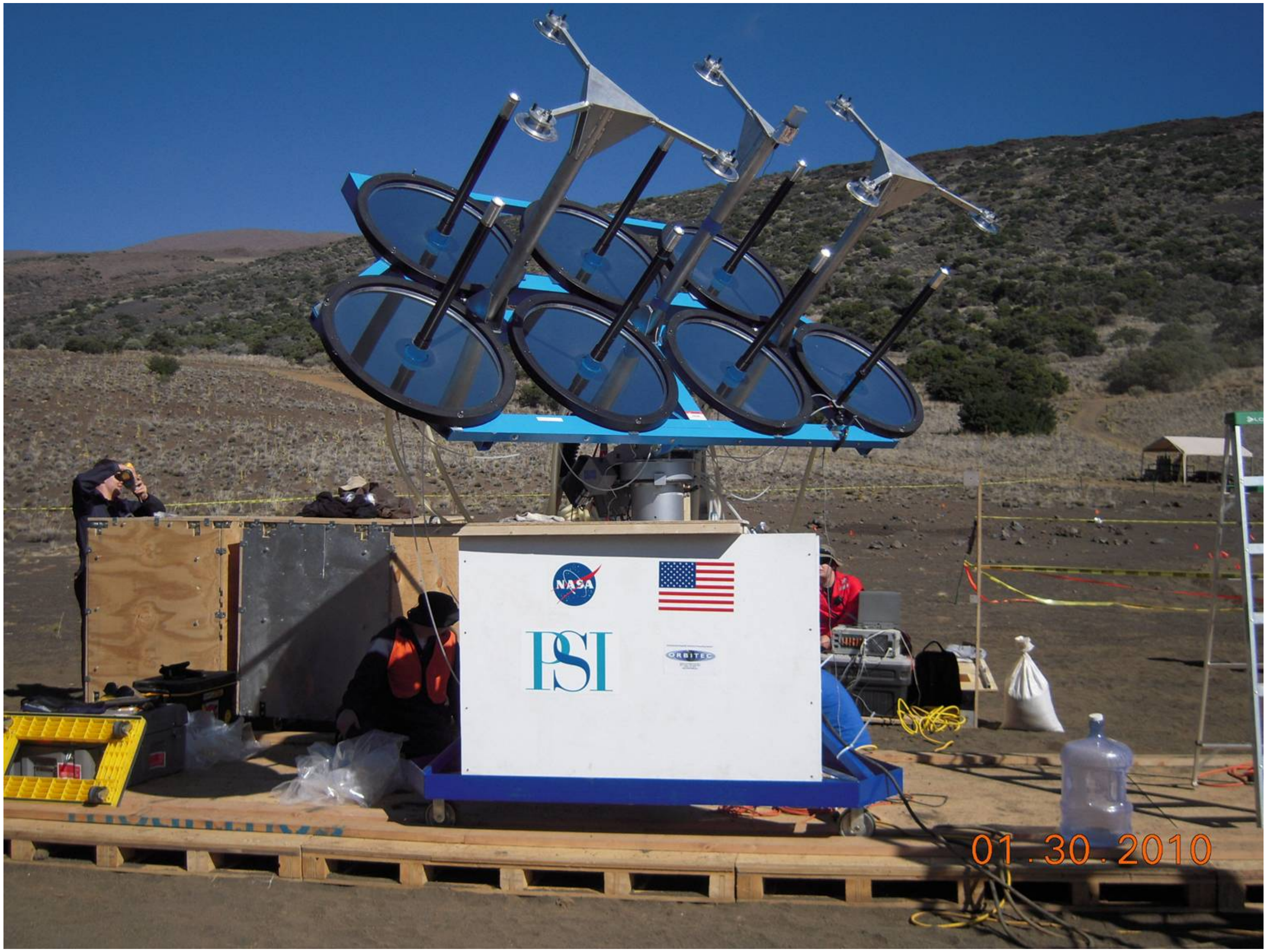
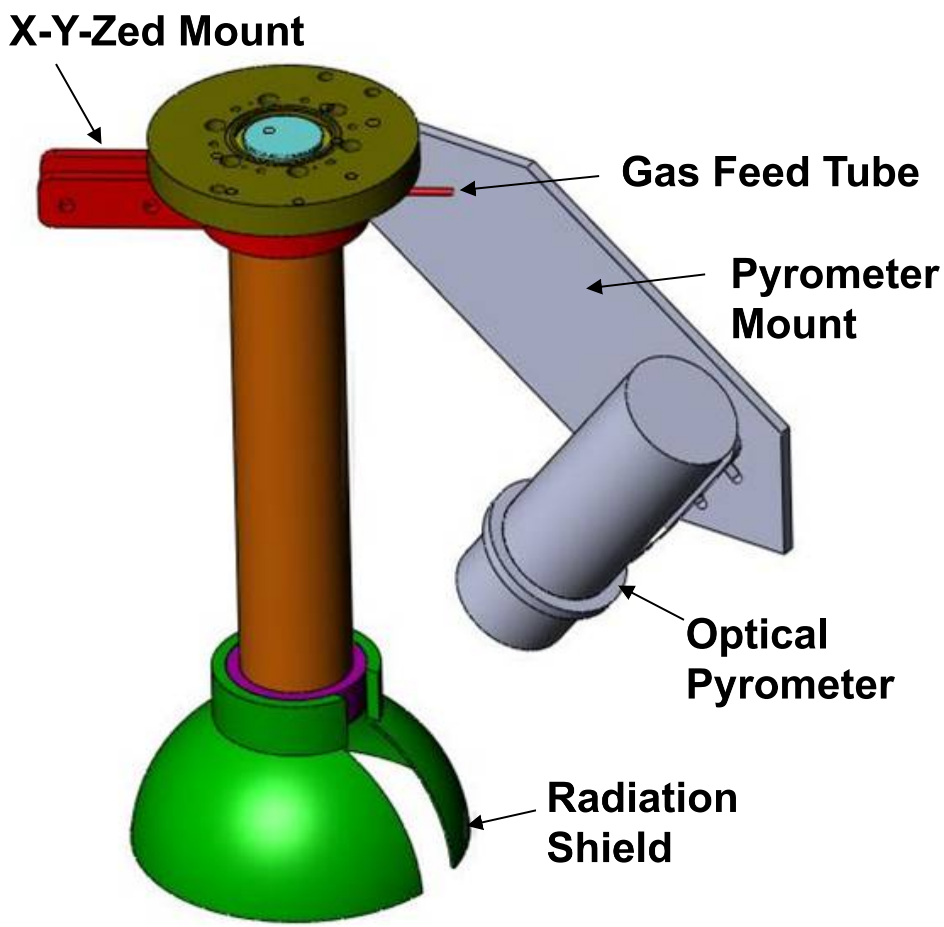
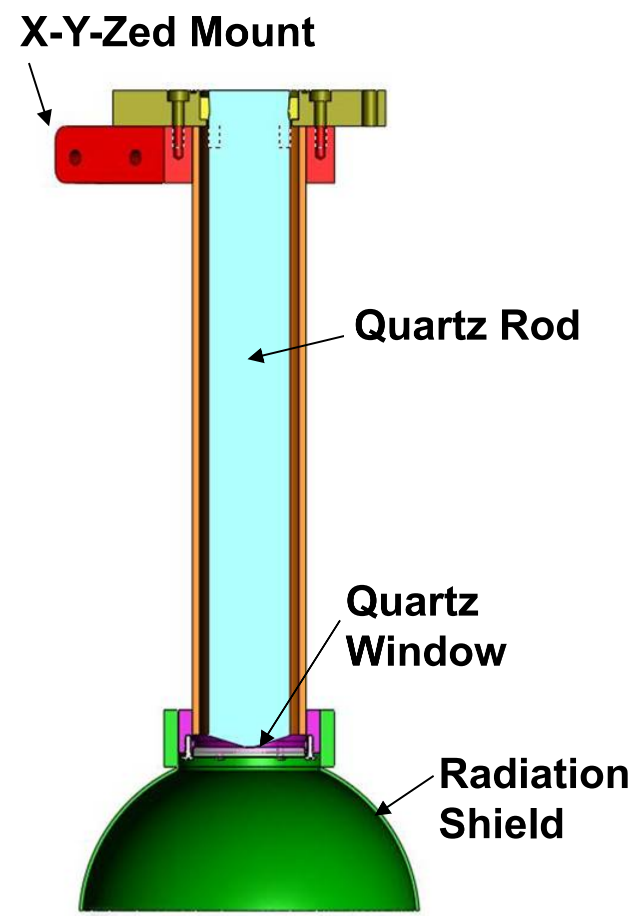


X-Y-Zed Table During Sintering

Sintering Quartz Rod Design

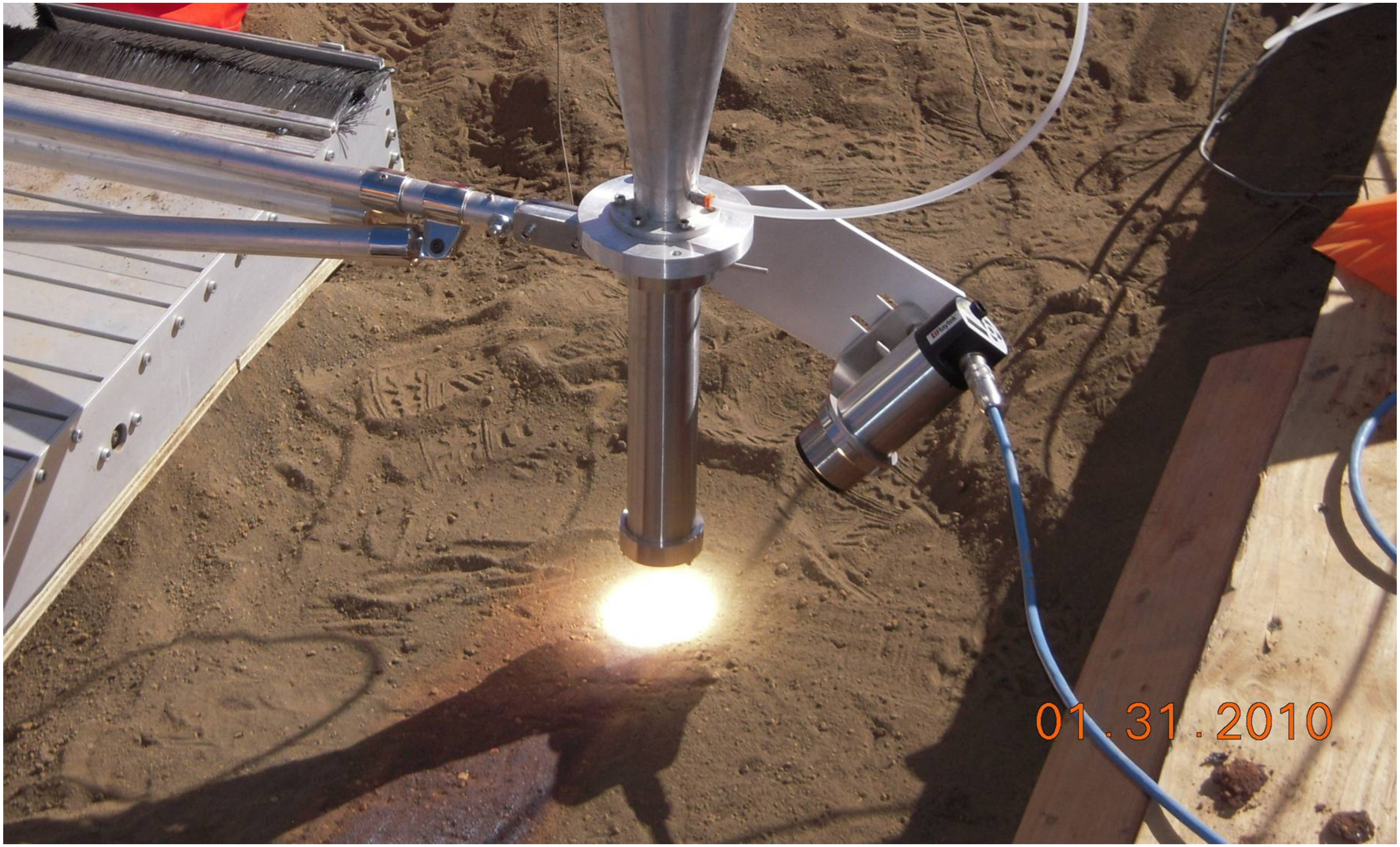




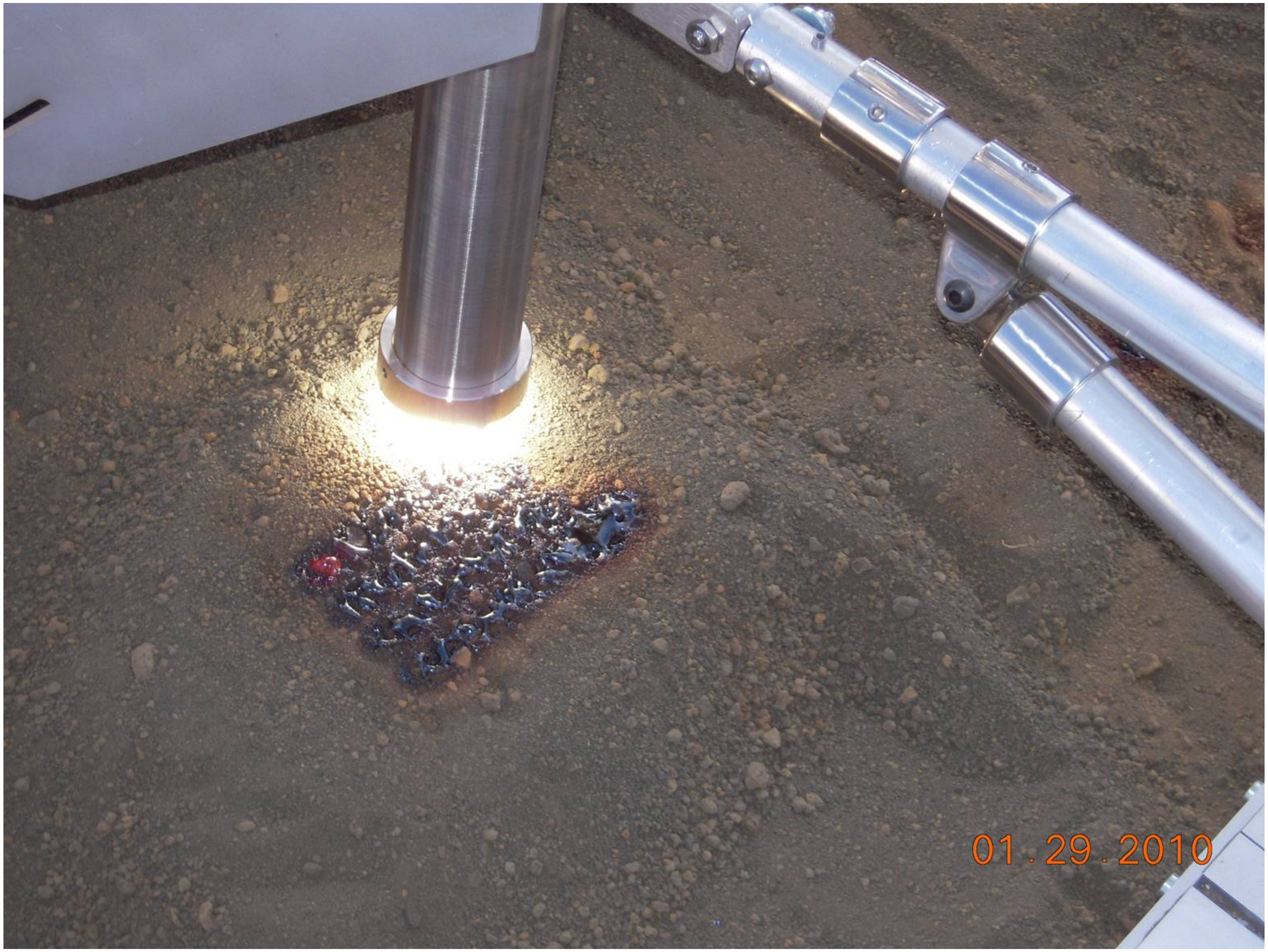
One-Color Optical Pyrometer

- **Raytek MMG5H**
- **5 micron measurement**
- **Solar energy doesn’t interfere with the measurement**
- **Sensor was calibrated for emissivity at 550 ºC**

Sintering Quartz Rod Assembly Photo



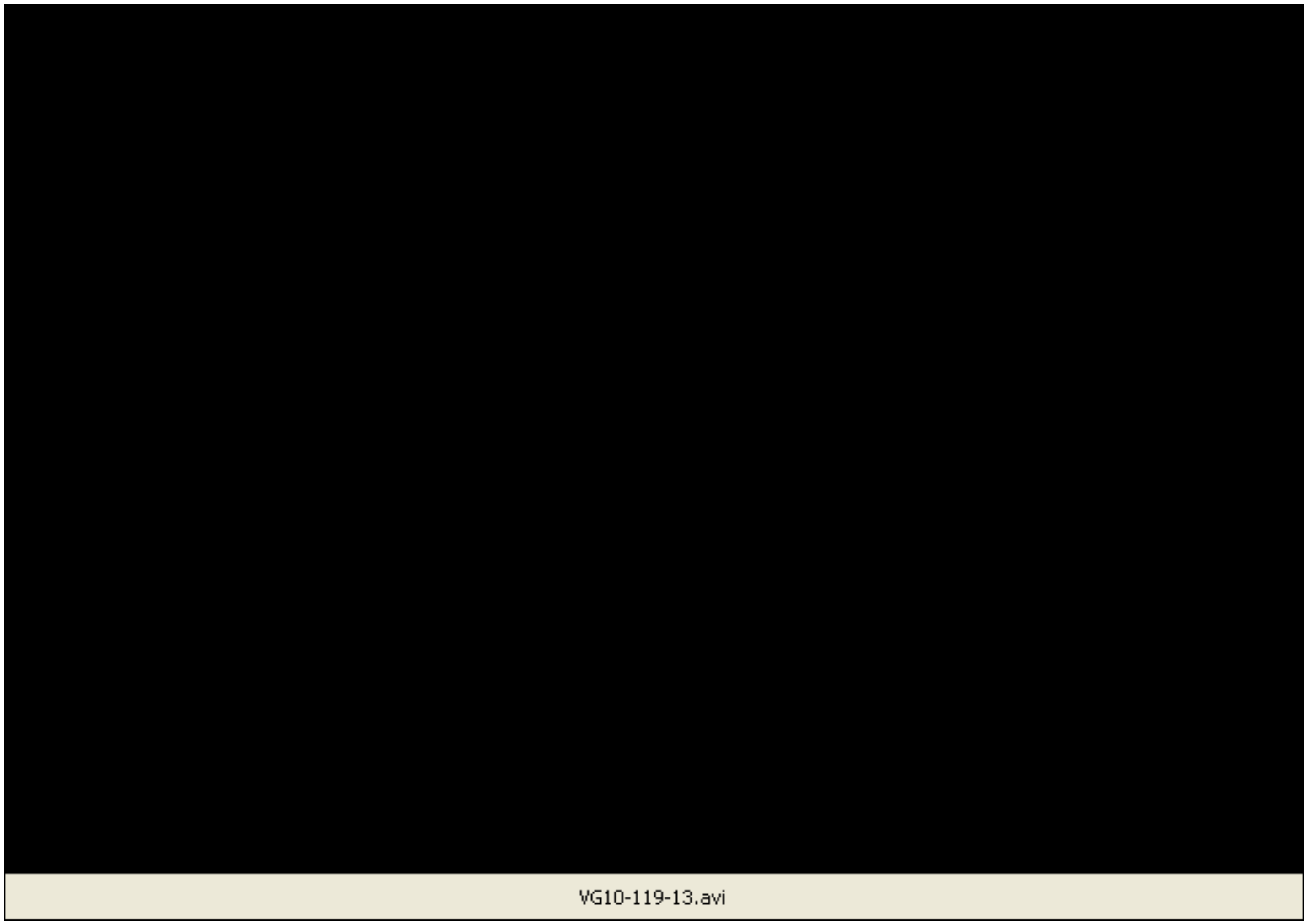
Melting Tephra



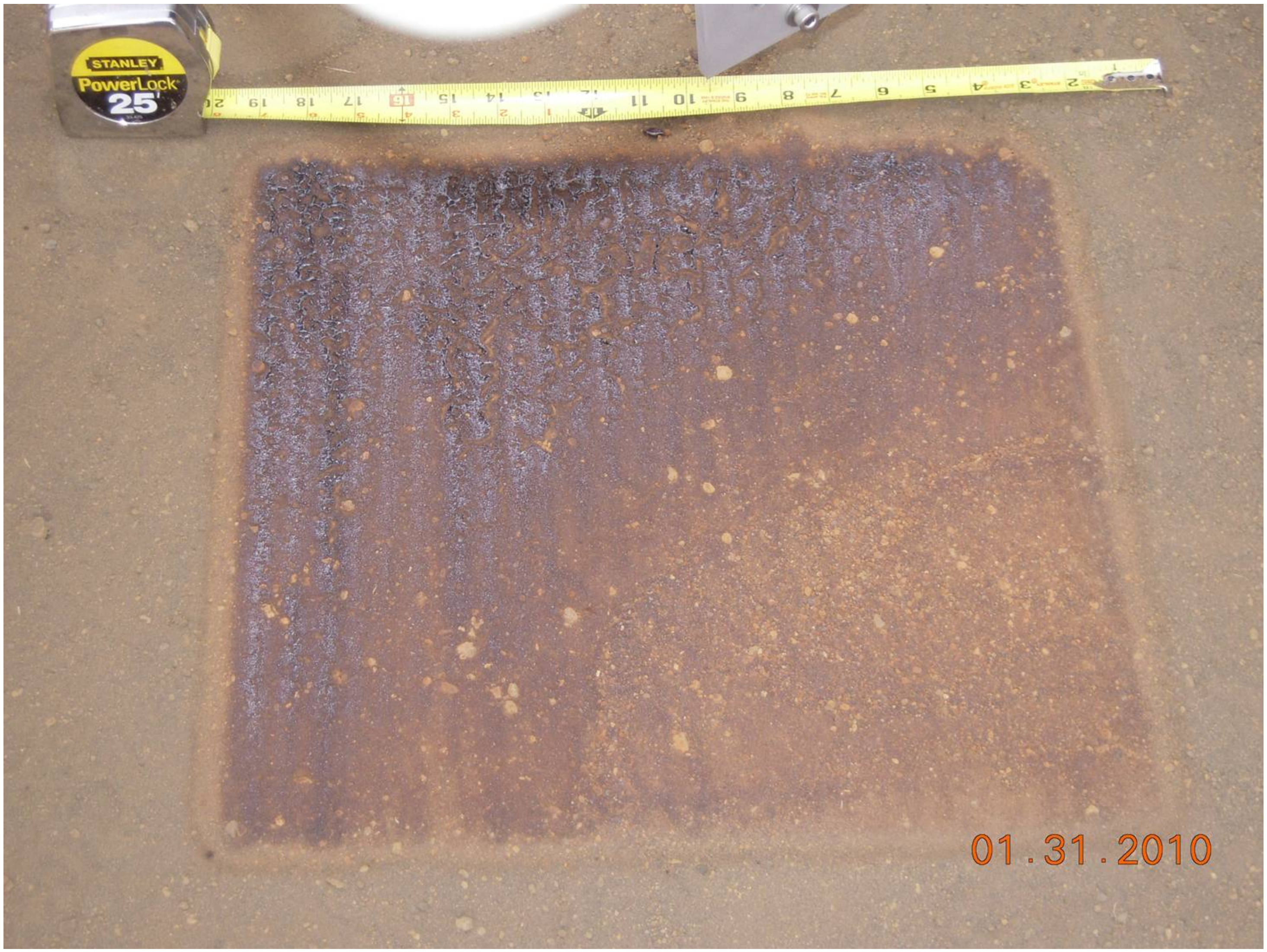
Process Optimization

- 500 W – 560 W power in full sun
- 2 in from tephra surface
- Temperatures reached more than 1300º C at steady state
- Multiple trials at different speeds and distances
- 2.35 mm/sec produced ~1100º C surface temperatures consistently

Sintering Video



15” x 15” Sintered Test Patch



Sintered Patch After Thruster Firing

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Lessons Learned

- Optimum sintering temperature for tephra ~1100º C
- Distance from the source is a critical parameter
- Rocks in the tephra drastically increase power required to sinter
- Multiple layers required to survive thruster impingement
- Feedback system to adjust height or speed based on surface temperature is necessary when operating in changeable weather
- Optical output used was optimum for carbothermal reactor. Optimum for sintering would most likely focus to a line rather than a spot

Questions?