

A Dust Mitigation Vehicle Utilizing Direct Solar Heating

*"I think dust is probably one of our greatest inhibitors
to a nominal operation on the Moon."*

-Gene Cernan

Apollo 17 Technical Debrief

Dr. Eric Cardiff¹, Brandon Hall²

¹ NASA Goddard Space Flight Center, Propulsion Branch

² University of Maryland, College Park

Presentation Overview

- The Lunar Dust Problem
- Dust Transportation Mechanisms
- The Dust Mitigation Vehicle
- Testing Procedures
- Preliminary Results
- Discussion and Conclusion

The Lunar Dust Problem



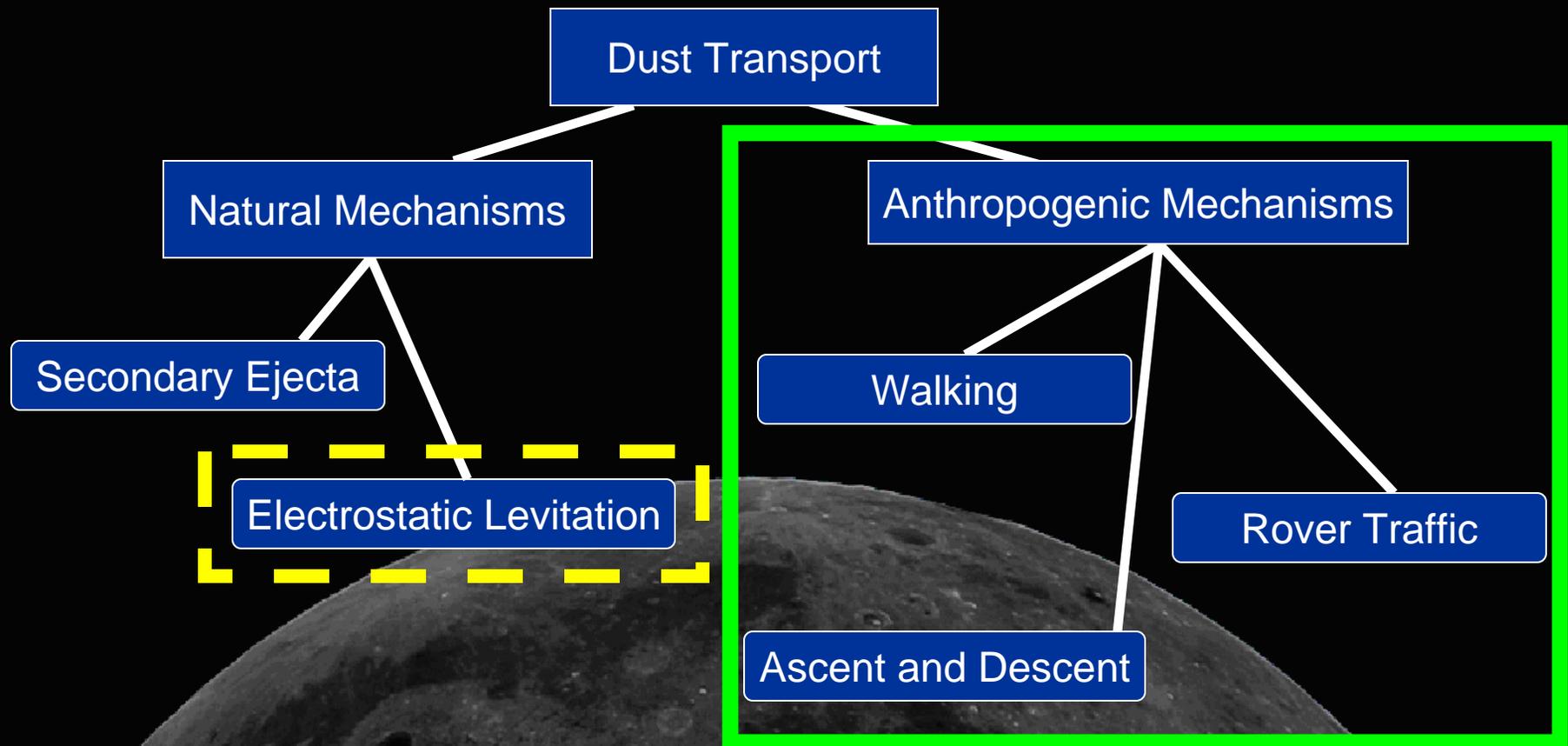
- Vision obscuration
- False instrument readings
- Dust coating and contamination
- Loss of traction
- Clogging of mechanisms
- Abrasion
- Thermal control
- Seal failure
- Inhalation and irritation

11/26/2008

A Dust Mitigation Vehicle (DMV)

3

Dust Transportation Mechanisms



Preventing Dust Transport

- Sinter/Melt particles to create hard, dust-free surface
- Systems have been proposed that utilize microwave sintering
- Direct solar heating can sinter/melt lunar regolith simulant



The Dust Mitigation Vehicle



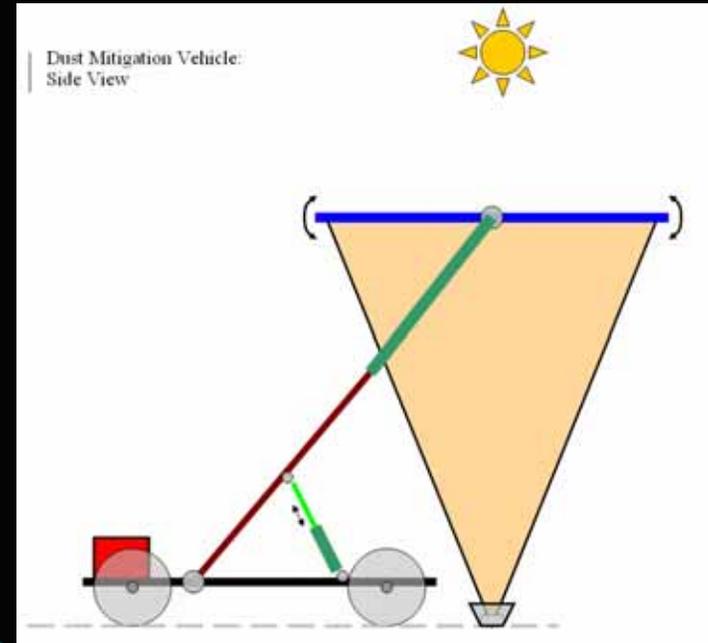
- Requires little to no electrical power to operate
- Solar Concentrator – Fresnel lens
- No consumables required for sintering/melting
- Controlled remotely

11/26/2008

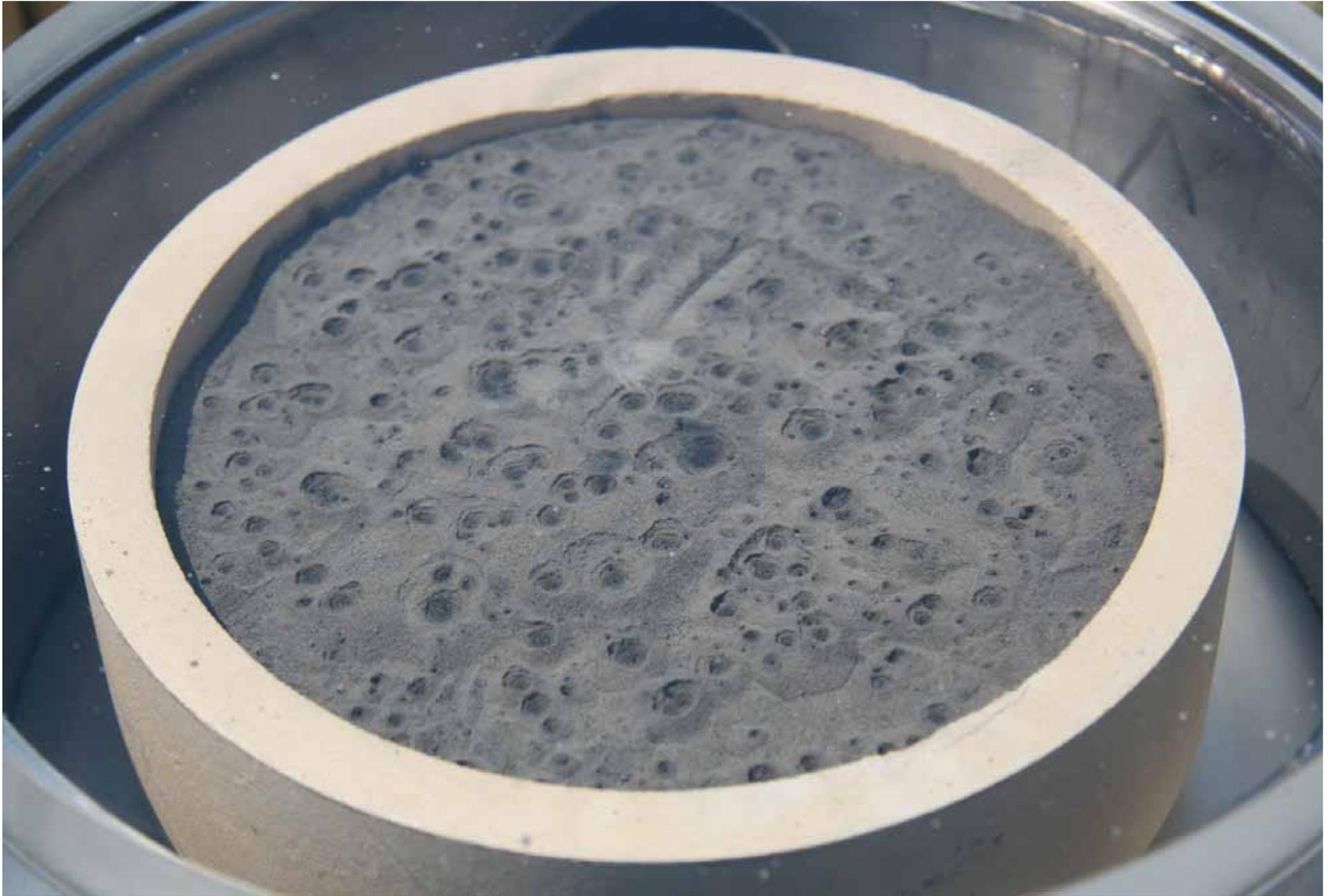
A Dust Mitigation Vehicle (DMV)

6

DMV Testing



- High vacuum, large aperture, custom chamber
- Large, ~8" zirconia crucibles
- JSC-1A / JSC-1AF lunar regolith simulant
- Record flux, duration, pressure and depth of melt/sinter



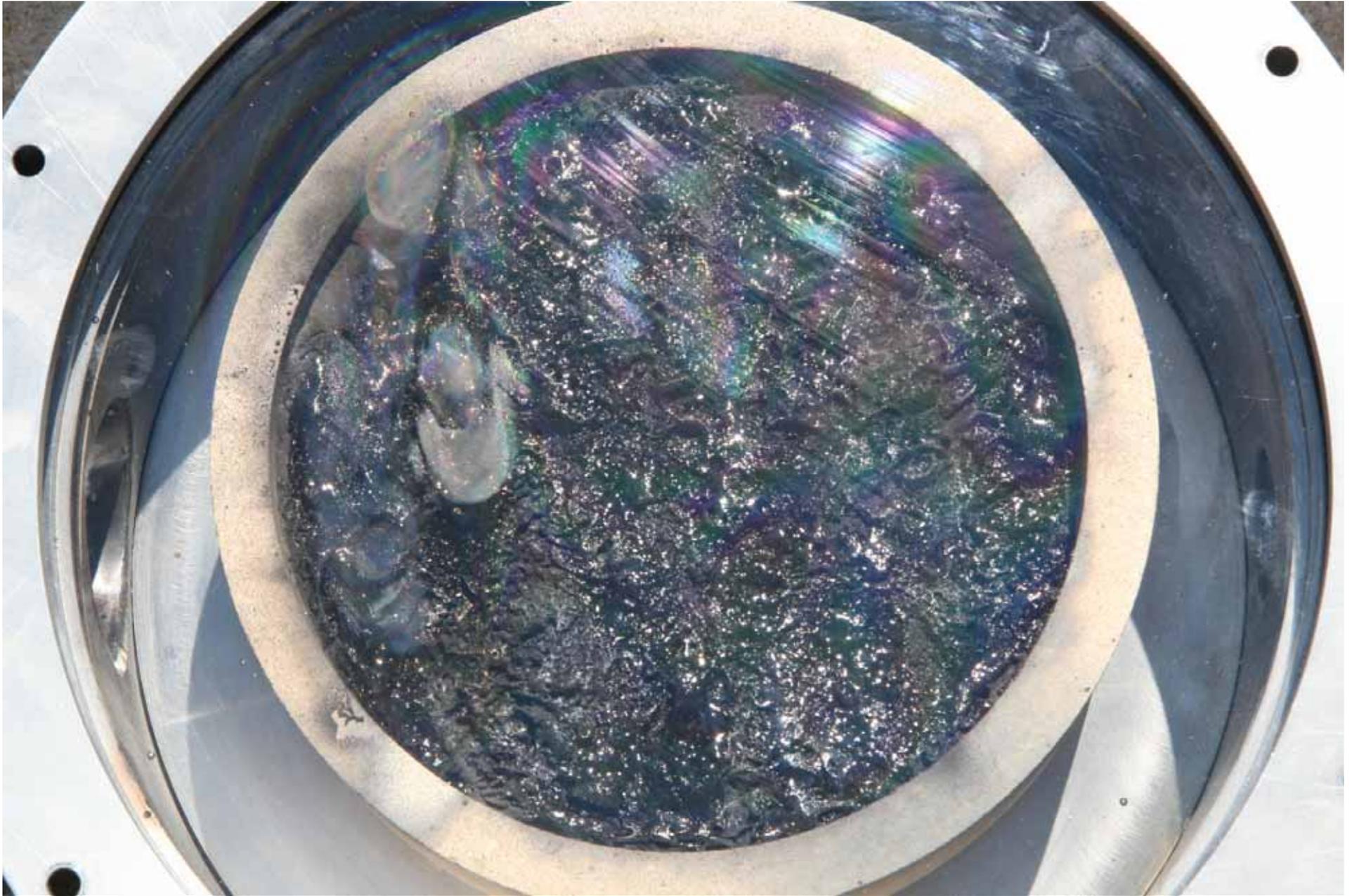
11/26/2008

A Dust Mitigation Vehicle (DMV)

8







11/26/2008

A Dust Mitigation Vehicle (DMV)

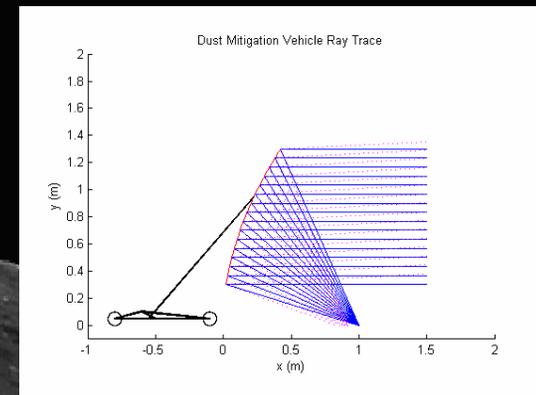
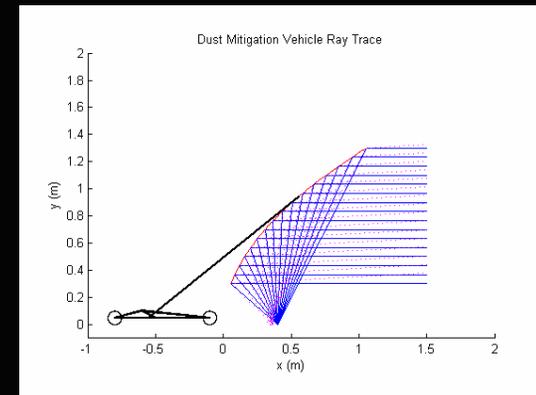
11

Preliminary Results

- Max measured rate -
~13 cm²/min
- ~0.5 cm depth
- Maximum depth –
~2.5 cm
- Low vacuum conditions
- Solar intensity greater
on Moon



Polar Variants of the DMV



- Horizontal incident sunlight
- Spot and linear focus variants

11/26/2008

A Dust Mitigation Vehicle (DMV)

13

Applications

- Create dust-free environments around lunar habitats
- Create roads using only *in-situ* resources
- Landing and launch pads

Future Work

- Further testing
- Analyze gas release
- Characterize “spattering” phenomena
- Better characterize intensity of focus
- Material properties
- Sintering/Melting on uneven terrain

Acknowledgments

Maria Lyon

Stuart Banks

Todd Bentley

Propulsion Branch

Tamela Maciel

Les Putnam

Mike Wilks

Questions?

11/26/2008

A Dust Mitigation Vehicle (DMV)

17