

The Optical Mining Testbed (OMTB): A Practical Large-Scale Laboratory Device for Rapidly Maturing the Technology of Asteroid ISRU

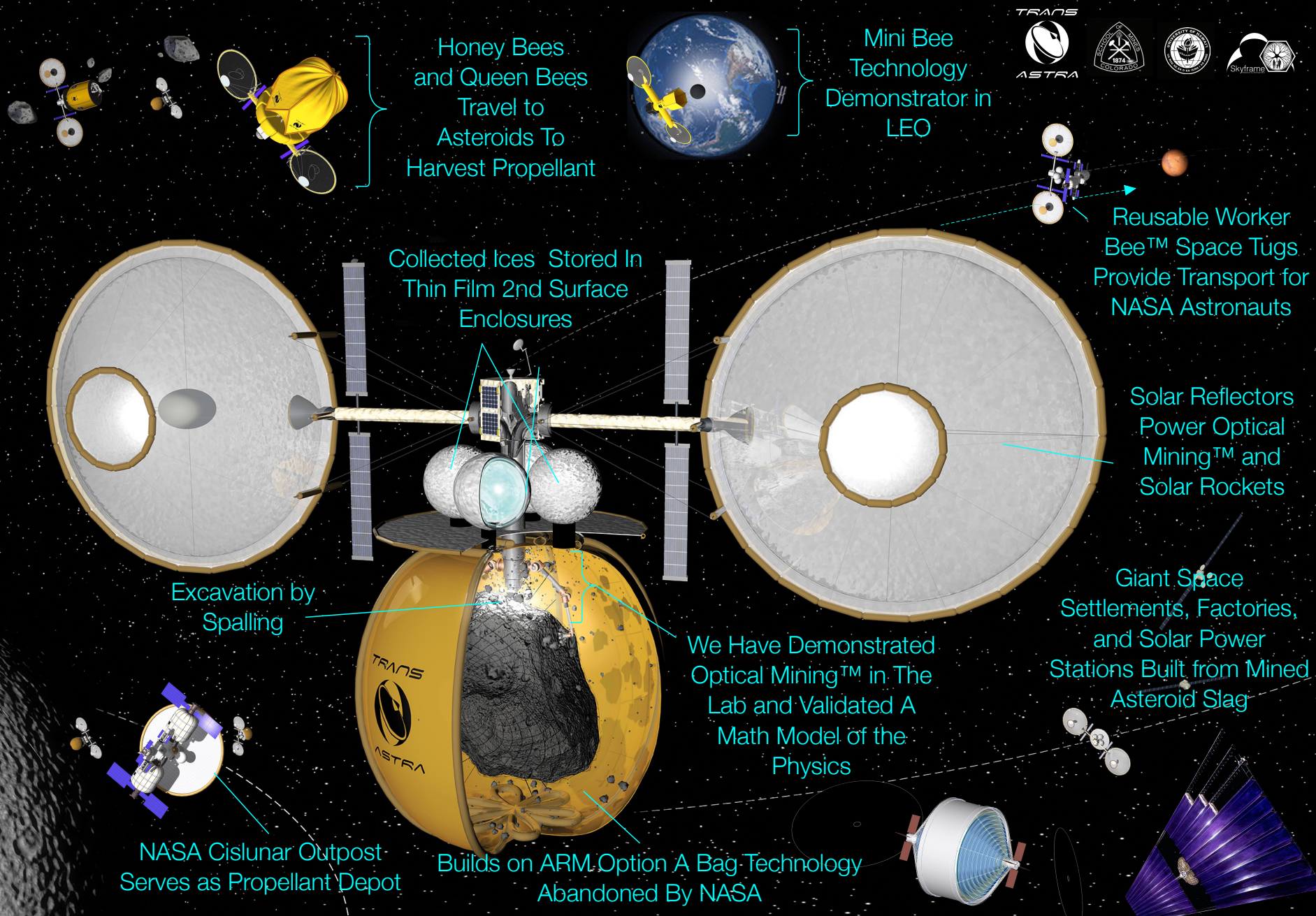
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Supported by NIAC Phase 2

Space Resources Roundtable, June 11– 14, 2019



Honey Bees
and Queen Bees
Travel to
Asteroids To
Harvest Propellant

Mini Bee
Technology
Demonstrator in
LEO



Reusable Worker
Bee™ Space Tugs
Provide Transport for
NASA Astronauts

Solar Reflectors
Power Optical
Mining™ and
Solar Rockets

Giant Space
Settlements, Factories,
and Solar Power
Stations Built from Mined
Asteroid Slag

We Have Demonstrated
Optical Mining™ in The
Lab and Validated A
Math Model of the
Physics

Builds on ARM Option A Bag Technology
Abandoned By NASA

NASA Cislunar Outpost
Serves as Propellant Depot

Excavation by
Spalling

Collected Ices Stored In
Thin Film 2nd Surface
Enclosures

Spalling in small scale

Before



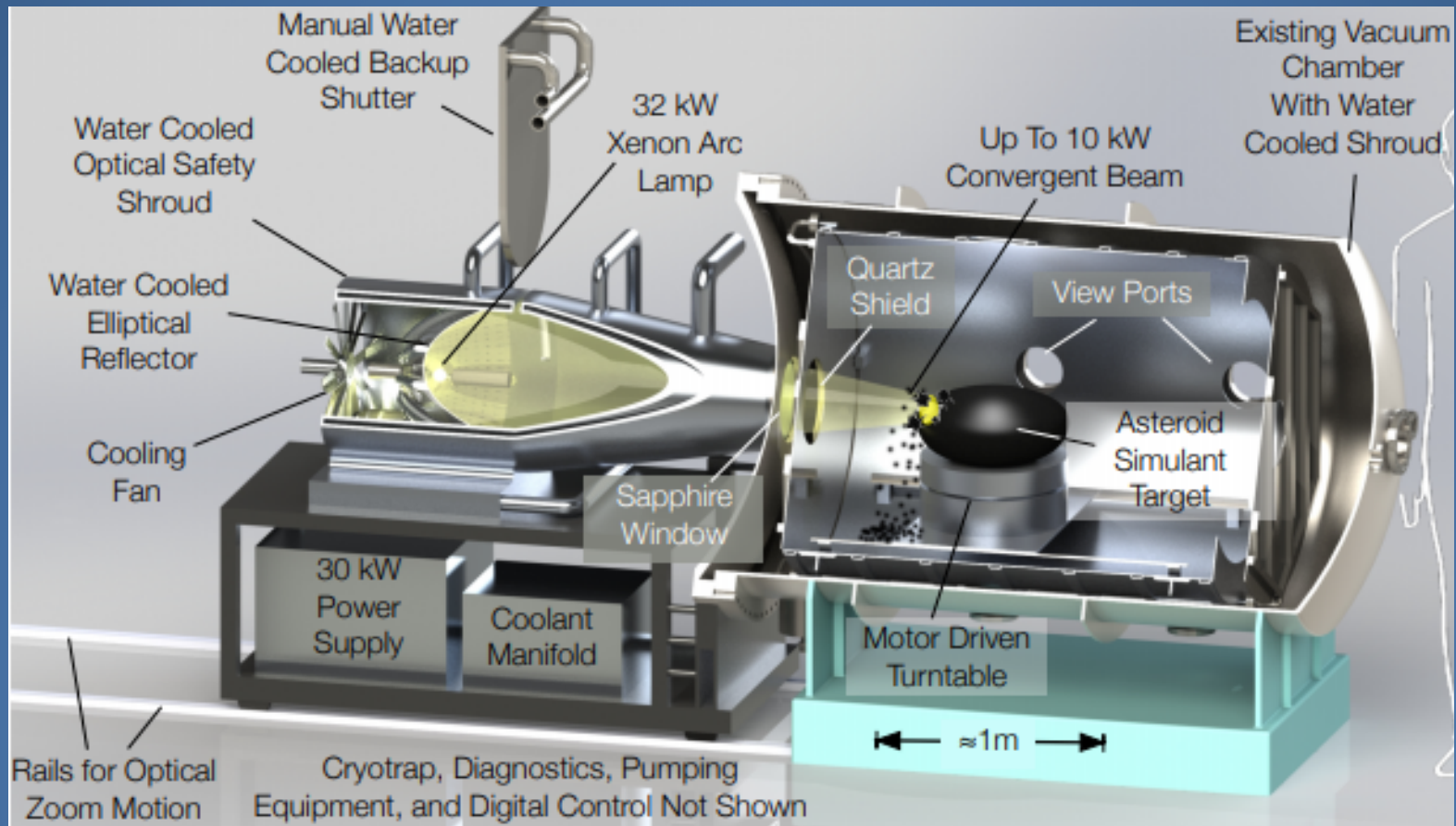
After



2 cm

Irradiance 135 W/cm^2 Final Pressure 22 torr

OMTB Design Concept



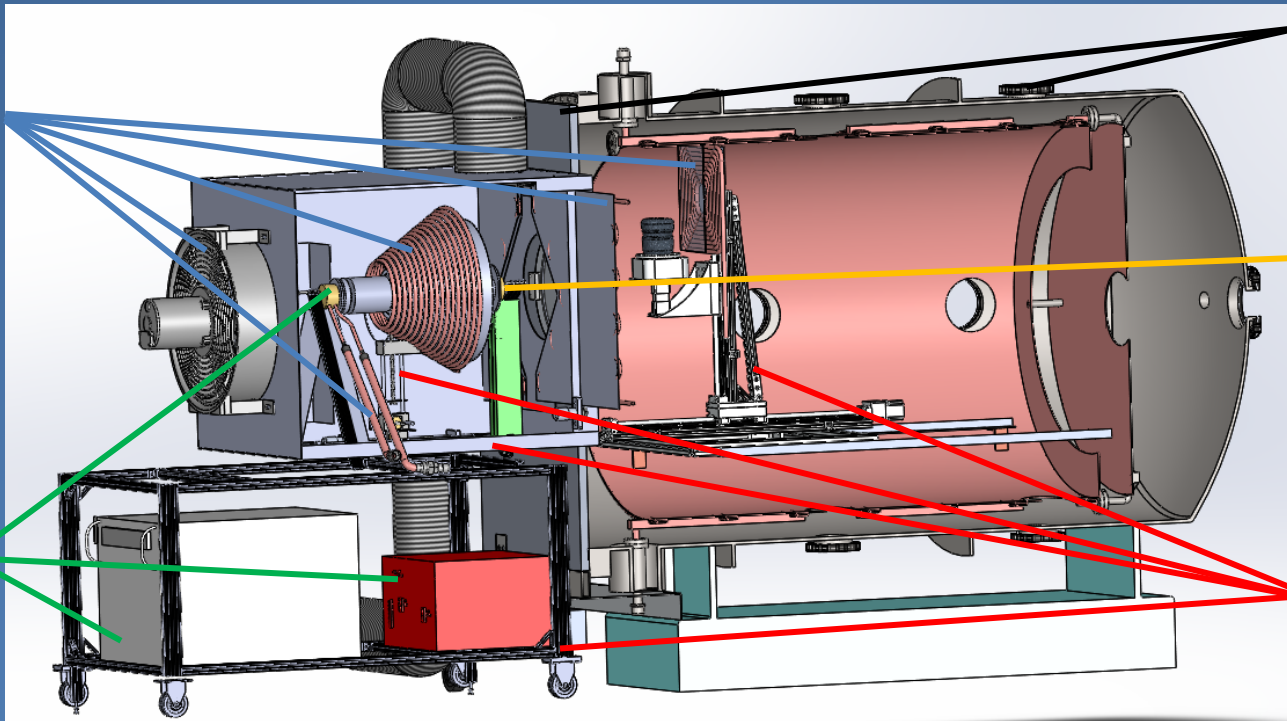
As designed

Thermal

- Air cooling
- Water Cooling
- Beam Block
- Shutters
- Cold Trap

Electrical

- Power Supply
- Booster
- Igniter
- Lamp



Vacuum

- Chamber
- Door

Optical

- Lamp
- Reflector

Mechanical

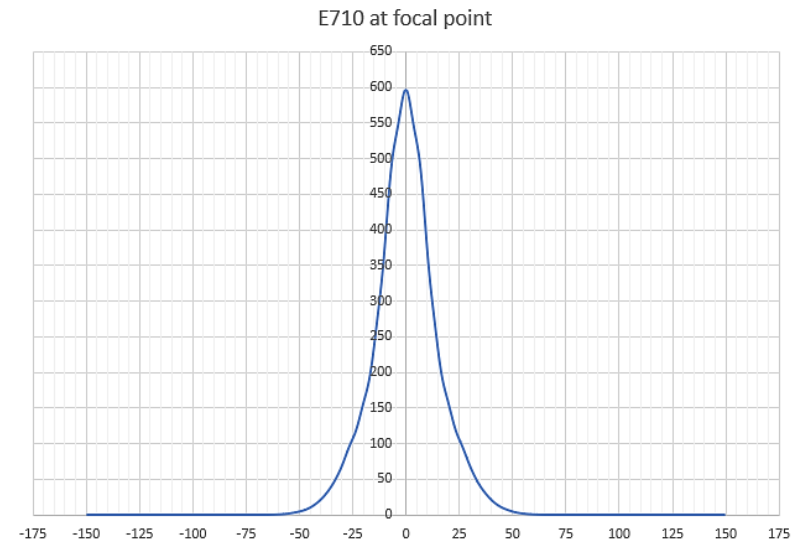
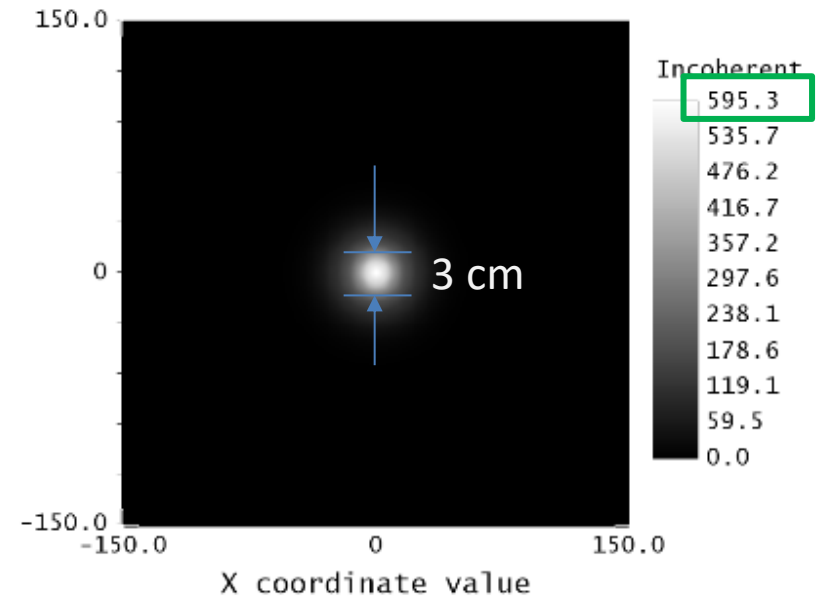
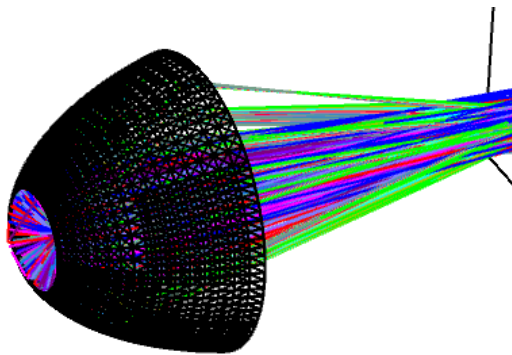
- Frame
- Shroud
- Reflector Positioning
- Sample Positioning

As built

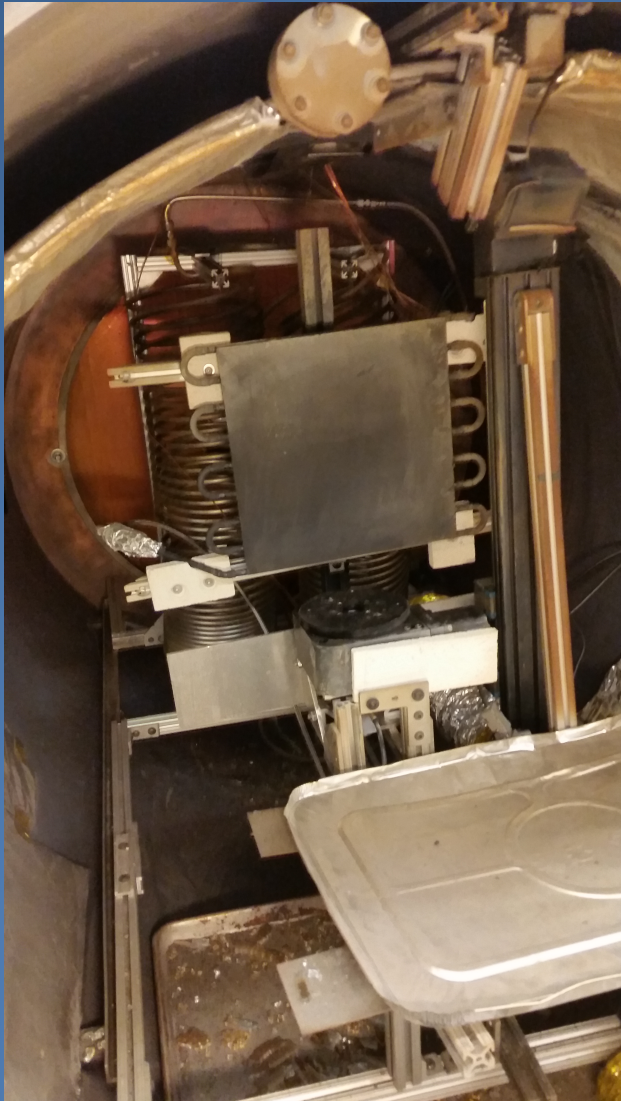


Optical Design

- Optical model predicts spot size and power transmission.
- Up to 600 W/cm^2 at focus.



Interior



Simulants of several asteroid types and surface structures

Sample Type	Description	Forms
CM	High strength, high volatiles	Monolith, cobble
CI	Low strength, high volatiles	Monolith, cobble
CR	High strength, low volatiles	Monolith
C2	Low strength, high carbonate content	Monolith

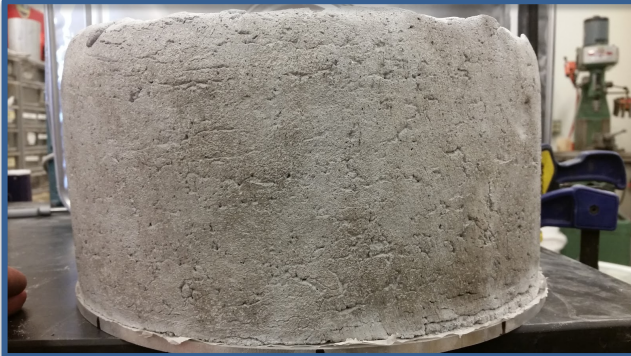
Forms	Description
Monolith	aka “cake”, solid and uniform, 30 cm diameter, 15 cm height
Cobble	2 to 5 cm irregular cobbles cemented together as a “wall”



Physical structures vary with manufacturing method, CI example



- Wetted to a cake batter
- Poured into a form and baked
- Flaky outer rind, soft outer layer, hard inside.



- Wetted to a modelling clay
- Pressed into a form and baked
- Salty outer layer, hard throughout.



- Wetted to just enough to hold together
- Loosely assembled in a form and baked
- Soft, porous, weak surface.

CM Monoliths



- Wetted to a modelling clay
- Pressed into a form and baked
- Outer layer, hard throughout



- Wetted to just enough to hold together
- Loosely assembled in a form and baked
- Hard outer layer, porous, weak inside



- Wetted to consistency of “wet sand”
- Compressed with surcharge to 11 kPa
- Consistent, moderate strength

CI “Dirt clod” Cake Excavation Test



CI “Dirt clod” Cake Excavation Test

Before



After continuous rotation, 40 minutes



Test	Duration (min:sec)	Mass Excavated	Water Collected
Fixed position	9:53	732 g	4.4 g
Continuous rotation	14:11	1018 g	3.2 g

High mass excavation of 4.3 kg/hr, but low water production

Tests to date: 4 simulants, 8 tests, >10 system tests



- Speed and excavation tests
- Skin delaminated



- Speed test
- Significant melting
- Skin delaminated



- Speed tests
- Little spalling
- Good water collection relative to debris mass, ~20%

Next steps

- Tests on additional samples
 - Optimally prepared CM and CI monoliths
 - Deskinned CM and CI
 - CR and C2 monoliths
 - CI and CM cobbles



- Water analysis, debris analysis