HOMES

Habitat Orientable & Modular Electrodynamic Shield

California Institute of Technology

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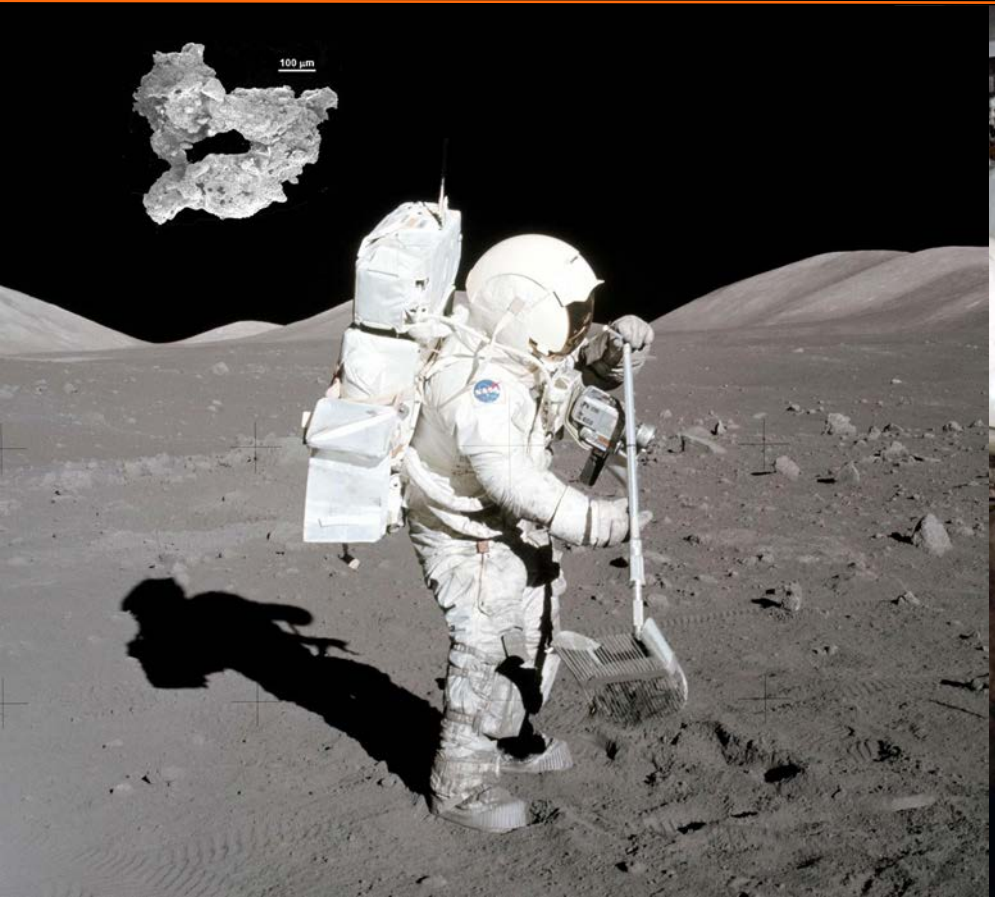
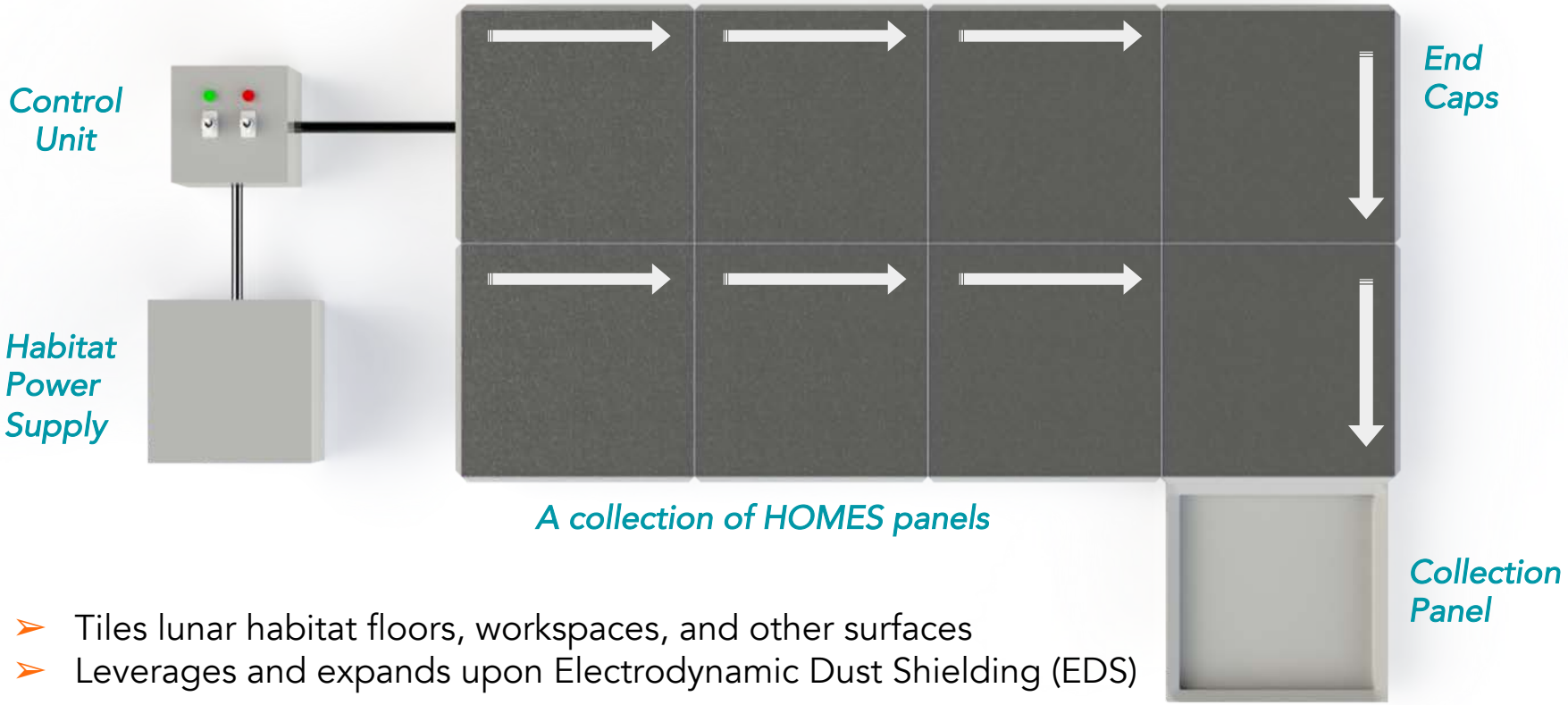
The Problem with Lunar Dust



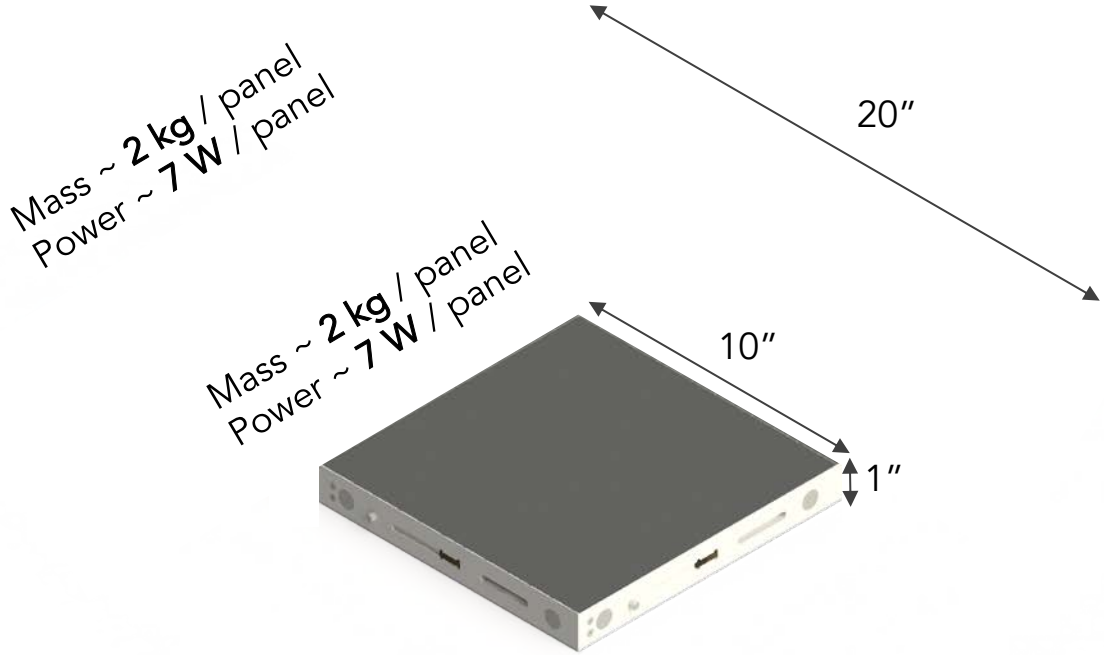
The Solution - HOMES Overview



- Tiles lunar habitat floors, workspaces, and other surfaces
- Leverages and expands upon Electrodynamic Dust Shielding (EDS)

State of the Art in Dust Mitigation

- Modular
- Scalable
- Orientable
- Robust
- Portable
- Easy to use
- Time-saving



4 connected HOMES panels

ConOps

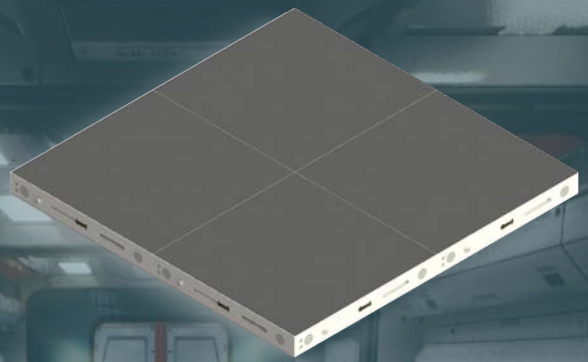
Phase 1 - Launch

HOMES is packaged and prepared for launch

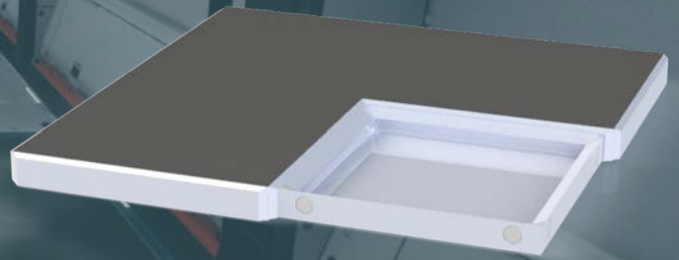
HOMES is stowed inside a lunar habitat for later setup

Phase 2 - Assembly

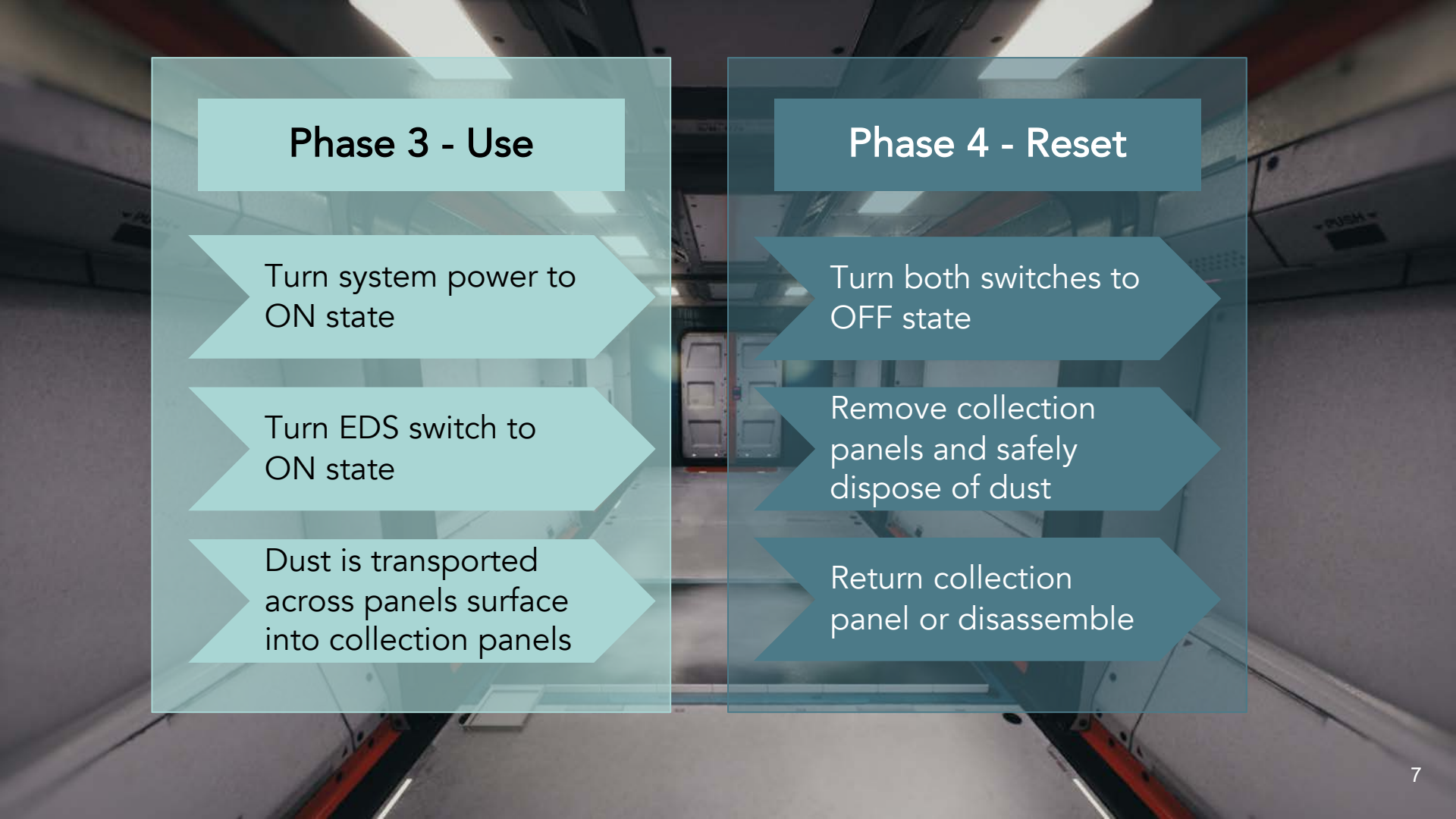
- Panels are tiled together in lunar habitat
- Attach collection panels in desired locations
- End caps attached on exposed panel edges
- Control unit connected to panels and power source



Four HOMES panels connected together



End cap and collection panel attached



Phase 3 - Use

- Turn system power to ON state
- Turn EDS switch to ON state
- Dust is transported across panels surface into collection panels

Phase 4 - Reset

- Turn both switches to OFF state
- Remove collection panels and safely dispose of dust
- Return collection panel or disassemble

Panels Can Be Connected Without Tools

Easy assembly and disassembly of two HOMES panels

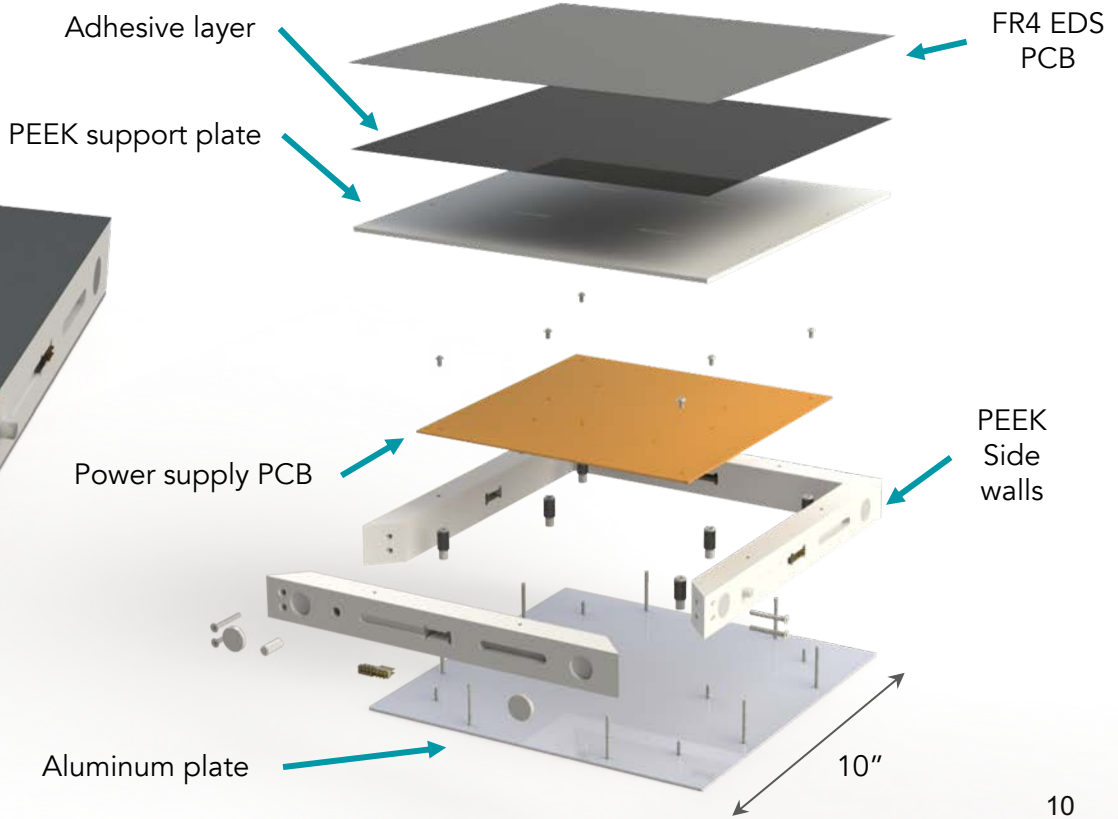
HOMES Modularity Demonstration

Three HOMES panels oriented 90 degrees with respect to the next and one collection panel

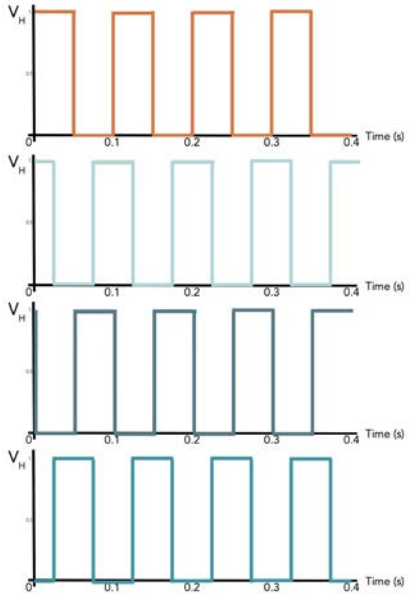
1x Speed

Internal Panel Assembly

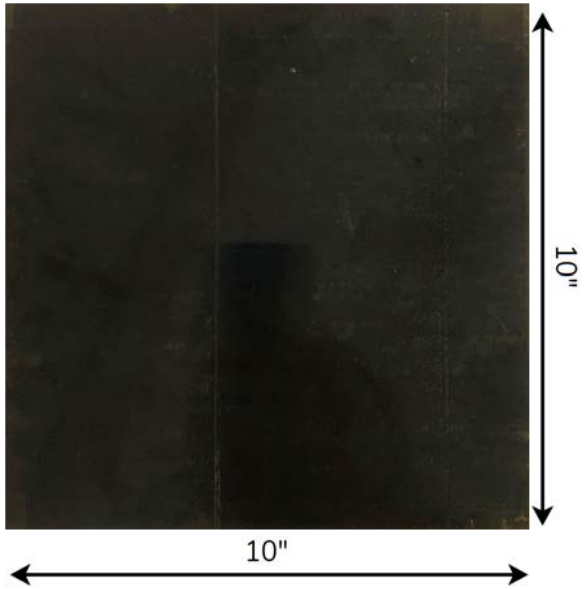
Full HOMES panel



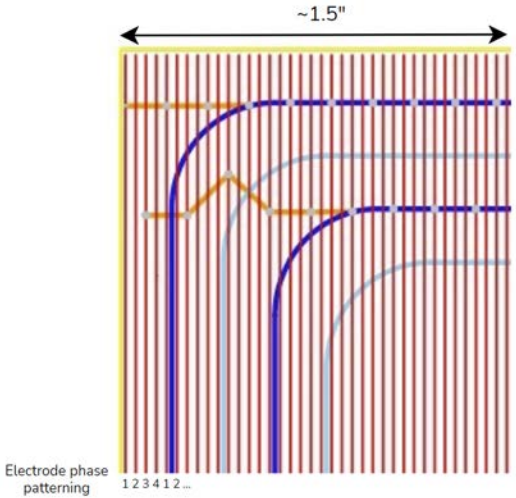
Low-Cost EDS and Power Supply



4-Phased, 3.8kV, 10 Hz square-waves generated by custom power supply integrated into each panel



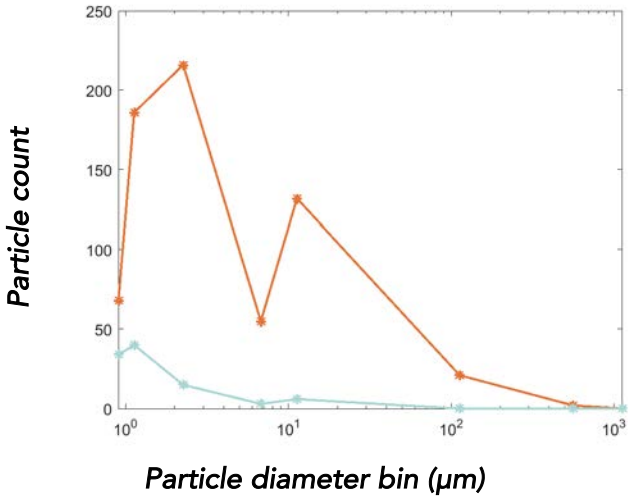
EDS using FR4 substrate printed circuit board (PCB)



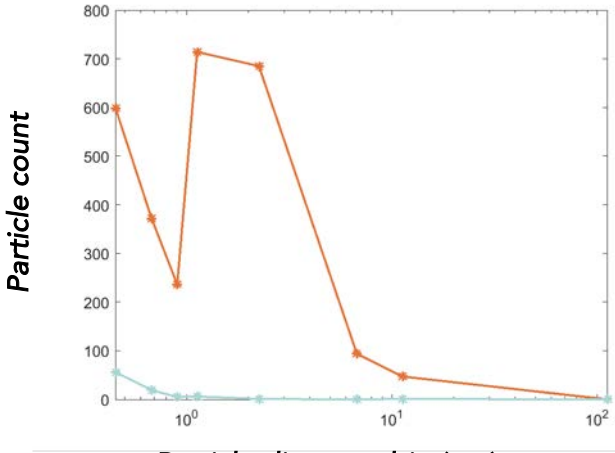
Close-up of upper left-hand corner of EDS PCB layout. Electrodes in red, spaced 1 mm apart. Power loops and connecting tracks in orange, purple and blue

HOMES clears >98% dust in 60 seconds

Coarser dust population



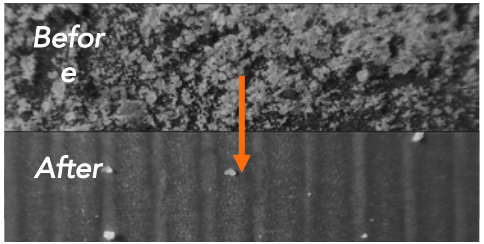
Finer dust population



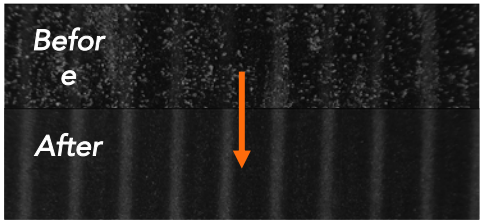
Before use of HOMES

After 60 s of HOMES

Coarse Dust



Fine Dust



Microscope images of HOMES before and after 60s of use

Testing Program Summary

	Test Name	TRL	Results
Electrical	*Dust Locomotion*	4	98-99% of dust cleared
	High Potential	4	Kapton and conformal coating protects from arcing
	Accelerated Lifetime	5	Functioning after 400 continuous operating hours
Mechanical	*Load*	5	Sustained 442.8 N load for 20s
	Impact	5	Sustained 24.7 cm impact from astronaut
	Vibration	5	Sustained minimum workmanship standard

Accomplishments

- Successfully demonstrates proof of concept for first ***modular*** EDS system
- Reliably moves >98% of dust in 60 seconds
- Pending TRL 5

Before

After

1mm

Future Work

Path-to-Flight	Future Improvements
Better protection of EDS PCB and screen printed arrow	*Reduce SWaP*
Further vibration testing and packaging	*Develop thermal management*
Further lifetime testing	*Adapt design for different environments*

Easily adaptable to other environments including Mars

Acknowledgements

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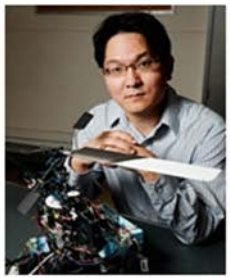

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Former JPL Director
Advisor & Speaker

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MCE Professor
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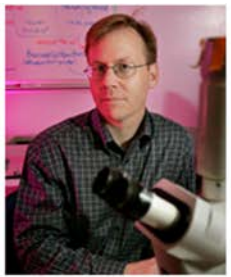

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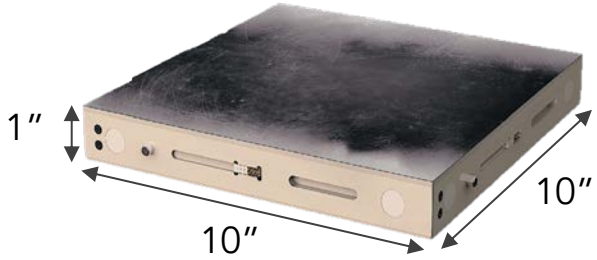
Habitat Orientable and Modular Electrodynamic Shield (HOMES)

HOMES: modular panels that tile together to actively clean floors, workspaces, walls, and surfaces in lunar habitats

Leverages and expands upon Electrodynamic Dust Shielding (EDS) technology

Portability, low power requirement, and long-term durability make HOMES an ideal dust mitigation solution to enable extended human presence on the Moon

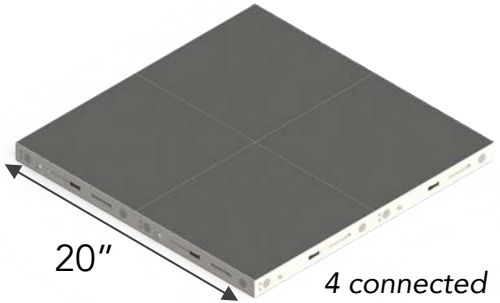


HOMES panel

Mass ~2 kg
Power ~ 7 W

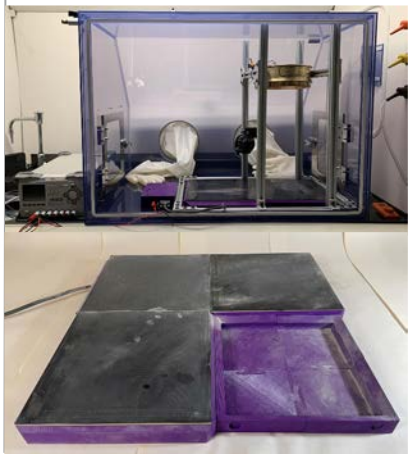
State of the Art EDS

Modularity
Scalability
Orientability
Robustness
Ease of use / Portability



4 connected HOMES panels

Testing & Verification - TRL 5



Dust Removal
removes >98% of dust (0.5-500 μm)
Modularity
successfully connected 4 panels
Long Lifetime
survived equivalent >10 years of use
Launch & Astronaut-Ready
load, impact, and vibration tested