HOMES
Habitat Orientable & Modular Electrodynamic Shield
California Institute of Technology

ADVISORS
Dr. Soon-Jo Chung
Richard Abbott
Dr. Manan Arya
Dr. Charles Elachi
Dr. Jason Kastner
Dr. Michael Mello

Malcolm Tisdale
Team Lead
Isabella Dula
Mechatronics Lead
Calle Junker
Verification Lead
Amrita Mayavaram
Electronics Lead

Nathan Ng
Validation Lead
Luis Pabon
Manufacturing Lead
Jules Penot
Treasurer
Polina Verkhovodovva
Design Lead

Nisreen AlSaud
Hope Arnett
Kristine Chelakkat
Kaila Coimbra
Tanmay Gupta
Athena Kolli
Sorina Lupu
Rithvik Musuku
Kemal Pulungan
Raha Riazat
Sydney Richardson
Parul Singh
Leah Soldner
Ellande Tang
Helen Wexler
Sarah Yun
The Problem with Lunar Dust
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

Mass ~ 2 kg / panel
Power ~ 7 W / panel

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Phase 1 - Launch

HOMES is packaged and prepared for launch

HOMES is stowed inside a lunar habitat for later setup
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

Phase 2 - Assembly

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
Internal Panel Assembly

- Adhesive layer
- PEEK support plate
- Power supply PCB
- FR4 EDS PCB
- PEEK Side walls
- Aluminum plate

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**

Particle diameter bin (μm)  
Particle count

Particle diameter bin (μm)  
Particle count

Before use of HOMES

After 60 s of HOMES

Microscope images of HOMES before and after 60s of use
## Testing Program Summary

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

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

<table>
<thead>
<tr>
<th>Path-to-Flight</th>
<th>Future Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better protection of EDS PCB and screen printed arrow</td>
<td>Reduce SWaP</td>
</tr>
<tr>
<td>Further vibration testing and packaging</td>
<td>Develop thermal management</td>
</tr>
<tr>
<td>Further lifetime testing</td>
<td>Adapt design for different environments</td>
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Easily adaptable to other environments including Mars.
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Thank you to our mentors:
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

**State of the Art EDS**

- Modularity
- Scalability
- Orientability
- Robustness
- Ease of use / Portability

**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

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