Hypersonic Inflatable Aerodynamic Decelerator (HIAD) Project

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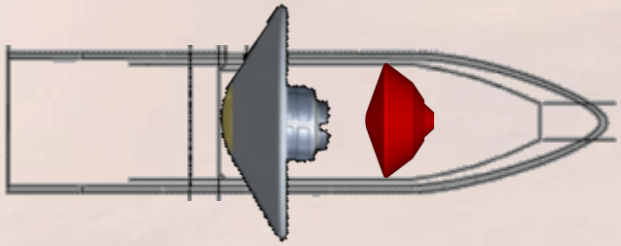
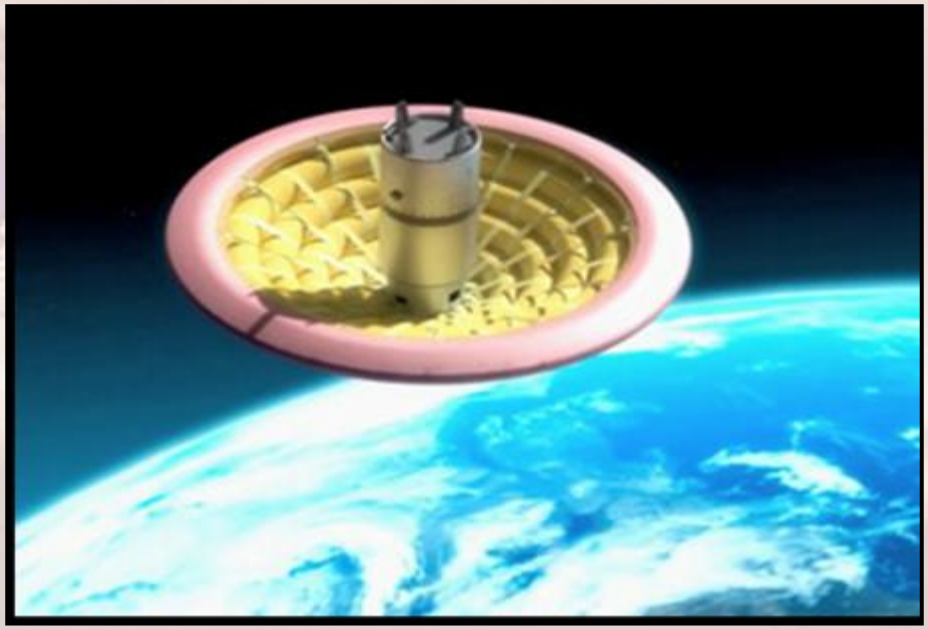
DEVELOP Engineering Team: Kapton Tape Testing Team

HIAD Overview

HIADS: ↑ Elevation ↑ Surface Area ↑ Payload Volume/Mass



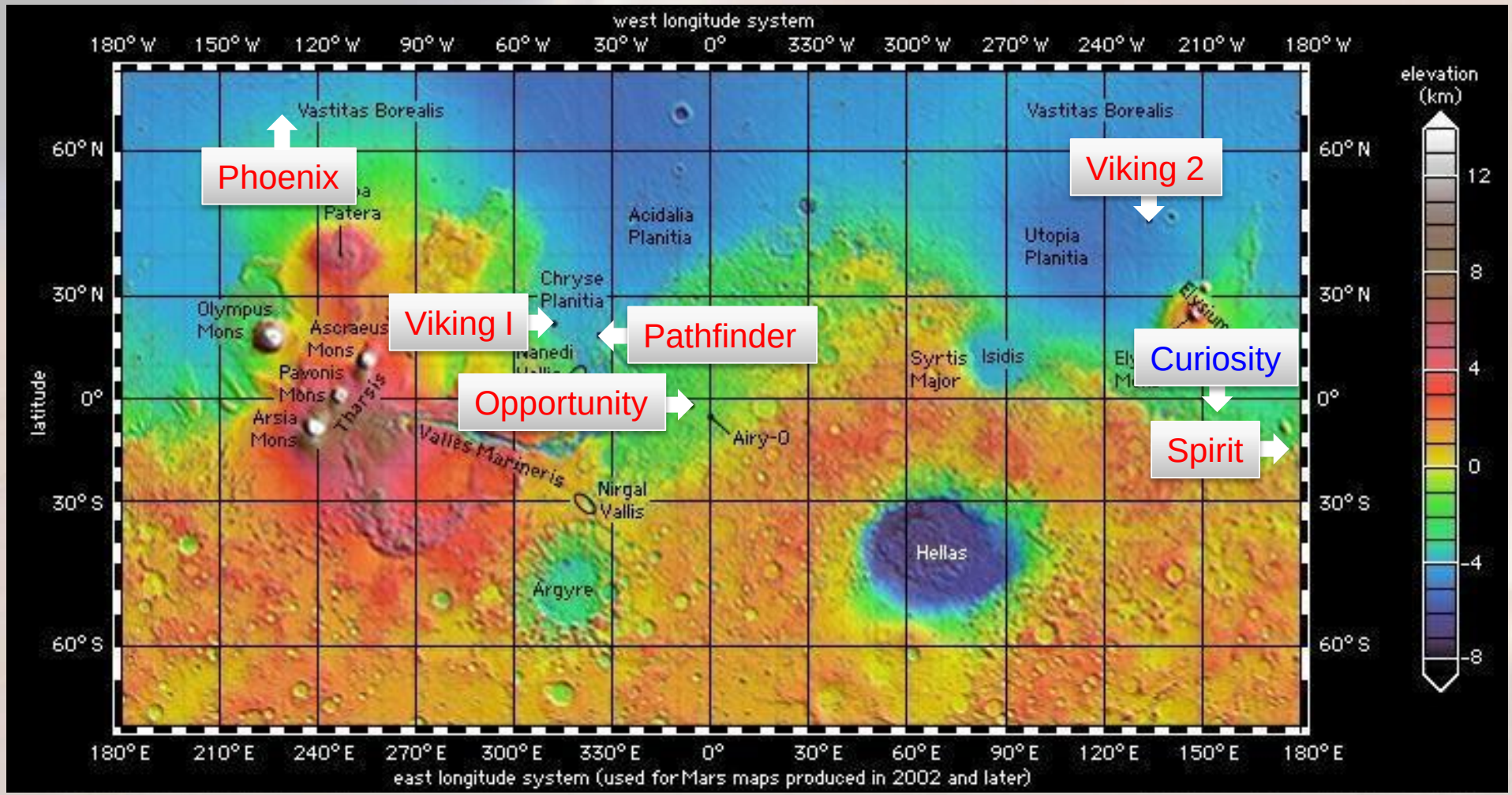
- A HIAD is an inflatable structure that deploys in space, and enters through an atmosphere
- Since a HIAD can be vacuum packed to a smaller diameter, the size of the payload faring is no longer a limitation
- Decelerates at a faster rate
- Inflatable Reentry Vehicle Experiment-3 (IRVE-3)
- HIAD Earth Atmospheric Reentry Test (HEART)



Computer depiction of IRVE-3 entering Earth's atmosphere

IRVE-3 Before and After Packed HIAD

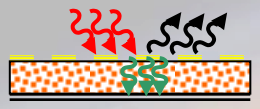
Seven Mars Entry Descent and Landing (EDL) Successes



Vision for HIAD Mission Infusion

System Development and Qualification

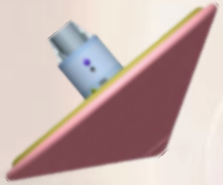
TPS



Inflatable Structures

Development and ground testing of HIAD components.

Sub-Orbital Flight Testing



IRVE-3

Sub-orbital flight tests on a cost-effective test platform (heating, lift, maneuverability).

System Demonstration

HIAD Earth Atmospheric Reentry Test (HEART)

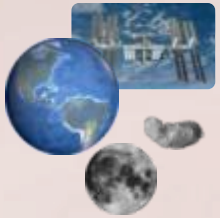
Flight test to demonstrate system performance at relevant scales and environments.

Initial OCT investment spans these elements

Potential on-ramps for future investments.

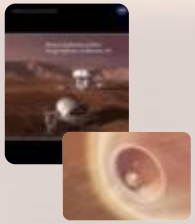
6–25 meter HIAD Class

Robotic Missions
(entry or aerocapture):
– Mars
– Venus
– Titan
– Neptune (and other gas giants)



Robotic or Crewed Earth Return
(entry or aerocapture):
– LEO (including ISS)
– GEO, NEO, Lunar

DoD Applications



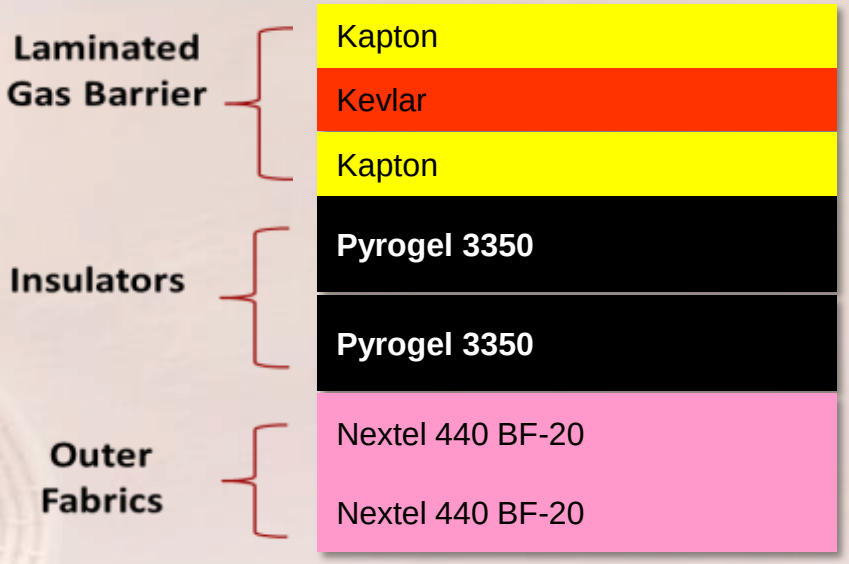
Technology Development & Risk Reduction for Human Mars Missions

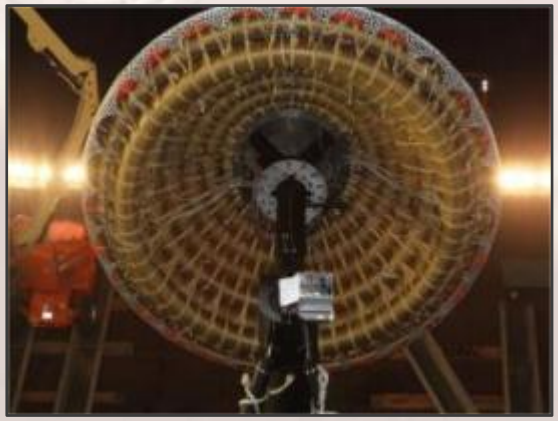
Two Main Subsystems of HIADs

Inflatable Structure
- The inflated toroid rings are held together by Kevlar straps
- These straps see large loads upon entry

Flexible Thermal Protection System (TPS)
- Used to protect vehicle and payload from heat and pressure of atmospheric entry
- Flexible system comprised of fabric materials quilted together
- Quilting causes holes in the gas barrier (Kapton-Kevlar Laminate) where Kapton tape is applied to help prevent leaks from reaching the inflatable

Layers of TPS for IRVE-3:



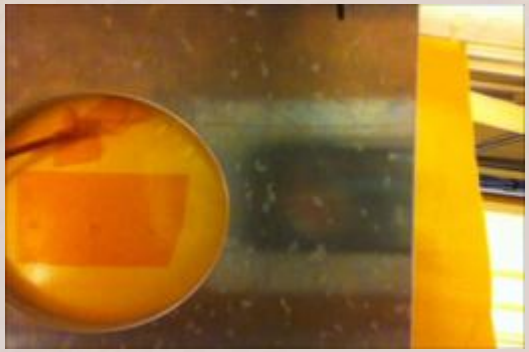


Photographs of inflatable structure and flexible TPS

HIAD Team Summer Student Objective

- **Need**
  - Determine the optimal Kapton tape out of 4 types based on temperature and pressure flight conditions
    - 4 Kapton tapes: P224, 1205, Electrical Tape 92, 3M 5413
    - Pressure differential, 1.8 psig
    - Temperature of under side of TPS, 300 °F
- **Objectives**
  - Test Kapton Tape's ability to prevent gas permeability at flight conditions with constant pressure and varying temperature
  - Evaluate the effects of construction and stowing parameters on the test samples

Engineering Development Unit inspection



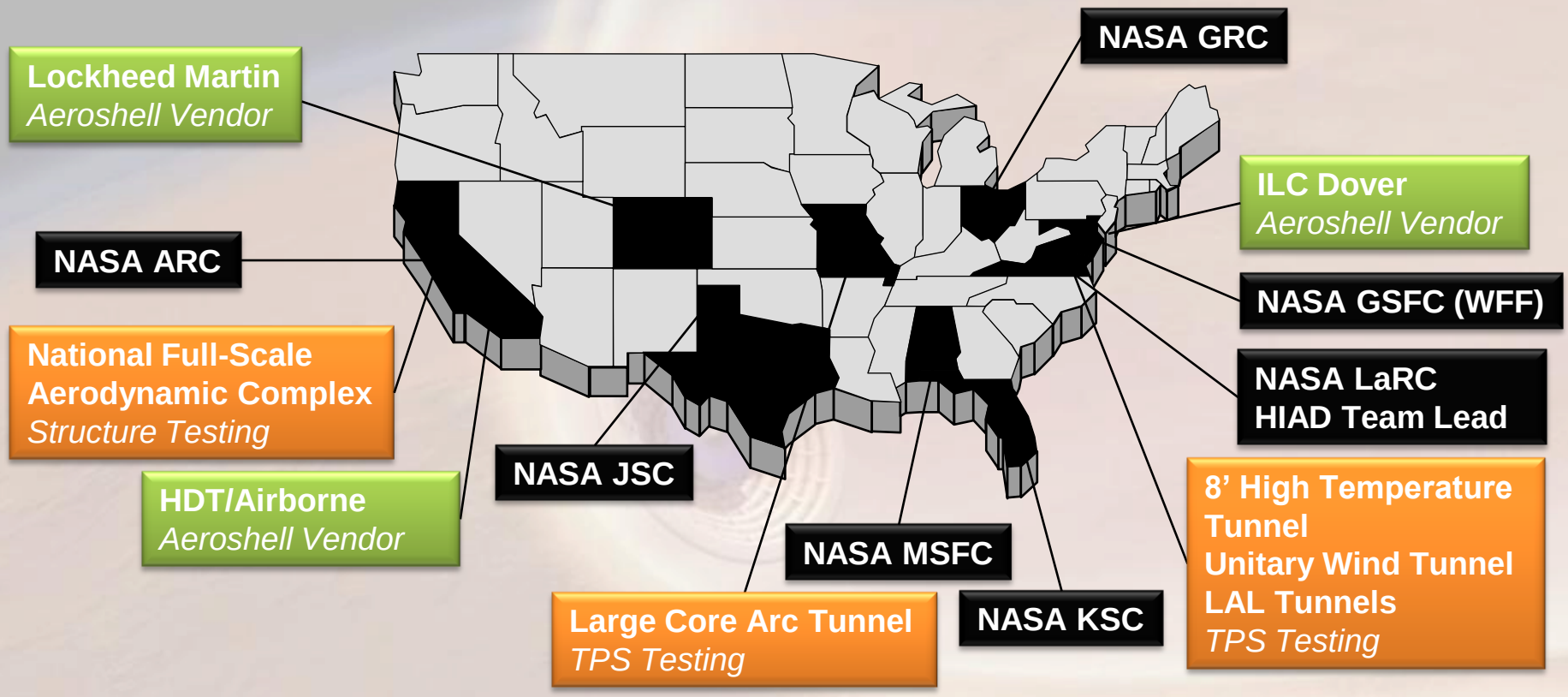
Kapton tape sample in the test set-up

Computer Aided Design (CAD) representation and fabricated test set up

Summer Student Engineering Team

IRVE-3 Mission Success and Outreach

HIAD Team and Testing Facilities



NASA Center | Industry/Academia* Team | Testing Facility

*GA Tech, U of Vermont, U of Akron, U of Santa Clara, MIT, U of Virginia, Virginia Tech, U of Arizona
Warwick High School, Tabb High School, Maury High School

HEART — Concept of Operations

Thank You!

For More information:

www.nasa.gov/HIAD

NASA HIAD