

# Bigelow Expandable Activity Module Project

Advanced Exploration Systems Program | Human Exploration And Operations Mission Directorate (HEOMD)



## ABSTRACT

The Bigelow Expandable Activity Module (BEAM) project is a NASA-industry partnership with Bigelow Aerospace (BA) that is developing the first human-rated expandable (also called "inflatable") space habitat for demonstration on the International Space Station (ISS). The partnership offers NASA substantial cost savings for technology development and for future exploration missions that could use commercially provided expandable structures and habitats.



Bigelow Expandable Activity Module (BEAM) Mockup

## ANTICIPATED BENEFITS

### To NASA funded missions:

The NASA-Bigelow partnership enables both partners to learn how to develop, launch, install and test expandable structures, all at substantial cost savings relative to either party doing these things alone. The BEAM Project develops structural and mechanical system requirements for a human-rated expandable module in an external orbital environment and verifies those requirements. After BEAM installation on the ISS, NASA will gain valuable insight into the performance of an expandable module in orbit.

### To NASA unfunded & planned missions:

By partnering with Bigelow Aerospace, NASA supports the development of a potential commercial provider of expandable structures and habitats. This partnership and development can offer NASA substantial cost savings for future exploration missions that could use commercially provided structures.

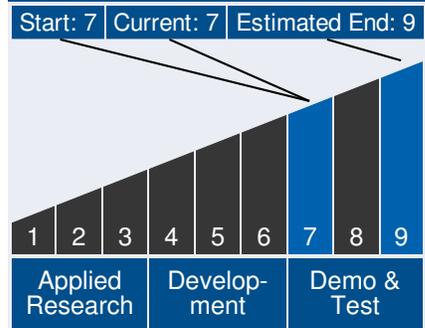
### To the commercial space industry:

By partnering with Bigelow Aerospace, NASA supports the development of a potential commercial provider of expandable structures and habitats. This can create new markets for international space travel opportunities, microgravity research, manufacturing and tourism.

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## Technology Maturity



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## To the nation:

This technology can support the nation's goals for human long-term space exploration and the development of new commercial markets.

## DETAILED DESCRIPTION

The BEAM project advances expandable habitat technology by conducting a flight demonstration of a commercially designed expandable system to achieve Technology Readiness Level 9.0. The primary performance requirement is to demonstrate that the BEAM can successfully launch and berth to the ISS, deploy and expand, and maintain long-term pressure without leakage. The leak performance is defined as both short-term, immediately after deployment, and long-term, for the balance of the two-year mission.

The demonstration will consist of the following critical technology objectives:



### Management Team

**Program Director:**

- Jason Crusan

**Program Executive:**

- Barry Epstein

**Project Manager:**

- Stephen Munday

**Principal Investigator:**

- Gerard Valle

### Technology Areas

**Primary Technology Area:**

Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

- └ Materials (TA 12.1)
  - └ Flexible Material Systems (TA 12.1.3)
    - └ Structural Textile Material (TA 12.1.3.1)

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1. Launch of a packed expandable structure in a Commercial Resupply Services (CRS) launch vehicle
2. Safe deployment (expansion) on ISS
3. Passive air exchange with ISS and an environment inside the BEAM supporting periodic, temporary ingress by the ISS crew
4. Measure deployment loads during expansion of the BEAM on ISS
5. Determine radiation protection capability of an expandable structure in low Earth orbit and demonstrate the performance of advanced active radiation sensors on ISS
6. Long-term structural performance of expandable shell after exposure to atomic oxygen, vacuum, radiation and thermal cycling
7. Demonstrate performance of structural health monitoring systems
8. Measure long-term leak performance of expandable bladder and bladder joints after launch and deployment cycle
9. Develop structural and mechanical system requirements for a human-rated expandable module in external orbital environment and successfully verify those requirements
10. Develop crew restraints and mobility aids for Intravehicular Activity (IVA) inside an expandable module
11. Develop and implement "housekeeping" procedures for internal surfaces of an expandable module

In addition, BEAM will demonstrate jettisoning of a large expandable structure from ISS at end of mission or during a contingency depressurization. Typically, ISS payloads are disposed with the returning cargo vehicle at the end of the payload mission. BEAM will provide the first demonstration of robotic jettison of a large 3K lbs (1380 kg) structure from ISS.

## Technology Areas (cont.)

### Secondary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

- └ Environmental Control and Life Support Systems and Habitation Systems (TA 6.1)

### Additional Technology Areas:

Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

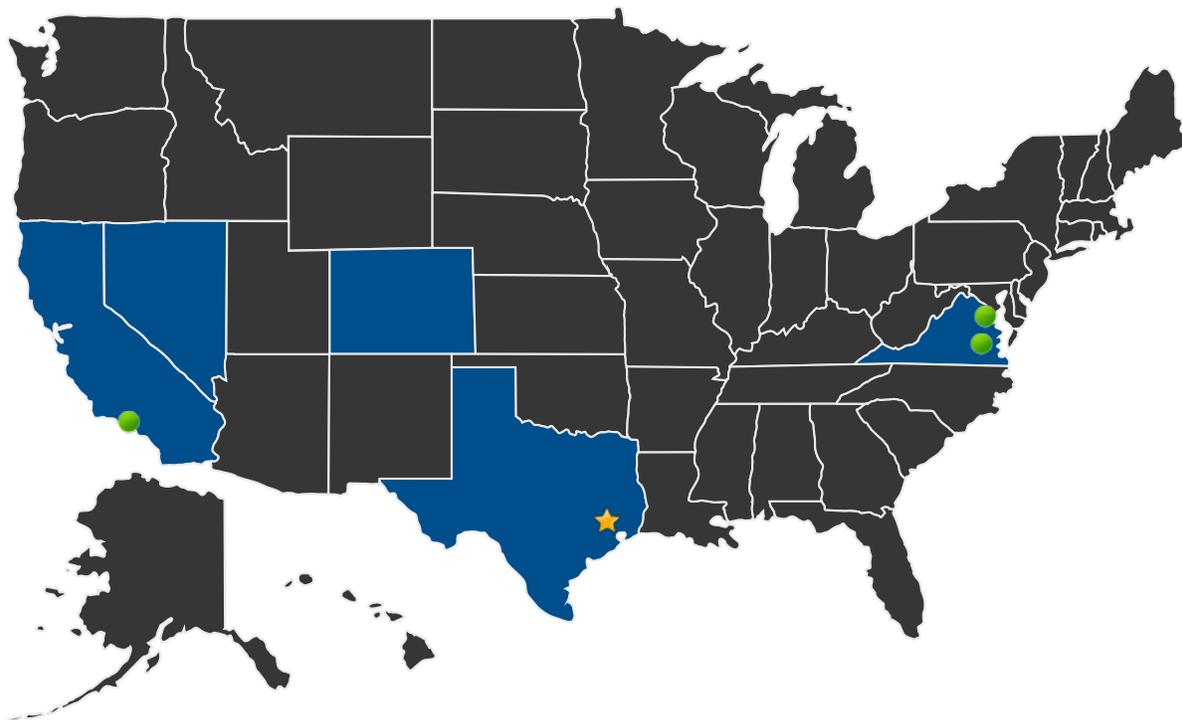
- └ Structures (TA 12.2)
  - └ Lightweight Concepts (TA 12.2.1)
    - └ Composite and Inflatable Habitat (TA 12.2.1.3)
    - └ Lander and Surface Habitat (TA 12.2.1.6)

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## U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

★ **Lead Center:**  
Johnson Space Center

● **Supporting Centers:**

- Jet Propulsion Laboratory
- Langley Research Center
- NASA Headquarters

**Other Organizations Performing Work:**

- ATA
- Bigelow Aerospace
- Boeing
- Jacobs
- Sierra Nevada Corporation (SNC)
- SpaceX
- Wyle Laboratories

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## Contributing Partners:

- TASI

## LATEST SUCCESS STORY

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### Success Story AES BEAM 2015-08-28

Success Story AES BEAM 2015-08-28

## PROJECT LIBRARY

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### Success Stories

- Success Story AES BEAM 2015-08-28
  - (<http://techport.nasa.gov:80/file/17665>)

## IMAGE GALLERY

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*Inside View of BEAM Module Mockup*

## DETAILS FOR TECHNOLOGY 1

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### Technology Title

Bigelow Expandable Activity Module (BEAM) Project

### Technology Description

This technology is categorized as a hardware system for manned spaceflight

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The demonstration will consist of the following critical technology objectives:

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## Capabilities Provided

The BEAM project advances human-rated expandable habitat technology by launching, berthing, expanding, and testing a full-scale module on the ISS. Upon installation, the BEAM will allow for periodic, temporary ISS crew ingress. The BEAM Project develops structural and mechanical system requirements for a human-rated expandable module in an external orbital environment and verifies those requirements. It also provides technology demonstration data on integrated expandable structure deployment on the ISS and associated loads, the radiation protection capability of expandable structures, and micro-meteoroid orbital debris (MMOD) impact detection.

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## Potential Applications

Expandable structures have the potential to meet current and future NASA requirements for deep space exploration deployable habitat systems. This includes habitable modules in orbit and at lunar or Martian bases. A primary BEAM project goal is to help meet deep space exploration habitat needs at a fraction of the cost of in-house development. Expandable modules also provide the advantages of lower mass and low launch volume relative to metallic habitat modules, thus simplifying requirements for launch transportation systems.