

Lunar CATALYST Project

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



ABSTRACT

Lunar Cargo Transportation and Landing by Soft Touchdown (Lunar CATALYST) is a NASA initiative to encourage the development of U.S. private-sector robotic lunar landers capable of successfully delivering payloads to the lunar surface using U.S. commercial launch capabilities. NASA entered into no-funds-exchanged Space Act Agreement (SAA) partnerships with three competitively-selected companies (Astrobotic Technology, Masten Space Systems, and Moon Express), and is providing in-kind contributions including technical expertise, access to test facilities, software, and the loaning of equipment.

ANTICIPATED BENEFITS

To NASA funded missions:

Development of commercial capabilities to deliver payloads to the lunar surface may provide a cost-effective means of executing various types of science and exploration missions on the Moon. Missions like NASA/HEOMD's Resource Prospector, which aims to find, excavate, and characterize lunar volatiles such as water, hydrogen, and oxygen, could benefit from these capabilities.

To NASA unfunded & planned missions:

Development of commercial capabilities to deliver payloads to the lunar surface may provide a cost-effective means of executing various types of science and exploration missions on the Moon, including:

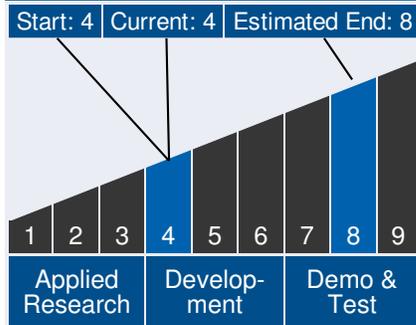


Astrobotic Technology, Masten Space Systems, and Moon Express Robotic Lunar Landers

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Technology Maturity



Management Team

- Program Director:**
- Jason Crusan

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- **Resource prospecting.** Surface missions to characterize the extent, distribution, and form of lunar volatiles such as water, hydrogen, and oxygen will provide critical "ground truth" and inform the development of sustainable and affordable exploration architectures. A Lunar Exploration and Analysis Group (LEAG) report concluded that "small near term missions can provide critical data to resolve important unknowns regarding polar volatiles science and resource utilization."
- **Technology demonstrations.** Missions to deploy technology demonstration payloads and use the Moon as a proving ground can lower the risk and accelerate the development of exploration systems, including those with application to the surface of Mars, such as regolith processing, habitation, and mobility.
- **Sample return.** In the report, Vision and Voyages for Planetary Science in the Decade 2013-2022, the National Research Council recommended Lunar South Pole-Aitken Basin Sample Return as a candidate NASA New Frontiers science mission.
- **Geophysical network deployment missions.** In the report, Vision and Voyages for Planetary Science in the Decade 2013-2022, the National Research Council recommended Lunar Geophysical Network as a candidate NASA New Frontiers science mission.

To the commercial space industry:

The Lunar CATALYST initiative encourages and facilitates development of U.S. commercial robotic lunar cargo delivery capabilities by bringing decades of technical experience (most recently NASA's Mighty Eagle and Morpheus projects) to bear, and provides NASA technical expertise, access to test facilities, software, and the loaning of equipment. Providing these resources has been a critical force-multiplier that is accelerating the progress of commercial robotic lunar lander development.

To the nation:

Lunar CATALYST fulfills NASA's charter to "seek and

Management Team (cont.)

Program Executive:

- Nantel Suzuki

Project Manager:

- Greg Chavers

Technology Areas

Primary Technology Area:

Robotics and Autonomous Systems (TA 4)

- └ Systems Engineering (TA 4.7)
 - └ Modularity, Commonality, and Interfaces (TA 4.7.1)
 - └ Marsupial Robot Interfaces (TA 4.7.1.4)

Secondary Technology Area:

In-Space Propulsion Technologies (TA 2)

Additional Technology Areas:

Space Power and Energy Storage (TA 3)

Robotics and Autonomous Systems (TA 4)

- └ Systems Engineering (TA 4.7)

Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)

Entry, Descent, and Landing Systems (TA 9)

Modeling, Simulation, Information Technology and Processing (TA 11)

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

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encourage, to the maximum extent possible, the fullest commercial use of space". Stimulating the commercial supply of space capabilities enhances the United States' potential to realize sustainable and affordable space exploration.

DETAILED DESCRIPTION

Lunar Cargo Transportation and Landing by Soft Touchdown (Lunar CATALYST) is a NASA initiative to encourage the development of U.S. private-sector robotic lunar landers capable of successfully delivering payloads to the lunar surface using U.S. commercial launch capabilities. In September 2014, NASA entered into no-funds-exchanged Space Act Agreement (SAA) partnerships with three competitively-selected companies, and the nominal term of the SAAs is three years. Lunar CATALYST is an initiative of the Human Exploration and Operations Mission Directorate's Advanced Exploration Systems (AES) Division, and the industry partnerships are managed under the AES Lander Technology project at MSFC. The initiative is supported by an engineering team of experts who developed NASA's Morpheus and Mighty Eagle lander testbeds, with support from ARC, GRC, GSFC, JPL, JSC, KSC, LaRC, and MSFC.

Although NASA is providing in-kind contributions, including technical expertise, access to test facilities, software, and the loaning of equipment, the landers are owned by the industry partners, and much of the technical design and development information is proprietary. General information about Lunar CATALYST is available on NASA's website (<http://www.nasa.gov/lunarcatalyst>), and additional information may be obtained from the companies themselves: Astrobotic Technology, Masten Space Systems, and Moon Express.

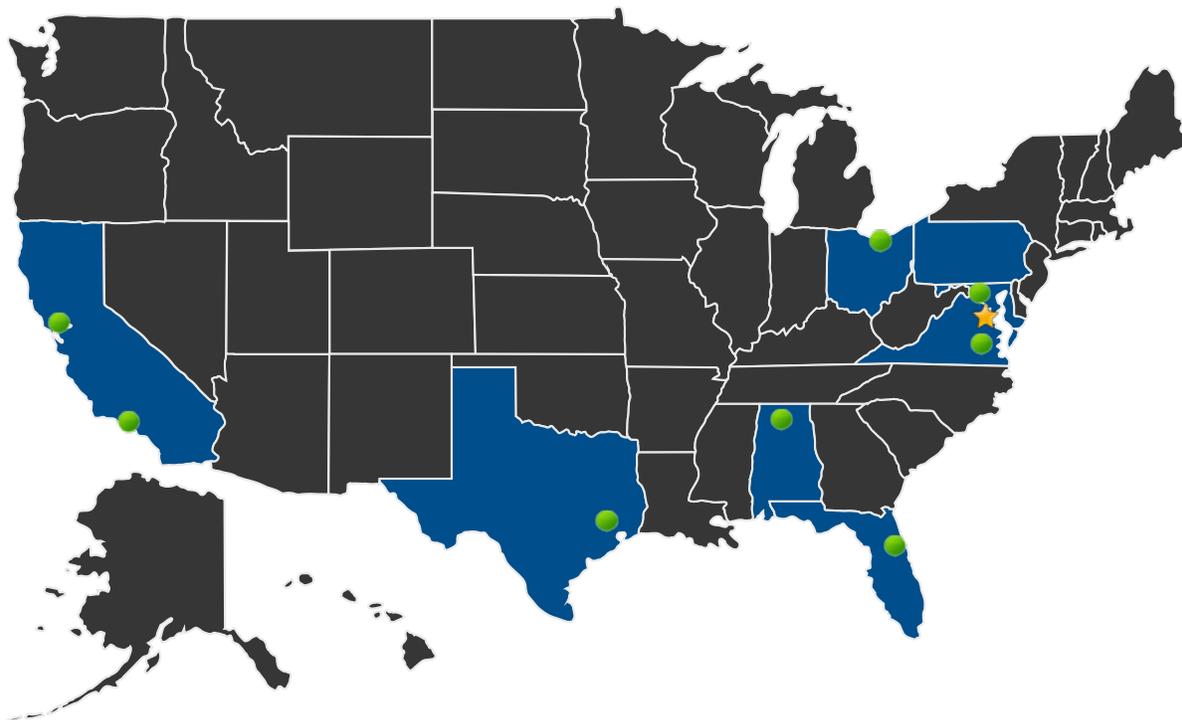
In response to the January 2014 Lunar CATALYST Announcement calling for proposals, partners were selected based on both technical and financial considerations.

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work ★ **Lead Center:**
NASA Headquarters

- **Supporting Centers:**
- Ames Research Center
 - Glenn Research Center
 - Goddard Space Flight Center
 - Jet Propulsion Laboratory
 - Johnson Space Center
 - Kennedy Space Center
 - Langley Research Center
 - Marshall Space Flight Center

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Contributing Partners:

- Astrobotic Technology, Inc.
- Masten Space Systems, Inc.
- Moon Express, Inc.

DETAILS FOR TECHNOLOGY 1

Technology Title

Robotic Lunar Lander

Technology Description

This technology is categorized as a hardware system for unmanned spaceflight

Commercial robotic lunar landers.

Capabilities Provided

Delivery of cargo to the lunar surface.

Potential Applications

- Resource prospecting
- Technology demonstrations
- Sample return
- Geophysical network deployment missions