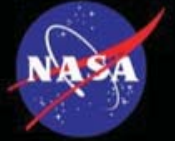


Extreme Access & Lunar Ice Mining In Permanently Shadowed Craters Project

Center Innovation Fund: KSC CIF Program

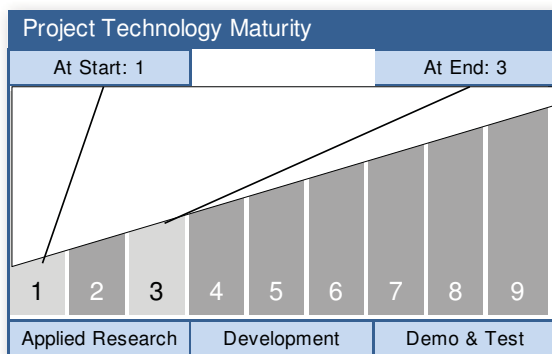
Space Technology Mission Directorate (STMD)

National Aeronautics and
Space Administration



ABSTRACT

Results from the recent LCROSS mission in 2010, indicate that H₂O ice and other useful volatiles such as CO, He, and N are present in the permanently shadowed craters at the poles of the moon. However, the extreme topography and steep slopes of the crater walls make access a significant challenge. In addition temperatures have been measured at 40K (-233 C) so quick access and exit is desirable before the mining robot cold soaks. The Global Exploration Roadmap lists extreme access as a necessary technology for Lunar ...***Read more on the last page.***



Technology Area: Mobility TA04.2 (Primary)
Robotics, Tele-Robotics & Autonomous Systems
TA04 (Secondary)

ANTICIPATED BENEFITS

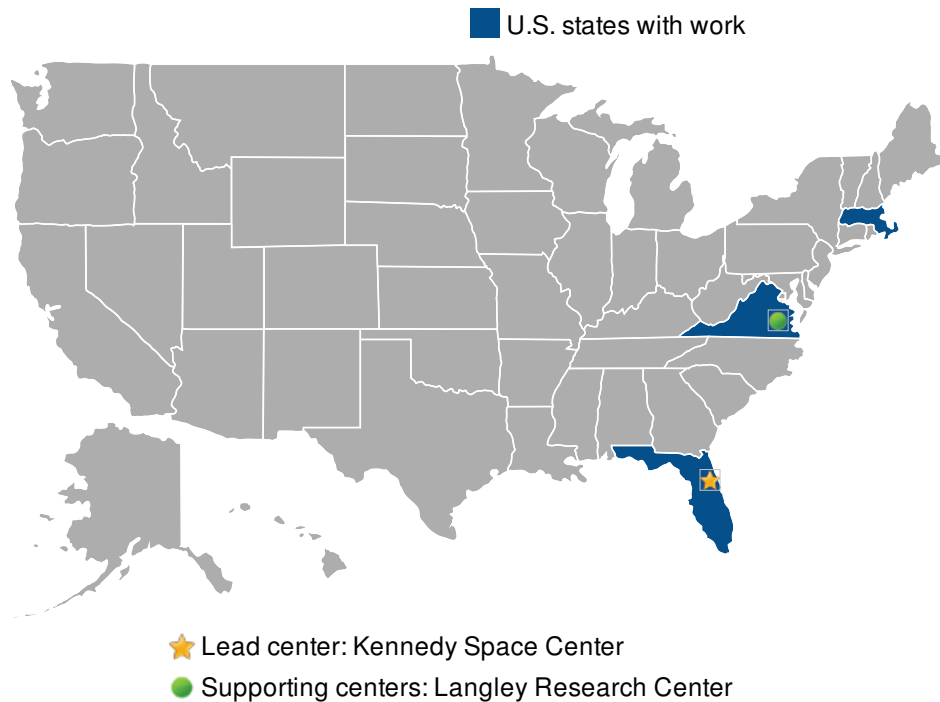
To NASA funded missions:

Lightweight Composite material (Carbon Fiber hybrid) structures and parts
Micro-Excavator with zero-net reaction force for mining
Cold gas rocket propulsion system concept design with re-charging capability from mined volatiles at the "mother ship" lander
Integrated bread board test in the GMRO lab regolith testbed.

To NASA unfunded & planned missions:

This proposal solves the extreme access problem with a new device that is a flying ...

Read more on the last page.



DETAILED DESCRIPTION

The mission for this project is to develop a very light micro excavator with the ability to drive on the surface and autonomously fly into the dark crater cold traps to mine water ice in the regolith autonomously, delivering ice to the ISRU Mother-Ship lander and re-charging its cold gas propulsion system and batteries.

MANAGEMENT

Program Executive:
Burton Summerfield

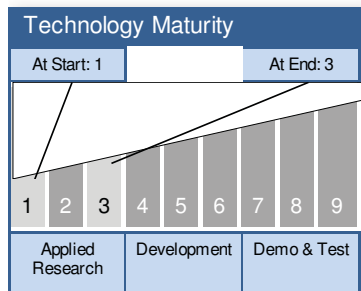
Program Manager:
Nancy Zeitlin

Project Manager:
Nancy Zeitlin

Principal Investigator:
Robert Mueller

TECHNOLOGY DETAILS

Extreme Access & Lunar Ice Mining in Permanently Shadowed Craters



TECHNOLOGY DESCRIPTION

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This technology is categorized as a hardware system for unmanned spaceflight

• Technology Area

- TA04.2 Mobility (Primary)
- TA04 Robotics, Tele-Robotics & Autonomous Systems (Secondary)
- TA02 In-Space Propulsion Technologies (Additional)
- TA07 Human Exploration Destination Systems (Additional)
- TA14 Thermal Management Systems (Additional)

CAPABILITIES PROVIDED

Recent missions have shown that ice exists on the moon and Mars near the poles. However, only Mars ice has been confirmed by “ground truth: (Phoenix). This technology will allow a fast and economical method of obtaining Lunar polar ice ground truth in permanently shadowed craters.

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IMAGE GALLERY



Extreme Access prototype during tethered flight testing.

ABSTRACT (CONTINUED FROM PAGE 1)

Exploration.



ANTICIPATED BENEFITS

To NASA unfunded & planned missions: (CONT'D)

micro-mining robot.

To the commercial space industry:

This proposal meets the objectives of the Technology Area TA02 In Space Propulsion Technologies, TA 04 Robotics, Tele Robotics and Autonomous Systems, Technology Area 07, Human Exploration Destination Systems and TA 14 Thermal Management Systems Roadmaps. It is in direct alignment with the KSC technology capability area of In-Situ Resource Utilization (ISRU) and Surface Systems and strategically important as a future line of business for KSC.

