

# Fabrication of Regolith-Derived Radiation Shield Project

Center Independent Research & Developments: KSC IRAD Program | Science Mission Directorate (SMD)



## ABSTRACT

Mars and asteroids have little or no atmosphere, and do not possess a magnetosphere that can protect humans, mechanisms and electronics from damaging Galactic Cosmic Radiation (GCR) and solar particle events (SPE) as does the Earth. These types of space radiation present one of the highest risks to a human crew during interplanetary journeys and to onboard electronics. This project aims to evaluate the effectiveness of carbonaceous asteroid materials as a potential radiation shielding material.

## ANTICIPATED BENEFITS

### To NASA funded missions:

The **logistics required** to set up a human outpost on another planetary surface are vast and prohibitively expensive. Space transportation costs are high, so the corresponding value of **In-Situ Resource Utilization (ISRU)** to make **structures** using local materials is also high.

By developing new technologies to transport, position, emplace, bind and form a net shape with regolith, radiation shields and other structures can be built on Asteroids, the Moon, Mars and other moons so that humans and machines will be better protected from radiation during their missions which means higher reliability and safety.

Radiation shields will be used on planetary bodies by persons and equipment during their missions. Shields can be developed with varying thickness of the radiation barriers depending on the amount of protection required. Terrestrial applications in radiation protection with hydrated minerals are also possible.

### To the commercial space industry:

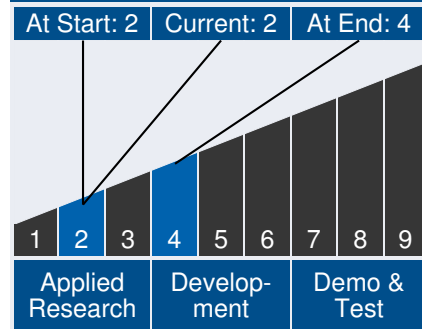
This project helps to enable the human exploration of space by



## Table of Contents

- Abstract . . . . . 1
- Anticipated Benefits . . . . . 1
- Technology Maturity . . . . . 1
- Management Team . . . . . 1
- Detailed Description . . . . . 2
- Technology Areas . . . . . 2
- U.S. Locations Working on this Project . . . . . 3
- Details for Technology 1 . . . . . 4

## Technology Maturity



## Management Team

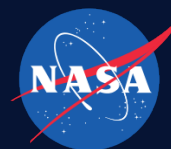
### Project Manager:

- Nancy Zeitlin

*Continued on following page.*

# Fabrication of Regolith-Derived Radiation Shield Project

Center Independent Research & Developments: KSC IRAD Program | Science Mission Directorate (SMD)



providing a means to mitigate the harmful effects of space radiation using locally acquired space resources at planetary locations.

## To the nation:

This project helps to enable the continued exploration of the solar system by humans.

## DETAILED DESCRIPTION

---

Mars and asteroids have little or no atmosphere, or a magnetosphere, to protect humans, mechanisms and electronics from damaging Galactic Cosmic Radiation (GCR) and solar particle events (SPE) as does the Earth. High energy protons are found in GCR and SPE, but the energy level is much higher for GCR (several GeV) compared to SPE (~10 MeV). These types of space radiation present one of the highest risks to a human crew during interplanetary journeys and to onboard electronics. This project aims at evaluating the effectiveness of carbonaceous asteroid materials as a potential radiation shielding material since they can contain hydrated minerals, and to fabricate protection panels using technology developed during FY14 project "3D Additive Construction with Regolith for Surface Systems". Surface Systems applications on Asteroids, the Moon, Mars and Martian moons will require the stabilization of loose, fine, dusty regolith to create a structure to mitigate radiation effects to protect humans, mechanisms, and electronics. This project will demonstrate in-situ construction of radiation shields using regolith simulants so that materials will not have to be transported from Earth.

Recent work performed at KSC has shown promising results in 3D printing a 0.2 meter dome from planetary regolith simulants using an existing 3D-positioning platform. This current project will utilize the 3D regolith printer technology to fabricate radiation shield elements that will be tested to

### Management Team (cont.)

#### Principal Investigator:

- James Mantovani

#### Co-Investigator:

- Ivan Townsend

### Technology Areas

#### Other Technology Areas:

- Radiation Mitigation (TA 6.5.2)
- Consumables Production (TA 7.1.3)

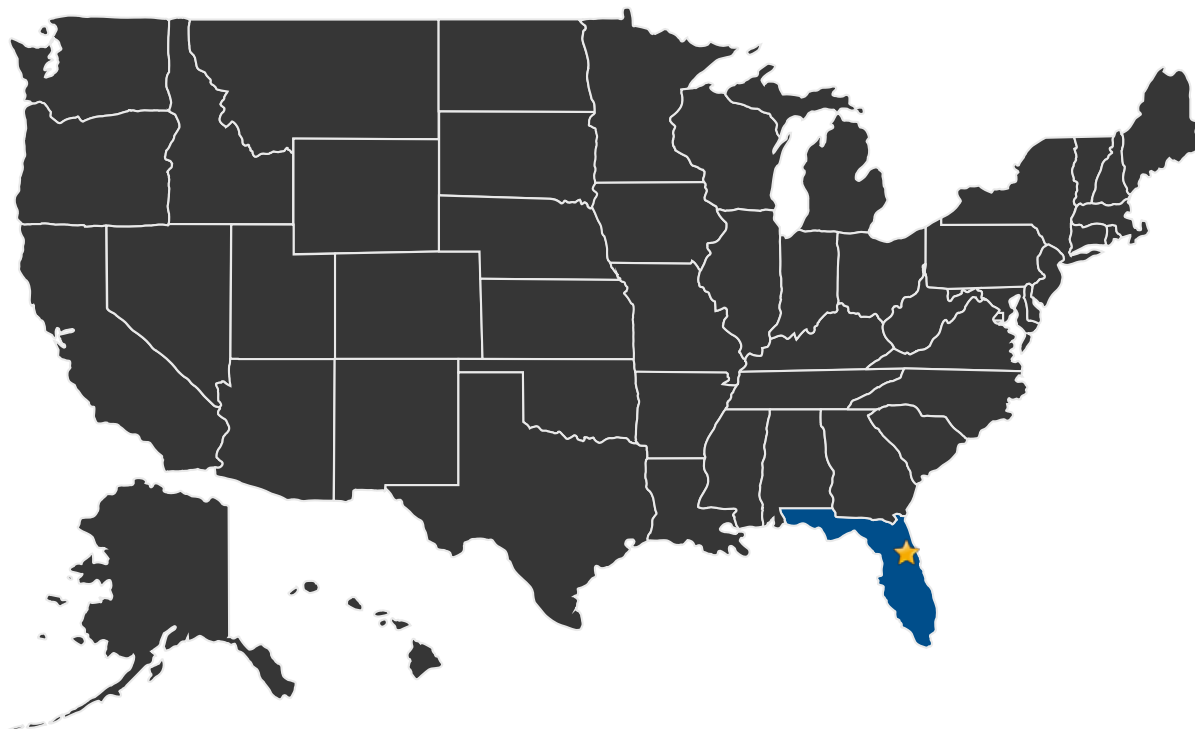
# Fabrication of Regolith-Derived Radiation Shield Project

Center Independent Research & Developments: KSC IRAD Program | Science Mission Directorate (SMD)



determine their radiation stopping capability.

## U.S. LOCATIONS WORKING ON THIS PROJECT



■ U.S. States With Work      ★ **Lead Center:**  
Kennedy Space Center

### Contributing Partners:

- University of Central Florida (UCF)

# Fabrication of Regolith-Derived Radiation Shield Project

Center Independent Research & Developments: KSC IRAD Program | Science Mission Directorate (SMD)



## DETAILS FOR TECHNOLOGY 1

---

### Technology Title

Regolith Derived Radiation Shield

### Technology Description

This technology is categorized as a material for other applications

This technology is intended to utilize asteroid regolith as a space resource that can be fabricated into a radiation shield to protect humans from harmful space radiation during explorations of the solar system. Some asteroids consist of hydrated minerals that contain water which is useful for radiation shielding.

### Capabilities Provided

There is a considerable cost savings to be gained by utilizing local (in-situ) space resources as a feedstock for the production of useful hardware as opposed to launching that hardware out of earth's gravity well. Using regolith on asteroids to fabricate radiation shields avoids the expense of launching such massive objects out of earth's gravity well.

### Potential Applications

This technology is intended to help enable the safe exploration of space by humans.