

3D Printed Composite-Z and Graded-Z Radiation Shields (CoGZ-Rad), Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



ABSTRACT

Composite-Z and Graded-Z Radiation Shields (CoGZ-Rad) uses novel multi-material 3D printing techniques to fabricate a cost-effective and lightweight radiation shielding comprised of polymers and polymer composites. CoGZ-Rad relies on advancing the concept of the graded-atomic number (graded-Z) radiation shielding by utilizing new materials and materials configurations to form graded-Z, composite-Z, and compositionally graded-Z radiation shields utilizing lightweight and low cost polymers to increase the lifetime of COTS electronics in the space environment. Printing for the CoGZ-Rad effort requires a novel additive manufacturing technique in the form of multimaterial 3D printing through a single 3D printer nozzle which assists in materials mixing and the dilution of the composite 3D printer feedstock. This will allow for any of the materials configurations to be printed without a large number of materials or printer feedheads to be required. In addition to the 3D printing advancements, we will also be building a physics design tool to assess shield performance with respect to single event effects and single event upset. In Phase I, we will demonstrate the feasibility of CoGZ-Rad as a radiation shield through laboratory fabrication and testing. In phase II, we will demonstrate flight qualification of the technology to TRL-6.

ANTICIPATED BENEFITS

To NASA funded missions:

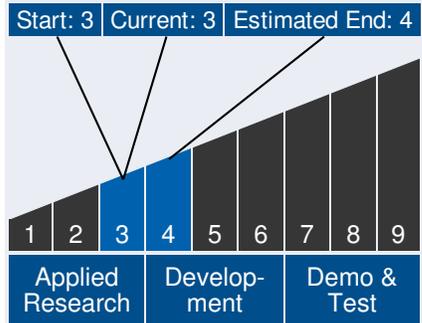
Potential NASA Commercial Applications: The proposed 3D Printed Composite-Z and Graded-Z (CoGZ) Radiation Shields effort directly supports the top challenge of "Radiation " identified in NASA Technology Roadmap 2015 by using high-hydrogen-content materials for passive radiation shielding to protect electronics from solar particle events and other radiation exposures. The CoGZ-Rad technology will enable NASA to use lightweight, low cost radiation shielding materials to protect electronics on aerospace vehicles and large space structures,



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Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

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enabling the use of low cost COTS parts to build the electronics. With the degree of flexibility inherent in the 3D printing fabrication methodology of CoGZ-Rad, the shields which can be created are appropriate for use in many space bodies, ranging from manned spacecraft to small scale satellite bodies.

To the commercial space industry:

Potential Non-NASA Commercial Applications: 3D Printed Composite-Z and Graded-Z Radiation Shields (CoGZ-Rad) will provide cost-effective space radiation mitigation to improve reliability and lifetime of a wide range of commercial missions. By utilizing additive manufacturing to create the technology, CoGZ-Rad can be used as structural radiation shielding or as conformal covers. The cost to implement the CoGZ-Rad technology scales with the implementation, making it affordable and optimal at all scales ranging from Cubesats to interplanetary manned missions.

Management Team (cont.)

Principal Investigator:

- Rachel Muhlbauer

Technology Areas

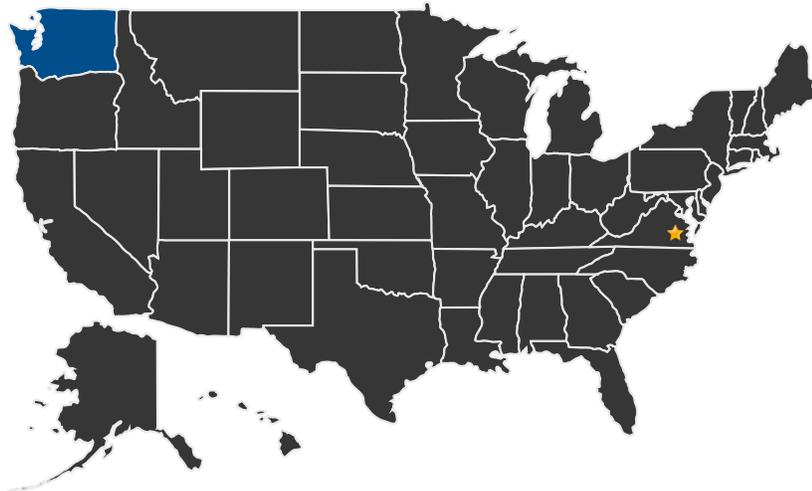
Primary Technology Area:

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

└ Radiation (TA 6.5)

└ Protection Systems (TA 6.5.3)

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ Lead Center:
Langley Research Center

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Other Organizations Performing Work:

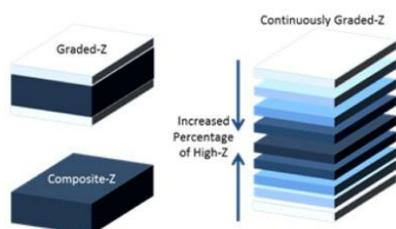
- Tethers Unlimited, Inc. (Bothell, WA)

PROJECT LIBRARY

Presentations

- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23469>)

IMAGE GALLERY



3D Printed Composite-Z and Graded-Z Radiation Shields (CoGZ-Rad), Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

3D Printed Composite-Z and Graded-Z Radiation Shields (CoGZ-Rad), Phase I

Potential Applications

The proposed 3D Printed Composite-Z and Graded-Z (CoGZ) Radiation Shields effort directly supports the top challenge of "Radiation " identified in NASA Technology Roadmap 2015 by using high-hydrogen-content materials for passive radiation shielding to protect electronics from solar particle events and other radiation exposures. The CoGZ-Rad technology will enable NASA to use lightweight, low cost radiation shielding materials to protect electronics on aerospace vehicles and large space structures, enabling the use of low cost COTS parts to build the electronics. With the degree of flexibility inherent in the 3D printing fabrication methodology of CoGZ-Rad, the shields which can be created are appropriate for use in many space bodies, ranging from manned spacecraft to small scale satellite bodies.