National Aeronautics and Space Administration

NASA**facts**

Space Technology
Game Changing Development
Thick Galactic Cosmic Rays Shielding

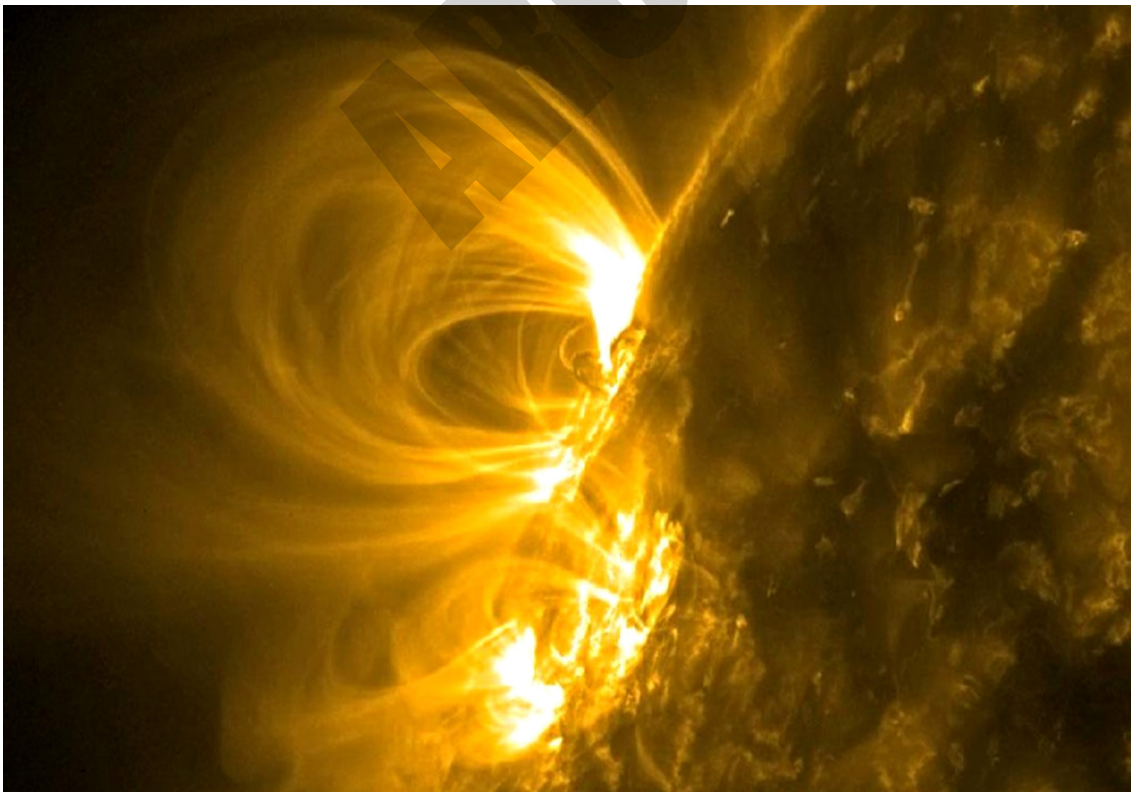
Description

Galactic and solar radiation pose risks to both astronauts and space-based assets. Galactic cosmic rays (GCRs) represent an ever-present background radiation comprising energetic protons and heavier elements. Energetic charged particles can also come from periods of increased solar activity, coined solar energetic proton (SEP) events. Unlike GCRs, SEP events are transient, randomly occurring increases in the radiation environment. Events can last from hours to days with event frequency modulated by the roughly 11-year solar cycle. SEP intensity levels can be more than a million times those during solar quiet times. Both radiation sources represent risks to humans in space through direct human exposure and also from damage to space-based equipment and systems.

Success Story

Mitigation strategies for SEP events have predominantly relied on passive shielding techniques where materials such as aluminum and polymers are used to 'absorb' the incident radiation. Passive shielding techniques are also useful in reducing astronaut GCR exposure, but the deeply penetrating high energy component of the GCR environment cannot be completely ameliorated with shielding ma-

ARCHIVED



Solar Dynamics Observatory extreme ultraviolet imagery showing constantly changing magnetic field lines.

terials. Astronaut GCR exposure on long duration missions, like the mission to Mars, will exceed NASA's permissible exposure limits, making GCR risk mitigation one of NASA's highest priority challenges.

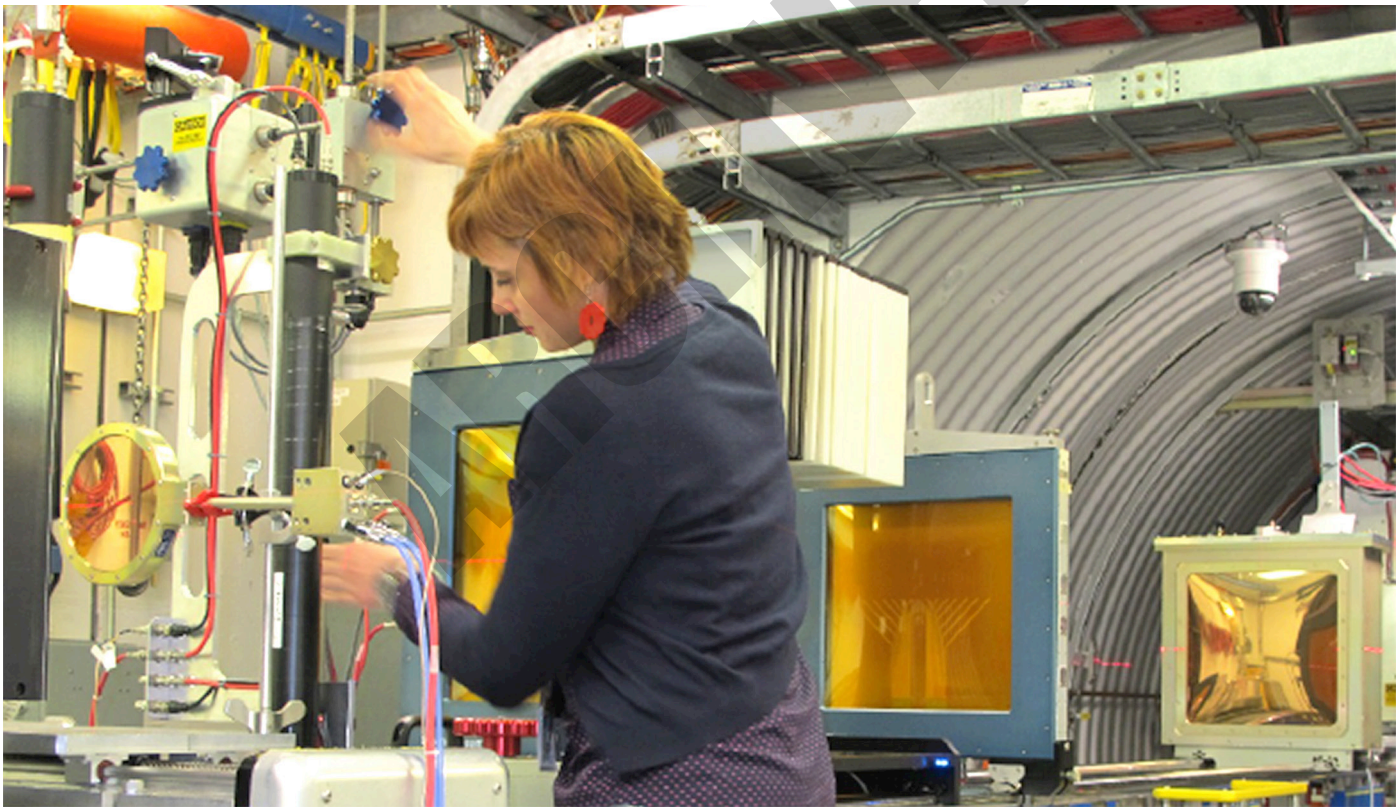
Benefit

The Advanced Radiation Protection project is a Game Changing Development project being conducted and managed at NASA's Langley Research Center with support from The University of Tennessee, Southwest Research Institute, Johnson Space Center, and the NASA Space Radiation Laboratory at Brookhaven National Laboratory. This project is currently focused on validating optimal shield thicknesses for multiple materials for GCR mitigation and also quantifying the uncertainty associated with space radiation transport calculations used in astronaut risk estimation.

Thick target charged particle beam measurements and transport code benchmarks will be used to validate optimal shield thicknesses and quantify transport uncertainty for a variety of spacecraft materials. The uncertainty in astronaut exposure estimates related to thick shield transport uncertainty will then be quantified using realistic spacecraft geometry and detailed human body models. The results of this effort will enable spacecraft designers to minimize the shielding mass on exploration vehicles while keeping astronaut radiation exposure as low as reasonably achievable.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit
http://gameon.nasa.gov/



The experimentalist places a small calibration ion chamber in the center of the NSRL beam. When the beam particles hit it, the signal from the ion chamber will be used to calibrate the radiation dose delivered to the targets.

National Aeronautics and Space Administration

Langley Research Center
Hampton, VA 23681

www.nasa.gov

FS-2016-11-270-LaRC