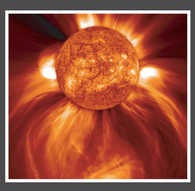
National Aeronautics and Space Administration

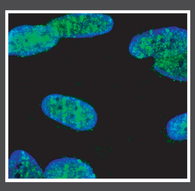
Human Research Program

Space Radiation Program Element

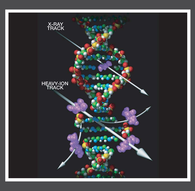
The Space Radiation Project conducts research and develops standards to assure that human exploration of space does not exceed an acceptable level of risk from radiation exposure. Effects of space radiation on health are an important safety concern for long-term space travel. Space radiation health risks include cancer, damage to the central nervous system, degenerative tissue diseases (such as cataracts and heart diseases), and acute radiation syndromes. These health risks need to be understood and reduced to ensure crew health and safety during future space exploration missions.



When a solar flare or a coronal mass ejection occurs large amounts of high-energy protons are released.



Experiments at the Space Radiation Laboratory show modifications to the histone protein, H2AX, an indicator of DNA double strand breaks along the trajectories of titanium ions through cell nuclei.



The energy that ionizing radiation deposits as it travels through living tissue causes structural damage to DNA and alters many cellular processes.

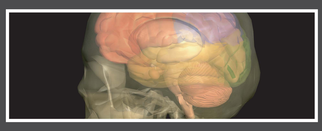
Current NASA research includes understanding the relationship of DNA and chromosome damage to the health risks from radiation, such as cancer and neurological disorders.

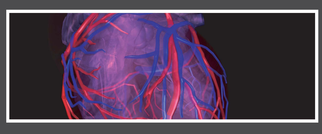
Space Radiation Risks

The harmful biological effects of high energy and charge (HZE) particles and secondary protons and neutrons are of prime concern for human exploration. Current NASA research is targeted at understanding and mitigating these harmful biological effects. NASA has identified these top health concerns for exposure to space radiation:

Carcinogenesis
Occupational radiation exposure could cause increased cancer morbidity or mortality risk in astronauts.

Central Nervous System Disease
Acute and late radiation damage to the central nervous system (CNS) may lead to changes in motor function and behavior, or neurological disorders.





Degenerative Tissue Effects
Radiation exposure may result in degenerative tissue diseases (non-cancer or non-CNS) such as cardiac, circulatory, or digestive diseases, as well as cataracts.

Acute Radiation Syndromes
Acute radiation syndromes, such as nausea, vomiting, and fatigue, may occur due to occupational radiation exposure.

Space Radiation Facilities

Brookhaven National Laboratory (BNL)
The purpose of the NASA Space Radiation Laboratory (NSRL) at BNL is to provide a ground-based facility to simulate the space radiation environment, including Galactic Cosmic Rays and Solar Proton Events.

This facilitates the study of the genetic consequences of heavy ions in a hierarchy of biological systems. NSRL can accommodate a range of simple biological systems in which damage is studied in isolated DNA to very complex systems such as 3D cell cultures and animal models.

Loma Linda University (LLU) Proton Treatment Center (PTC)
LLU PTC is a proton facility designated for patient treatment and research. NASA collaborates with LLU to augment the NSRL capability for PI studies utilizing proton beam irradiations.