

Multi-model Ensemble Risk Assessment (MERA) – Space Radiation Risk Modeling

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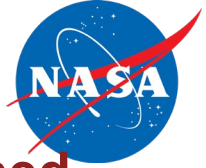
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⁺Disclaimer: This poster was prepared while Z.S. Patel was employed at KBR/NASA JSC. The opinions expressed in this poster are the author's own and do not reflect the view of the National Institutes of Health, the Department of Health and Human Services, or the United States government.



How does NASA model Space Radiation Risk?

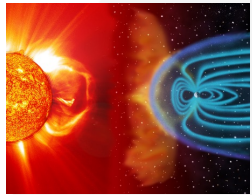


Space radiation environment

Space flight radiation risk

Ground-based radiobiology and epidemiology

nasa.gov/sites/default/files/14-271.jpg

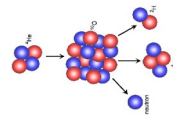


Environment models

Shielding models

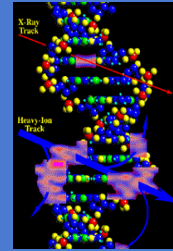
Radiation transport models

Physics models

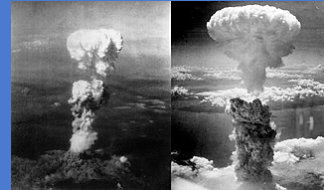


Crew Dosimetry

nasa.gov/centers/johnson/slsd/about/divisions/hacd/hrp/about-space-radiation.html

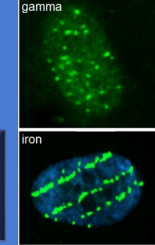


https://commons.wikimedia.org/wiki/File:Atomic_bombing_of_Japan.jpg



Cancer Risk

humanresearchroadmap.nasa.gov/evidence/reports/Carcinogenesis.pdf



Cardiovascular Disease

Central Nervous System Decrements

Radiation Quality
NSRL data

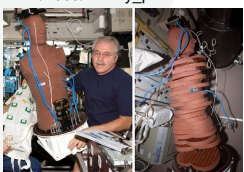
Dose Rate

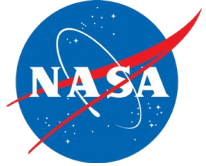
Epidemiology
LSS cohort
Million Worker

Background cancer rates

Background survival rates

science.nasa.gov/science-news/science-at-nasa/2009/27may_phantomtorso

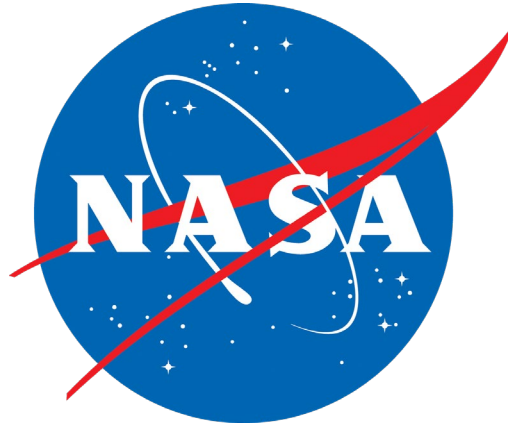




MERA – Space Radiation Risk Modeling

- NASA's radiation risk models are based on current state-of-the-art
 - Tissue exposures are modeled using current best practices
 - Physics and transport models are extensively validated against spaceflight data
 - Radiobiology and radiation epidemiology are leveraged to inform risks
 - Models are updated with the newest research to remain state-of-the-art
- Ensemble risk models provide a more complete picture of risk
 - Uncertainty due to choice of models (model form) was previously unquantified
 - Central estimates for ensemble members are in good agreement
 - Sparse data leads to significant uncertainty at the 95% confidence level
- Cancer is not the only space radiation risk of concern
 - Significant work is being done to develop models of Cardiovascular and degenerative Central Nervous System radiation risks; efforts are less mature than cancer
 - Techniques are being developed to account for risk reduction due to countermeasures
 - The role of individual risk factors is under investigation
 - NASA also has a strong interest in the combined effects of space flight stressors on the human system

Thank you for your attention!
Questions?



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