National Aeronautics and Space Administration

# 23rd Annual NASA Space Radiation **Investigators' Workshop**

July 8–11, 2012
Durham, North Carolina

program

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# 23rd Annual NASA Space Radiation Investigators' Workshop

## July 8–11, 2012

## Durham, North Carolina

### Sponsored By

NASA Johnson Space Center
Duke University
Universities Space Research Association
Division of Space Life Sciences

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# Guide to Technical Sessions

## Saturday, July 7, 2012

| | | |
|---|---|---|
| 3:00 p.m. | Forest Room | NSCOR Meeting |

## Sunday, July 8, 2012

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|---|---|---|
| 9:00 a.m. | Forest Room | NSCOR Meeting |
| 3:00 p.m. | Presidents Ballroom I/II | Opening Session |
| 7:00 p.m. | Ambassador Ballroom | Poster Session I<br>*CNS*<br>*Space Physics and Technology*<br>*Student Posters* |

## Monday, July 9, 2012

| | | |
|---|---|---|
| 7:45 a.m. | Presidents Ballroom I/II | Eye Opener Lecture I |
| 8:30 a.m. | Presidents Ballroom I/II | Cancer I |
| 1:30 p.m. | Presidents Ballroom I/II | CNS I |
| 1:30 p.m. | Presidents Ballroom III/IV | Physics and Space Technology I |
| 3:30 p.m. | Presidents Ballroom I/II | Cancer II |
| 6:00 p.m. | Ambassador Ballroom | Poster Session II<br>*Cancer*<br>*Non-Cancer Effects* |

## Tuesday, July 10, 2012

| | | |
|---|---|---|
| 7:45 a.m. | Presidents Ballroom I/II | Eye Opener Lecture II |
| 8:30 a.m. | Presidents Ballroom I/II | Red and Blue Team Debate — Cancer Risk |
| 10:30 a.m. | Presidents Ballroom I/II | Cancer III |
| 10:30 a.m. | Presidents Ballroom III/IV | Physics and Space Technology II |
| 12:00 p.m. | Presidents Ballroom I/II | The Health Risks of Extraterrestrial Environments Project Committee Meeting |
| 1:30 p.m. | Presidents Ballroom I/II | Red and Blue Team Debate — CNS and Non-Cancer |
| 3:30 p.m. | Presidents Ballroom III/IV | Physics and Space Technology III |
| 7:00 p.m. | Ambassador Ballroom | Student Poster Competition Award |

## Wednesday, July 11, 2012

| | | |
|---|---|---|
| 7:45 a.m. | Presidents Ballroom I/II | NSRL User Group Meeting |
| 8:30 a.m. | Presidents Ballroom I/II | CNS II |
| 10:10 a.m. | Presidents Ballroom I/II | Non-Cancer Effects |

**Sunday, July 8, 2012**
**OPENING SESSION**
**3:00 p.m. Presidents Ballroom I/II**

3:00 p.m. Cucinotta F. A. * Kirsch D. *
*Welcome from NASA and Duke University*

3:10 p.m. Cucinotta F. A. *
*Cancer Risk Assessment and Mitigation for Exploration Missions* **[#8122]**
We review NASA's new model to estimate space radiation cancer risks and the uncertainties in these risk estimates. Challenges and new approaches to mitigation research for cancer risks for chronic GCR exposures are discussed.

3:50 p.m. Dunbar B. *
*Radiation Risk Mitigation and the NRC Report on NASA Technology Roadmaps* **[#8131]**
This presentation discusses the NRC study process and its findings related to radiation risk management.

4:30 p.m. Held K. Koretsky A. Meyn R. Robbins M. Nowakowski R. Schimmerling W. Beven G. Barratt M. Tanzi R. Cucinotta F. Hein A. Sulzman F. Koroshetz W. J. *
*Report of the NASA Space Radiation Ad Hoc Expert Panel on CNS Risks* **[#8067]**
A panel of experts reviewed NASA-funded studies of animals exposed to high energy particles. These demonstrate brain alterations but do not establish a clinically significant brain exposure. The panel made recommendations to define this threshold.

5:10 p.m. BREAK

5:30 p.m. Shaw L. M. *
*Predictive Performance of CSF Biomarkers for Conversion from Mild Cognitive Impairment to Alzheimer's Disease* **[#8129]**
Here we summarize our experience in the qualification of CSF Amyloid beta42 (Abeta42), total tau (t-tau) and tau phosphorylated in the 181 threonine position (p-tau181).

6:10 p.m. Hogan B. *
*Towards an Understanding of Epithelial-Mesenchymal Interactions in the Adult Lung* **[#8125]**
The lung is a very dynamic organ system and its multiple functions depend to a large extent on the maintenance of its complex, three-dimensional tissue architecture.

**Sunday, July 8, 2012**
**POSTER SESSION**
**7:00 p.m. Ambassador Ballroom**

**CNS**

Guilarte T. R. Kleiman N. J. Dziedzic J. M.
*Translocator Protein 18 kDa (TSPO), a Potential In-Vivo Biomarker of Space Radiation Induced CNS Injury* **[#8102]**
Translocator Protein 18 kDa (TSPO) is an early, sensitive and predictive biomarker of brain injury, neuro-inflammation, and neurodegeneration that can be quantitatively measured in the living human brain using non-invasive techniques.

Mao X. W. Gridley D. S.
*Role of NADPH Oxidase in Low-Dose Radiation-Induced Neurovascular Remodeling in Mouse Hippocampus* **[#8049]**
The purpose of this study is to investigate whether the superoxide-producing enzyme NADPH oxidase is involved in alterations of neurovascular remodeling induced by low-dose proton radiation.

Marty V. Minassian N. Cohen T. Nelson G. Spigelman I.
*Radiation-Induced Alterations in Synaptic Transmission of Dentate Granule Neurons Depend on the Dose and Species of Charged Particles* **[#8100]**
Using whole-cell patch clamp recording, excitatory and inhibitory neurotransmission of hippocampal dentate granule neurons was examined in male C57BL/6 mice at three months after they were irradiated with protons, silicon, or iron-charged particles.

Moncaster J. A. Wojnarowicz M. Sarangi S. Minaeva O. Blakely E. A. Goldstein L. E.
*Effects of Space Radiation on Hippocampal-Dependent Learning and Neuropathology in Wild-Type and Alzheimer's Disease Transgenic Mice* **[#8119]**
It is unknown how space radiation causes cognitive impairments and by what mechanism(s) radiation exposure might predispose individuals to develop Alzheimer's disease. We are investigating this issue.

Raber J. Allen A. Baure J. Habdank-Kolaczkowski J. Davis M. J. Olsen R. Yeiser L. Rosi S. Fike J. R.
*Charged Particle Radiation, Reactive Oxygen Species, and CNS Function* **[#8057]**
Low-dose whole-body space irradiation causes hippocampus-dependent cognitive changes and changes in neurogenesis in the dentate gyrus but there does not seem to be a simple relationship between radiation-induced changes in cognition and neurogenesis.

Rabin B. M. Gomes S. Shukitt-Hale B. Heroux N. Bonilla J. Carrihill-Knoll K. L.
*Reliability of the Disruptive Effects of Exposure to Protons on Neurocognitive Performance* **[#8001]**
Although exposures to protons reliably produced deficits in cognitive performance, there were differences in the effectiveness with which protons produce a decrement in performance between two separate runs.

Rudobeck E. Vlkolinsky R.
*Functional Effects of Proton Radiation on Synaptic Transmission and Plasticity in the Hippocampus of APP/PSEN1 Transgenic Mice* **[#8084]**
We describe effect of proton radiation on synaptic plasticity in the hippocampal neurons of APP/PSEN1 transgenic mice. We used *in vitro* electrophysiology to test if radiation aggravates decrements associated with Alzheimer's type neurodegeneration.

Shih H.-Y. Rivera P. D. LeBlanc J. A. Cole M. G. Amaral W. Z. Eisch A. J. Chen B. P. C.
*Fractionated and Non-Fractionated High-LET 56Fe HZE Particle Radiation Cause Similar Long-Term Deficits in Adult Hippocampal Neurogenesis* **[#8069]**
We find that fractionated vs. non-fractionated delivery of 1.0 Gy of 56Fe particles are equally detrimental to hippocampal neurogenesis in mice. Thus, past work with non-fractionated delivery is useful for predicting the CNS risk of space radiation.

Sokolova I. Obenaus A. Nelson G. Vlkolinsky R.
*Radiation-Induced Suppression of LTP is Associated with Altered Intrinsic Membrane Properties in Hippocampal CA1 Neurons* **[#8106]**
1 Gy radiation with $H^+$ reduced hippocampal neuron excitability and suppressed LTP in the CA1 area of the hippocampus. At the cellular level, these changes were associated with altered intrinsic membrane properties of the CA1 pyramidal neurons.

Sureshkumar M. A. Chaudhary P. C. Dhawan J. A. Biegon A. Naidu M.
*Fractionated Ionizing Radiation Skews Differentiation of Glial/Oligodendrocyte Progenitor Cells and Induces Cognitive Defects* **[#8041]**
We find significant induction of DNA repair enzyme apurinic endonuclease-1 and inhibition of glial progenitor cell differentiation, with dose fractionation. Our rat spinal cord study indicates demyelination and significant cognitive defects nine months post exposure.

Vlkolinsky R. Campbell-Beachler M. Sokolova I. Obenaus A. Nelson G. A.
*Functional Effects of Proton, Silicon and Iron Radiation on Synaptic Excitability in the Mouse Hippocampus* **[#8114]**
This study compares functional effects of low doses of proton, silicon, and iron radiation on synaptic excitability and plasticity in three major neuronal fields of the mouse hippocampus.

Wyrobek A. J. Lowe X. R. Rabin B. M. Marchetti F. Bhatnager S. Snijders A.
*Molecular Characterization of Long-Term Degenerative CNS Risks from Space Radiation: Studies of Molecular and Cellular Defects in the Choroid Plexus* **[#8132]**
Irradiation with graded doses of $^{56}Fe$ or $^{12}C$ induced specific neurocognitive deficits after exposure that was associated with cellular and molecular damages to the choroid plexus, an organelle that produces CSF and is important for CNS homeostasis.

## SPACE PHYSICS AND TECHNOLOGY

Aghara S. K. Hu X.
*Radiation Environment Characterization on the Lunar Surface from SPE and GCR Interactions* **[#8027]**
This paper will present radiation environment characterization on the lunar surface using Monte Carlo simulations for two primary environments: (1) Solar Particle Events (SPE); and (2) selected GCR heavy ions (carbon, oxygen and iron).

Cengel K. A. Sanzari J. Billings P. Diffenderfer E. S. Gridley D. Wroe A. Weissman D. Kennedy A. R.
*Towards a Personalized Dosimetry Approach for Astronauts: Combining Computational and Biological Modeling to Predict the Topography of the Energy-Dose-Toxicity Landscape for Solar Particle Event Radiation* **[#8064]**
Our results predict major acute and subacute skin and internal organ toxicity may be a significant clinical problem in SPE exposed astronauts and that personalized, physiologically resolved, event specific dosimetry will be clinically valuable.

Cucinotta F. A. PhD Kim M. Y. PhD
*Pion Absorption and Nuclear Fragmentation Using the QMSFRG Model* **[#8074]**
Pions are produced as secondary radiation by GCR. For describing pion transport in shielding/tissue, interaction cross sections for pions with target atoms are needed. We consider the QMSFRG model to calculate $\pi^+$, $\pi^-$, and $\pi^0$ cross sections.

Plante I. Cucinotta F. A.
*Green's Functions of the Diffusion Equation for Simulation of Chemical Species in Biological Systems* **[#8107]**
In this work, we present an approach based on Green's functions of the Diffusion Equation to simulate stochastic systems. Two applications, the activation of the molecule TGF-beta in cell cultures and simulations of bi-molecular reactions are presented.

Dingfelder M. Jorjishvili I. G.
*Heavy Ion Track Structure Simulations in Liquid Water and Bone* **[#8046]**
We present new interaction cross sections for electrons, protons, and alpha particles with (metallic) calcium, a major component of (trabecular) bone and the implementation of a transport model into MC track structure codes.

Kim M. Y. Ponomarev A. L. Cucinotta F. A.
*A Hybrid GERMcode-HZETRN Model for Studying Light Particle Transport Physics* **[#8056]**
A hybrid model using the stochastic GERMcode and the deterministic HZETRN is developed to couple the light and heavy particle production events, in which the energy conservation in nuclear fragmentation and the distribution of particle multiplicities are considered.

Saganti P. B. Burks D. R. Erickson G. M. Cucinotta F. A.
*3D Visualization Depicting the Far Side of the Sun: Radiation Risk Assessment* **[#8124]**
Making use of the SWAN (Solar Wind Anisotropies) data from the SOHO spacecraft we have been analyzing the far side images of the solar disk in the pursuit of solar activity predictions of one to two weeks prior to their appearances in the visible part of the solar disk.

## STUDENT POSTERS

Bellone J. A. Hartman R. E. Vlkolinský R.
*Low Doses of Proton Radiation Do Not Induce Spatial Learning or Memory Deficits in a Mouse Model of Alzheimer's Disease* **[#8004]**
APP/PS1 mice and their wild-type littermates were exposed to low doses of proton particle radiation. Transgenic mice were found to have greater behavioral deficits than the wild-type mice, but radiation doses up to 1 Gy had no effect on performance.

Farin A. Manzo N. Terry K. Stripp B.
*Modeling Cell-Intrinsic Effects of Low vs High LET Ionizing Radiation on Lung Epithelial Progenitor Cells* **[#8104]**
Exposure to both low- and high-LET radiation results in a dose-dependent loss of lung epithelial progenitor cells, as modeled using 3D culture assays.

Krigsfeld G. S. Sanzari J. A. Savage A. R. Kennedy A. R.
*The Mechanism and Treatment of Coagulopathy in Proton Irradiated Ferrets* **[#8127]**
We have hypothesized that SPE radiation activates the coagulation cascade, leading to the SPE-induced hypocoagulable state.

Moding E. J. Woodlief L. Z. Lee C. L. Ma Y. Kirsch D. G.
*Role of p53 in Lung Carcinogenesis After Exposure to Space Radiation* **[#8015]**
To investigate the role of p53 in HZE radiation-induced lung cancer, we are genetically manipulating p53 levels in mice predisposed to non-small cell lung cancer and exposing them to fractionated irradiation with iron ions.

Todorova P. K. Camacho C. V. Gil del Alcazar C. R. Bachoo R. M. Burma S.
*Heterozygous Deletions of p53 and PTEN Cooperate with DNA Damage Induced by Fe Ions to Trigger High Grade Gliomas in Mouse Models* **[#8115]**
To evaluate the tumorigenic potential of HZE particles we are irradiating mouse GBM models with brain-specific heterozygous deletions of p53 and PTEN. In this model we find that Fe ions are significantly more transforming compared to X-rays.

Zheng X. Hudson F. Jaafar L. Dynan W. S.
*Long-Term Effects of a Single Exposure of the Vertebrate Embryo to High Charge and Energy (HZE) Particle Radiation* **[#8078]**
Long-term effects of exposure to the HZE particle radiation on normal tissues remain incompletely understood. Here we investigate these effects using a vertebrate model organism, the Japanese medaka (Oryzias latipes).

Adams C. J. Yu J. Mao J. H. Le P. T. DelRossario R. Hirst G. L. Wahl G. M. Barcellos-Hoff M. H. Balmain A.
*A Systems Genetic Analysis of Susceptibility to Development of Tumors Induced by High LET Radiation* **[#8019]**
We are using a systems genetics approach to identify genes and pathways involved in susceptibility to high vs. low LET radiation-induced tumorigenesis, using the novel radiation-sensitive p53 ΔP mouse model.

Alwood J. S. Tran L. H. Kumar A. K. Hilton D. Choi S. Y. Torres S. Limoli C. L. Globus R. K.
*Consequences of Low-Dose HZE Irradiation in the Cortical Bone of Aged Mice* **[#8112]**
Whether space radiation causes later changes to cortical bone, critical to bone's mechanical integrity, is not well understood. We hypothesized that HZE radiation alters mouse cortical tissue and produces a reduced state of cortical bone remodeling.

Davis C. M. Guida P. M. Hienz R. D.
*Individual Differences in Neurobehavioral Deficits Following Proton Irradiation are Related to Basal Dopamine Function* **[#8079]**
The inbred Fischer 344 and Lewis rats display inherent differences in basal dopamine (DA) function and served as subjects in the current study to assess the importance of DA system function in the behavioral and molecular responses to irradiation.

Illa-Bochaca I. Gonzalez M. Tang J. Mao J-H. Costes S. V. Barcellos-Hoff M. H.
*The Contribution of Non-Targeted Effects in HZE Cancer Risk* **[#8076]**
Our goal is to determine the contribution of NTE as a function of radiation quality on breast cancer. We present data of two experiments recently concluded where tumor latency, tumor growth, estrogen receptor status and tumor histology were measured.

Kandimalla R. Wang T. Tang X. Wang H.
*Interaction of APP(swe) Mutant and GSK3 Modulates Radiation Response in Hippocampal Neuronal Cells* **[#8091]**
In neurodegenerative diseases (AD, PD, HD, and ALS) there is accumulation of DNA damage with DNA repair defects. We found APP(swe) mutant down regulates ATM and DNA-PK activity and inhibits radiation-induced DNA damage response in neuronal cells.

Kim S. B. Pandita R. K. Kaisani A. Kumar R. Wright W. E. Pandita T. K. Shay J. W.
*Protective Role of Nrf2 Against Solar Particle Events-Induced Colorectal Cancer Progression* **[#8012]**
Simulated SPEs significantly decreased survival and increased invasive adenocarcinomas in the CPC;Apc mice. However, CDDO-EA provided for three days before exposure protected mice from SPEs-induced cancer progression and increased overall mice survival.

La Tessa C. Berger T. Kaderka R. Schardt D. Koerner C. Ramm U. Licher J. Matsufuji N. Vallhagen-Dahlgren C. Lomax T. Reitz G. Durante M.
*Out-of-Field Dose Studies with an Anthropomorphic Phantom: Comparison of X-Rays and Particle Therapy Treatments* **[#8072]**
The out-of-field dose distribution following irradiation of an anthropomorphic phantom with a 3-D treatment plan was measured for several radiation types (photons, protons, carbon ions) and delivery modalities (IMRT, passive modulation, scanning).

La Tessa C. Schuy C. Rusek A. Sivertz M. Durante M.
*Microdosimetry of 160 MeV/u $^{4}$He and 360 MeV/u $^{16}$O Beams in Water* **[#8077]**
The radiation quality of 160 MeV/u $^{4}$He and 360 MeV/u $^{16}$O beams interacting with water have been investigated by measuring microdosimetrical spectra in-beam and out-of-field. Furthermore, the dose distributions are calculated from the spectra.

Lee C. L. Blum J. M. Moding E. J. Woodlief L. Z. Borst L. Kim Y. Kirsch D. G.
*The Tumor Suppressor p53 Acts During Total-Body Irradiation to Promote Lymphoma Development* **[#8023]**
We show that temporary knockdown of p53 in mice using an inducible small hairpin RNA (shRNA ) during 1.8 Gy × 4 total-body irradiation with 320 kVp X-rays prevents lymphoma development by suppressing the expansion of mutant cells after irradiation.

Li Y. Qian H. Wang Y. Cucinotta F. A.
*Stochastic Modeling of DNA Fragments Rejoining* **[#8006]**
A stochastic model for DNA fragment rejoining is proposed to study the repair of DNA double strand breaks induced by high LET radiation. Numerical simulation agrees with data and reveals the impact factors of DNA fragments rejoining efficiency.

Manzo N. Farin A. Terry K. Stripp B.
*Proliferative and Clonogenic Potential of Lung Progenitor Cells Exposed to Ionizing Radiation* **[#8105]**
We show that the lung epithelium is a sensitive target for radiation, resulting increased airway epithelial progenitor cell proliferation and clonal expansion and may contribute to radiation-induced lung tissue remodeling and cancer development.

Saha J. Wang M. Hada M. Cucinotta F. A.
*Investigation of Switch from ATM to ATR Signaling at the Sites of DNA Damage Induced by Low and High LET Radiation* **[#8066]**
ATM and ATR kinase are responsible for the maintenance of genomic integrity. We demonstrate that transition from ATM to ATR signaling at DNA breaks leading to successful repair is inhibited by the complex type of damage induced by high LET radiation.

Tang J. Fernandez-Garcia I. Vijayakumar S. Chang J. Illa-Bochaca I. Nguyen D. H. Mao J. H. Costes S. V. Barcellos-Hoff M. H.
*Systems Modeling of Stem/Progenitor Self-Renewal Promotion Following Ionizing Radiation* **[#8031]**
In order to evaluate the long-term impact of radiation-induced death/senescence and stem cell self-renewal signaling in the mammary gland, we integrated agent-based computer models with *in vivo* measurements and *in vitro* cell culture data.

Tungjai M. Honikel L. Rithidech K.
*Comparative Effects of $^{28}$Si Ions on the Heart and the Bone Marrow of Whole-Body Irradiated Mice* **[#8029]**
The data demonstrated that exposure to $^{28}$Si ions can induce cell death in both the heart and BM of the same mouse. Further, chronic inflammation was found in both tissues after exposure to $^{28}$Si ions at the dose range of 0.1 to 0.5 Gy.

Wang T. Tang X. Wang Y. Wang C. Wang H.
*Homologous Recombination Mediates Persistent Clustered DNA Damage Processing* **[#8090]**
We investigated the processing of clustered DNA damage induced by high-LET using life-imaging, Our results suggest that clustered DNA damage information is inherited after mitosis and that homologous recombination plays critical role in repairing clustered DNA damage.

**Monday, July 9, 2012**
**EYE OPENER LECTURE I**
**7:45 a.m. Presidents Ballroom I/II**

7:45 a.m. Cucinotta F. A. *
*Space Radiation Biophysics*

**CANCER I**
**8:30 a.m. Presidents Ballroom I/II**

8:30 a.m. Schreiber R. D. *
*Deconstructing Cancer Immunoediting* **[#8126]**
Cancer immunoediting is the process by which the immune system controls and shapes cancer.

9:10 a.m. Barcellos-Hoff M. H. * Balmain A. Costes S. V. Demaria S. Mao J. H.
*NSCOR: The Contribution of Non-Targeted Effects in HZE Cancer Risk* **[#8021]**
Our studies are focused: evaluating the contribution of NTE in mammary carcinogenesis, systems genetics of radiation carcinogenesis, and modeling radiation effects, all of which are supported by a bioinformatics team.

9:40 a.m. Held K. D. * Lumpkins S. Yang H. Magpayo N. Schuemann J.
*LET Dependence of Response of Irradiated and Bystander Cells to Very Low Fluences of Charged Particles in 2D and 3D* **[#8018]**
This work extends our finding of a significant increase in DNA damage in irradiated and bystander cells at very low particle fluences to consider the importance of LET, track structure, and tissue architecture (2D vs. 3D) in bystander effects.

10:00 a.m. BREAK

10:20 a.m. Datta K. * Suman S. Kallakury B. Fornace A. Jr.
*Exposure to Heavy Ion Radiation Induced Persistent Oxidative Stress in Mouse Intestine* **[#8009]**
Long-term functional dysregulation of mitochondria and increased NADPH oxidase activity are major contributing factors towards heavy ion radiation-induced persistent oxidative stress in mouse intestine with potential for neoplastic transformation.

10:40 a.m. Aroumougame A. * Chen D. J.
*Mechanism of HZE Particles Induced Chromosome Instability* **[#8060]**
In this work, we found that the difficulties associated with clustered DNA lesions repair and checkpoint release before the completion of DNA repair contribute to the formation of chromosome aberration following exposure to HZE particles.

11:00 a.m. Li C-Y. * Li F. Liu X. Brogan J. Bedford J. S. Peng Y.
*A Novel, Facilitative Role for Caspases in Space Radiation Induced Mutagenesis and Carcinogenesis* **[#8068]**
Caspases are generally considered as tumor suppressors. In this study, we observe that in contrary to conventional wisdom, they play a facilitative role in space radiation induced carcinogenesis.

11:20 a.m. Stewart F. A. *
*Risks and Mechanisms of Radiation-Induced Cardiovascular and Cerebrovascular Disease* **[#8130]**
Epidemiological studies have shown a clear association between high therapeutic doses of thoracic irradiation and increased risks of cardiovascular disease in long-term cancer survivors, although these effects may take decades to manifest.

12:00 p.m. LUNCH

**Monday, July 9, 2012**
**CNS I**
**1:30 p.m. Presidents Ballroom I/II**

1:30 p.m. Nelson G. A. * Fike J. R. Limoli C. Obenaus A. Raber J. Spigelman I. Vlkolinsky R.
*CNS NSCOR Overview* **[#8061]**
Overview of the CNS NSCOR, which examines mouse CNS functional responses to HZE particles. Parameters include oxidative stress, neurogenesis, cognitive behavior, and associated gene expression and electrophysiological outputs focused on hippocampus.

2:00 p.m. Limoli C. L. * Kumar V. Tseng B. P. Tran K. Craver B. Giedzinski E.
*Redox Alterations and Changes to Neuronal Anatomy Caused by Low Dose Irradiation* **[#8034]**
Current work suggests that irradiation elicits ultrastructural changes in neuronal morphology. Reduced dendritic complexity and impaired synaptic remodeling may contribute to radiation-induced cognitive impairment during and after spaceflight.

2:20 p.m. O'Banion M. K. * Cherry J. Trojanczyk L. A. Lemere C. A. Williams J. P. Olschowka J. A.
*HZE Particle Irradiation Exacerbates Amyloid Pathology and Leads to Cognitive Dysfunction in the APP/PS-1 Mouse Model of Alzheimer's Disease* **[#8039]**
Male APP/PS-1 mice subjected to 10 and 100 cGy of 1 GeV/n iron irradiation at 3.5 months of age showed reduced performance on a task of novel object recognition and increased plaque deposition at 9 months of age.

2:40 p.m. Wang X. Richardson S. Casadesus G. Lee H. G. Zhu X. *
*Space-Like Radiation Causes Increased Alzheimer-Like Pathology in CRND8 APP Transgenic Mice* **[#8054]**
Our initial study demonstrated increased amyloid pathology in Alzheimer disease mouse model exposed to low dose of $^{56}$Fe or $^{28}$Si, suggesting that levels of $^{56}$Fe or $^{28}$Si exposure relevant to space mission may pose risk to space crew for developing AD.

3:00 p.m. BREAK

**CANCER II**
**3:30 p.m. Presidents Ballroom I/II**

3:30 p.m. Patel Z. S. Cucinotta F. A. Huff J. L. *
*Comparison of Low- and High-LET Radiation Effects on Genotoxic Damage and Differentiation in 3-D Organotypic Models* **[#8110]**
A cytokinesis block micronucleus assay was used to investigate genotoxic effects of low- and high-LET radiation on normal human epithelial cells grown in 3-D co-culture with stromal fibroblasts. Radiation effects on differentiation were also studied.

3:50 p.m. Girdhani S. * Lamont C. Sun M. Peluso M. Weremowicz J. Hahnfeldt P. Hlatky L.
*Anti-Angiogenic and Anti-Invasive Effects of Proton Radiation* **[#8116]**
We performed a systems level investigation (via molecular platforms, cells, tissues and *in vivo* experiments) to determine how proton radiation modulates critical hallmark cancer processes like angiogenesis, invasion, proliferation, and apoptosis.

4:10 p.m. Camacho C. V. Todorova P. Alcazar C. McEllin B. M. Mukherjee B. Story M. D. Bachoo R. M. Burma S. *

*Radiation and Gliomagenesis: A Sensitive Model System to Evaluate the Tumorigenic Potential of HZE Particles* **[#8120]**

In order to understand the carcinogenic consequences of particle irradiation, we are using transgenic mouse models of glioblastoma (GBM) with brain-specific deletions of key tumor suppressors. We find that Fe ions are at least four-fold more tumorigeneic than gamma rays.

4:30 p.m. Student Poster Summary Presentations

**Monday, July 9, 2012**
**PHYSICS AND SPACE TECHNOLOGY I**
**1:30 p.m. Presidents Ballroom III/IV**

1:30 p.m. Heilbronn L. H. * Beach M. Townsend L. W. Ronningen R. M. Marshall J.
*Neutron Data Base Development from 2005 to the Present* **[#8035]**
This paper will highlight the advances in the secondary neutron database since 2006. Those advances include the improvements to previously existing data, as well as new datasets produced by various groups around the world.

2:00 p.m. Werneth C. M. IV * Norbury J. W. Blattnig S. R.
*Inclusive Pion Cross Section Parameterizations* **[#8005]**
Thermal and Badhwar model parameterizations of inclusive pion cross sections are investigated for projectile energies ranging from 0.8 A GeV to 158 A GeV.

2:20 p.m. Bhatt S. Townsend L. W. * PourArsalan M.
*Double Differential Neutron Production Cross Sections for HZE Collisions Using Wallace's Method* **[#8003]**
Neutron and light ion transport is three-dimensional. We relax the usual small angle approximation in an abrasion-ablation model using higher-order correction terms to the Eikonal phase functions. Model calculations are compared to published data.

2:40 p.m. BREAK

3:00 p.m. La Tessa C. * Zeitlin C. Schuy C. Eichhorn A. Rovituso M. Rusek A. Sivertz M. Durante M.
*Physical and Dosimetrical Characterization of $^{4}He$, $^{12}C$ and $^{16}O$ Beams Interacting with Tissue-Like and Candidates-Shielding Materials* **[#8070]**
The fragmentation of 160 MeV/u helium; 200 and 400 MeV/u carbon; and 200, 360, and 400 MeV/u oxygen with water and bone-like materials has been investigated. Total charge-changing cross sections, yield, and energy spectra of all fragments is presented.

3:20 p.m. Wilkins R. * Gersey B. B. Hu X. Zhou J. Saganti P. Aghara S. Baburaj A. Barnett M. Johnson Q. Kirby K. K.
*Environmental and Transport Modeling Compared to Experimental Microdosimetry Results Utilizing the BERT and ERNIE Planetary Surface Testbeds Using Heavy Ions and High Energy Protons* **[#8123]**
Heavy ion and proton shielding data for simulated lunar and martian regolith materials will be presented and modeled. Material properties with respect to habitat applications will be discussed.

3:40 p.m. Hu S. * Kim M. Y. Cucinotta F. A.
*Modeling Acute Health Effects of Astronauts with ARRBOD* **[#8097]**
The ARRBOD software is designed to assess acute health risks to astronauts if they inexpediently encounter significant solar particle events. This presentation will discuss some of its new physical functionalities and biomathematical models.

4:00 p.m. Curtis S. B. *
*Fluence Rates and Energy Depositions from Delta Rays. How Important are They?* **[#8025]**
GCR exposures comprise fluences of particles of long tracks with accompanying delta rays. A model calculation of random energy deposition from electrons as a function of distance from the track will be reviewed. Dose rates at NSRL will be discussed.

**Monday, July 9, 2012**
**POSTER SESSION**
**6:00 p.m. Ambassador Ballroom**

## CANCER

Anderson J. A. Cucinotta F. A. O'Neill P.
*Modulating Radiation Induced TGFß, ATM and p38 MAPK Signalling in the DNA Damage Response* **[#8071]**
The TGFß and ATM signal transduction pathways play a role in cellular responses to IR. The combined action of TGFß, ATM, and p38 MAPK prevents phosphorylation of retinoblastoma protein, allowing it to become active and inhibit cell cycle progression.

Bailey S. M. Battaglia C. L. R. Idate R. Dregalla R. C. Sishc B. J. Liber H. L.
*Telomeric Proteins in the Radiation/DNA Damage Response* **[#8043]**
Appropriate cellular response to natural chromosomal termini (telomeres) and to exogenously created DNA DSBs is critical. We have been investigating the roles of telomere proteins in IR-induced mutation, chromosomal rearrangement, and instability.

Bennett P. V. Keszenman D. J. Johnson A. M. Sutherland B. M. Wilson P. F.
*Spectrum and Processing of Bistranded Clustered DNA Damage Induced in Primary Human Fibroblasts Exposed to Monoenergetic Proton Beams of SPE-like Energies* **[#8099]**
Levels of clustered DNA damages induced in cells by protons of SPE dominant energies measured both electrophoretically and by DSB-associated γ-H2AX pS139 nuclear foci to establish the RBE of proton exposures compared to 662 keV Cs-137 γ-rays.

Chang P. Y. Bjornstad K. A. Rosen C. J. Bakke J. P. Wang A. Du N. Colom R. M. Blakely E. A.
*Low-Dose, High-LET Harderian Gland Tumorigenesis: A Progress Report* **[#8089]**
We are studying heavy-ion-induced Harderan Gland tumorigenesis using low doses of HZE with LETs between 25 and 195 keV/μm to provide data to fill in the gaps from historical studies for estimates of targeted and non-targeted effects.

Chappell L. J. Cucinotta F. A.
*An Estimation of the Dose and Dose Rate Effectiveness Factor (DDREF)* **[#8093]**
Current models to estimate radiation risk use the LSS data. Transferring risks from these high dose rates to low doses and dose rates is a source of uncertainty in our risk calculations. We modeled the DDREF using the LSS data and radiobiology data.

Datta K. Suman S. Fornace A. J. Jr.
*Intestinal Tumorigenesis in $APC^{Min/+}$ Mice is Dependent on 56-Fe Radiation Dose* **[#8113]**
While we did not observe any dose dependency after γ irradiation exposures, tumorigenesis in small intestine after $^{56}Fe$ radiation was dose dependent with greater tumorigenesis at 4 Gy.

Ding D. Thomas S. N. Aypar U. Goetz W. Waters K. M. Morgan W. F. Yang A. J. Baulch J. E.
*Epigenetic and Genomic Alterations in Radiation Induced Genomic Instability* **[#8092]**
Evaluating the role of the mitochondrial subproteome, and mRi and mRNA in genomic instability we found altered protein, miR, and mRNA levels, demonstrating that multiple defects contribute to, and epigenetics play a role in, the instability phenotype.

Dziegielewska B. Valerie N. C. K. Parsons S. J. Larner J. M. Dziegielewski J.
*Effects of Dose, Dose-Rate and Quality of Space-Like Ionizing Radiation on Carcinogenic Transformation in Prostate Cells* **[#8058]**
Space-like ionizing radiation increases anchorage-independent growth and EMT markers expression in prostate cells in dose-, dose-rate, and LET-dependent manner. This increase is concomitant with increases in NTR1 expression and signaling.

Futtner C. Shan L. Onaitis M.
*High LET Radiation Does Not Alter Short-Term Tumor Pattern in K-Ras-Expressing Bronchiolar and Alveolar Cells* **[#8065]**
Type II cells initiate K-Ras-induced lung adenocarcinoma. We hypothesized that high-LET radiation may alter the distribution of tumors along the respiratory epithelium. However, high-LET radiation did not significantly change the distribution.

George K. Rhone J. Chappell L. J. Cucinotta F. A.
*Cancer Risk from Space Flight Estimated by Using Yields of Chromosome Damage in Astronaut Blood Lymphocytes* **[#8081]**
Relative cancer risks were estimated from astronaut biodosimetry data using the quantitative approach derived from the European Study Group on Cytogenetic Biomarkers and Health database.

Hada M. George K. Chappell L. Cucinotta F. A.
*Chromosome Aberrations in Human Lymphocytes, Fibroblasts and Epithelial Cells After Exposure to Very Low Doses of High LET Radiation* **[#8053]**
Chromosome aberrations were investigated in human lymphocytes, fibroblasts, and epithelial cells after exposed to very low doses of high-LET radiation. For doses less than 0.1 Gy a dose independent response above background frequencies were observed.

Jacobus J. A. Coleman M. C. Duda C. G. Martin S. M. Mapuskar K. Mao G. Aykin-Burns N. Joseph J. Kalyanaraman B. Gius D. Domann F. E. Olivier A. K. Knudson C. M. Spitz D. R.
*Mitochondrial Dysfunction In Vivo Alters Radiation Response, with Female Mice Most Susceptible to Lymphomagenesis, Following Exposure to Both High and Low LET Sources* **[#8098]**
Mitochondria may be important targets of high LET radiation. Altered mitochondrial metabolism is hypothesized to impact radiation response, along with gender. Our results show both mitochondrial dysfunction and gender as critical factors.

Kaisani A . K. Kim S. K. Delgado O. D. Richardson J. R. Wright W. W. Story M. S. Minna J. M. Shay J. S.
*Risk Assessment of Radiation Induced Invasive Cancer in Mouse Models of Lung Cancer* **[#8028]**
The study assesses the risk of radiation induced invasive cancer in mouse models of lung cancer. Current work focuses on mice irradiated with simulated solar particle events and observing lung cancer progression in these animals.

Keszenman D. J. Bennett P. V. Sutherland B. M. Wilson P. F.
*Clustered DNA Damage Induced by Proton Beams of Different Kinetic Energies* **[#8095]**
Proton energies important for space radiation health risks range from tens to hundreds of MeV. We have determined the yields of clustered DNA damages — DSBs, abasic and oxypurine clusters in DNA induced by proton beams of different kinetic energies.

Kosmacek E. A. Mackey M. A. Ianzini F.
*Iron Ion Irradiation Produces Changes in DNA Ploidy of Human Normal Fibroblast Cells Without Affecting Proliferation or Cell Death* **[#8013]**
Iron ion irradiation does not affect cell survival and leads to the formation of polyploid cells that maintain proliferative capability — high expression of proliferation marker Ki67, low senescence rate. These are cancer cell hallmarks. Iron ions induce a cancer phenotype.

Kosmacek E. A. Mackey M. A. Ianzini F.
*New Views: DNA Demethylation May Play a Role in Space Radiation-Induced Cell Polyploidization* **[#8020]**
Data showed link radiation-induced morphologic and phenotypic changes to genetic and epigenetic modifications. The latter affects the genetic stability of exposed cells and their progeny and may contribute to raise cancer risk from space radiation.

Kronenberg A. Gauny S. Kwoh E. Grossi G. Dan C. Grygoryev D. Turker M.
*Autosomal Mutations in Murine Kidney Epithelial Cells Exposed to Graded Doses of Densely Ionizing 1 GeV/amu Fe Ions* **[#8008]**
Mutatations are integral to cancer etiology. This study describes the types of autosomal mutations appearing in mouse kidney epithelial cells exposed to 1 GeV/amu Fe ions, and the ability to detect signature mutations as Fe ion fluence decreases.

Liber H. L. Idate R. Jalal N. Warner C. L. Bailey S. M.
*Radiation Quality and the Relationship Between Induced Telomere Aberrations and Mutagenesis* **[#8016]**
This project explores the effects of radiation quality on dose-response relationships for gene mutations and telomere aberrations. It examines both direct and non-targeted effects.

Loucas B. D. Eberle R. L. Cornforth M. N.
*High Energy Protons Produce Dose Rate Effects for Chromosome Aberrations in Human Fibroblasts* **[#8103]**
High-energy protons are often assumed to behave much like gamma photons insofar as their effects on biological systems. Here we demonstrate that such protons exhibit a pronounced dose rate effect for the production of chromosome aberrations in human cells.

Maier I. Parfenova L. Yamamoto M. L. Schiestl R. H.
*Intestinal Microbiota Inhibits Genotoxic Endpoints Upon Whole-Body Irradiation of Mice with Low Dose High-Energy Protons* **[#8073]**
In a mouse model with restricted microbiota we confirm the relative biological effectiveness of high-LET radiation to be dependent on the energy of the particles, and the lethality of non-repairable DNA damage induced by protons to depend on LET.

Meador J. A. Yu Y. Ullrich R. L. Amundson S. A.
*HZE-Induced Mammary Cancer Development Processes* **[#8085]**
Mammospheres from mice exposed to $^{56}$Fe or $^{28}$Si ions yield similar numbers of total dysplasias. HZE exposure yielded more dysplasias than gamma rays as predicted from high LET neutron experiments. Characterization of the dysplasias is underway.

Miller A. C. Cohen S. Rivas R. Miller K. Merlot R. Lison P.
*Characterization of a Non-Targeted Radiation Leukemogenesis Model* **[#8083]**
A murine model for the development of acute myeloid leukemia (AML) is available that allows an analysis of the non-targeted effects of irradiation without the complicating mutagenic effects on hematopoietic cells, i.e., non-targeted effects model.

Natarajan M. Yu H. Mohan S.
*Protein Cross-Talk Signaling Regulates Radiation-Induced Bystander Effects and Initiates Cancer Pre-Disposing Determinants* **[#8038]**
In this study we investigated (i) how radiation-triggered initial damage signals are amplified and transmitted to non-targeted cells, and (ii) how radial communication of those signals activate factors that are responsible for carcinogenesis.

Powell D. R. McCrary M. R. Conneely K. N. Vertino P. M.
*Epigenetic Memory of High LET Radiation Exposure* **[#8117]**
Our goal is to test the hypothesis that the risk of lung cancer associated with high LET radiation arises in part from an epigenetic "memory" of acute exposure encoded in DNA methylation patterns and manifest as stable alterations in gene expression.

Raber J. Belknap J. Kleiman N. J. Hall E. J. Ray F. A. Fallgren C. M. Weil M. M.
*Characterization of the Tumor Spectrum Arising in HZE Ion Irradiated Outbred Mice* **[#8022]**
This project is designed to compare tumor spectra, cognitive deficits, and visual decrements between HZE ion irradiated, gamma-ray irradiated, and unirradiated outbred mice. Genetic loci underlying susceptibility to these outcomes will be mapped.

Ray F. A. Zimmerman E. Cornforth M. N. Goodwin E. H. Bedford J. S. Bailey S. M.
*Detecting Chromosomal Inversions Using Chromatid Painting Strategies — Biodosimetry Applications* **[#8062]**
We recently reported a new methodology to detect chromosomal inversions with an ~10 fold improvement in resolution over existing techniques. We present recent advances in scoring and analysis of radiation induced inversions.

Rithidech K. R. Dunn J. J. D. Tungjai M. T. Honikel L. H. Whorton E. B. W.
*In Vivo Induction of Chromosome Instability and Aberrant Patterns of DNA Methylation in Hematopoietic Stem/Progenitor Cells (HSPCs) by $^{28}Si$ ions* **[#8024]**
We are using an established *in vivo* systems to develop quantitative methods for analyzing chromosome instability and DNA methylation associated with radiation exposure to hematopoietic stem/progenitor cells, the known target cell for radiation-induced myeloid leukemia.

Snijders A. M. Mannion B. J. Rydberg B. Leung S. G. Kronenberg A. Wiese C.
*An In-Vivo-Like Multi-Cellular Skin Model System for the Analysis of Radiation Quality Effects* **[#8082]**
A human *in-vivo*-like multi-cellular skin model system is used to elucidate the mechanisms that contribute to increased risk for skin cancer from space radiation. The effects of charged nuclei with LETs from 44 to 250 keV/μm are investigated.

Sridharan D. M. Wilson W. C. Whalen M. K. Chappell L. J. Cucinotta F. A. Pluth J. M.
*Effect of Low Energy Heavy Ions on Mammary Cancer Risk* **[#8118]**
To study track structure effects mammary epithelial and fibroblast cells were exposed to various radiation qualities, and monitored for DNA damage phospho-kinetics, centrosome aberrations, and telomere length changes using novel flow-based assays.

Steffen L. Bacher J. Peng Y. Le P. Ding L. Genik P. Ray A. Bedford J. Fallgren C. Bailey S. Ullrich R. Weil M. Story M.
*Molecular and Cytogenetic Characterization of High-LET and Low-LET Radiation-Induced Acute Myeloid Leukemia in Mouse* **[#8014]**
High-LET and low-LET radiation-induced murine myeloid leukemia is characterized by biallelic PU.1 mutation and ongoing genomic instability.

Tang J. Nguyen D. H. Illa-Bochaca I. Mao J. H. Costes S. V. Barcellos-Hoff M. H.
*Gene Expression Profiling of Mammary Tumors from Si-Particle Irradiation* **[#8032]**
Our preliminary analysis of functional relationships between differentially expressed genes between tumors arising from unirradiated and Si particle-irradiated hosts revealed that many biological processes are affected by HZE host irradiation.

Tang H. T. Xiao G. X. Behrens C. B. Schiller J. S. White M. W. Wistuba I. W. Minna J. M. Xie Y. X.
*Systems Biology and Integrative Approaches to Identify a Predictive Gene-Signature for Adjuvant Chemotherapy in Non-Small Cell Lung Cancer Patients* **[#8111]**
We integrate genetic alteration, siRNA functional data, and mRNA expression data to identify a functional gene set that predicts clinical benefit of ACT. The predictive effect of the signature has been validated in two independent NSCLC cohorts.

von Neubeck C. Kauer P. M. Robinson R. J. Chrisler W. B. Shankaran H. Sowa M. B.
*Cell Type Dependent Signaling and Its Effect in Tissue Regulation in a Human Skin Model After Exposure to Low Doses of Ionizing Radiation* **[#8088]**
Using heavy ions to look at cell type dependent signaling and its effect in tissue regulation in a human skin model after exposure to low doses of ionizing radiation.

Wang H. Wang P. Zhang XM. Wang J. Wang Y.
*Base Excision Repair of Ape1 Promotes Generation of DNA DSB in High Linear Energy Transfer Irradiated Cells* **[#8052]**
Our results suggest that the base excision repair (BER) function of Ape1 plays a key role in killing more cells through generating more DNA DSBs after cells are exposed to high-LET radiation.

Wang M. Saha J. Hada M. Pluth J. Anderson J. A. O'Neill P. Cucinotta F. A.
*Novel Smad Proteins Localize to IR-Induced Double-Strand Breaks: Interplay Between TGFβ and ATM Pathways* **[#8055]**
Smad2 and Smad7 contribute to radiation-induced DSB repair and function of Smad2 is dependent on the ATM pathway.

Werner E. Tang X. Wang H. Doetsch P.
*Concurrent Delayed ROS Stress and Genomic Instability in Response to a Single Exposure to Ionizing Radiation* **[#8048]**
After a single exposure to high or low LET radiation, surviving cells accumulate reactive oxygen species for up to eight population doublings. In high LET irradiated cells, this period correlated with persistent genomic and chromosomal instability.

Yaswen P. Kaur G. Gauny S. Parvin B. Kronenberg A.
*Epigenetic Effects of Radiation on Epithelial Cell Self-Renewal* **[#8040]**
A tissue specific risk model is being developed using primary human breast cells in organotypic cultures to determine the effects of radiation ionization density and dose on the frequency of altered differentiation/self-renewal.

Zhang X. Ng WL. Wang P. Tian L. Werner E. Wang H. Doetsch P. Wang Y.
*MicroRNA-21 Modulates Reactive Oxygen Species Levels Via Targeting SOD3 and TNFα* **[#8036]**
In this study, we identified two new targets of miR-21: SOD3 and TNFa (regulating SOD2), which is involved in the regulation of cellular ROS levels and affects high-linear energy transfer radiation-induced cell transformation.

## NON-CANCER EFFECTS

McDonald T. Yan X. Sasi S. P. Yang Y. Hlatky L. Shtifman A. Goukassian D. A.
*Transcriptional Profiling of Cardiac Cells Reveal an Immense Complexity of Gene Expression over one Month After a full Body 0.15 Gy $^{56}$Fe but not 0.9 Gy Proton Radiation* **[#8063]**
Main findings: an immense complexity of RNA transcription, regulation of biological pathways, included, but not limited to inflammation, DNA damage/repair, free radical scavenging and immune trafficking post 0.15 Gy $^{56}$Fe, but not 0.9 Gy proton IR.

Muralidharan S. Sasi S. Park D. Enderling H. McDonald T. Hlatky L. Shtifman A. Yan X. Goukassian D. A.
*TNFR2/p75 Signaling Induces Delayed Radiobiological Bystander Responses in BM-derived EPCs: Implications for Development of Countermeasures* **[#8030]**
There are two main finding: (1) BM-derived EPC exhibit radiation-induced non-targeted effects (NTEs); (2) TNF-TNFR2/p75 axis inhibits early and increases delayed NTEs in EPCs. Implications: inhibition of p75 signaling may decrease delayed NTEs.

Sasi S. P. Muralidharan S. Park D. Enderling H. Hlatky L. Yan X. Goukassian D. A.
*Bioequivalent Low Dose Full Body Proton and $^{56}$Fe Radiation Mediate Comparable DNA Damage, Apoptosis and Proliferation Responses in the Heart and BM-Derived EPC* **[#8044]**
Early BM-derived EPC apoptosis is a direct effect of IR, whereas later apoptosis and decrease in proliferation may be due to delayed NTEs. Heart-decay of p-H2AX foci are slower in cardiac non-ECs; IR-induced inflammation is long-lived in the heart.

Shtifman A. Pezone M. J. Sasi S. Coelho C. Peloso M. Hlatky L. Perepletchikov A. Yan X. Goukassian D. A.
*Divergent Regulation of Skeletal Muscle $Ca^{2+}$ Homeostasis and Long-Term Regeneration in Response to Bio-Equivalent Full Body Low Dose Single Proton or $^{56}Fe$ Radiation* **[#8037]**
There are two main findings: (1) radiation increases cytoplasmic [$Ca^{2+}$] and reduces depolarization evoked $Ca^{2+}$ release from the SR; (2) there is an ongoing muscle regeneration three months after a single 0.15Gy $^{56}Fe$ but not 0.9 Gy of proton radiation.

Yoshida K. Hada M. Teramura T. Cucinotta F. A. Morita T.
*Increase of Chromosome Breaks by Low- and High-LET Irradiation in Histone H2AX-Deficient Mouse ES Cells* **[#8045]**
The mouse Histone H2AX (+/+), (+/-) and (-/-) ES cells were exposed to $^{137}Cs$ γ-rays or 600 MeV/u $^{56}Fe$-ions. Chromosome aberrations were analyzed by FISH technique with whole-chromosome probes during the first cell division after irradiation.

**Tuesday, July 10, 2012**
**EYE OPENER LECTURE II**
**7:45 a.m. Presidents Ballroom I/II**

7:45 a.m. Fike J. *
*CNS Radiobiology*

**RED AND BLUE TEAM DEBATE — CANCER RISK**
**8:30 a.m. Presidents Ballroom I/II**

*Using data received from all workshop presenters, teams will debate the extent of positive progress (Blue Team), or lack of progress (Red Team), toward NASA's Space Radiation Research goals in the area of cancer risk.*

Red Team:
Alan Balmain
Mary Helen Barcellos-Hoff
David Kirsch
Peter O'Neill

Blue Team:
Marco Durante
Mark Onaitis
Jerry Shay
Robert Ullrich

10:15 p.m. BREAK

**CANCER III**
**10:30 a.m. Presidents Ballroom I/II**

10:30 a.m. Weil M. W. Ray A. Bacher J. W. Bedford J. S. Steffen L. S. Ding L. Bielefeldt-Ohmann H. Genik P C. Yu Y. McCarthy M. Fallgren C. M. Ullrich R. L. *
*The Radiation Carcinogenesis NSCOR* **[#8010]**
The Radiation Carcinogenesis NSCOR consists of four projects supported by three cores. In this presentation we will summarize some of the recent findings from these projects.

11:00 a.m. Park S. * Ding L. H. Larsen J. E. Minna J. D. Story M. D.
*Genomic Characterization of Transformed Human Bronchial Epithelial Cells Induced by Ionizing Radiation* **[#8086]**
We have carried out experiments to study the genomic characterization of transformed human bronchial epithelial cells after radiation. We performed gene expression profiling, array CGH, p53, and k-ras mutation studies from clones growing in soft agar.

11:20 a.m. Sridharan D. M. * Guo M. Chan R. Roppel R. D. Whalen M. K. Wilson W. C. Pluth J. M.
*Persistent ATF2 Signaling Unique to High LET Exposure is a Potential Surrogate Marker of Cancer Risk* **[#8121]**
Persistent phosphorylation of ATF2, unique to high LET exposures, is dependent on radiation quality and reflects prolonged cellular oxidative stress, suggesting its use as a biomarker to investigate radiation quality effects in estimating cancer risk.

11:40 a.m. Turker M. * Kronenberg A. Grygoryev D. Dan C. Ohrlich A. Eckelmann B. Gauny S.
*Toxicity and Mutagenesis in Three Mouse Tissues Exposed to Accelerated Fe Ions, Ti Ions, or Protons* **[#8007]**
Charged-particle toxicity and mutagenesis is being examined *in situ* in three radiosensitive tissues: kidney, spleen (T cells), and lung. The results to date indicate both particle and tissue specific differences, with kidney cells exhibiting the highest mutagenic response.

12:00 p.m. LUNCH

**Tuesday, July 10, 2012**
**PHYSICS AND SPACE TECHNOLOGY II**
**10:30 a.m. Presidents Ballroom III/IV**

10:30 a.m. O'Neill P. M. *
*Review of Existing Galactic Cosmic Ray Models and Recommendations for Improvement* **[#8017]**
Accuracy of current galactic cosmic ray (GCR) models is reviewed. New capabilities needed by the health physics and micro-electronis communities: worst-case statistics, prediction GCRs in the future, deep space (>10 AU) and high heliospheric latitude.

10:55 a.m. Kim M. Y. * Cucinotta F. A.
*Consideration of Integral Proton Fluence at High Energies for the Risk Assessment of Solar Particle Event* **[#8094]**
For consequences of large solar particle events, the risk prediction is improved by considering high-energy proton fluences.

11:15 a.m. Dicello J. F. * Cucinotta F. A. Dolecek Q. E. Rosenfeld A. B. Zaider M. Malak H.
*An Analysis of Spectra Obtained with a Version of a Space Qualifiable Solid-State Microdosimeter Capable of Detecting Event Sizes Below 0.1 keV/μm* **[#8087]**
Analyses of microdosimetric data down to 30 eV/μm show that failure to obtain data below 1 keV/μm or to correctly measure delta rays can result in loss of most events and corresponding dose from protons, HZEs, or mesons as well as overestimating risk.

11:35 a.m. Norman R. B. * Slaba T. C. Blattnig S. R.
*Recent Updates to HZETRN — Coupled Meson and Lepton Transport* **[#8002]**
HZETRN has been updated to include the transport of pions, muons, electrons, positrons, and photons. Model results will be compared with experiment and the effect on dose will be presented.

11:55 a.m. Aikens R. A. Jia Y. Lin Z. W. *
*Anisotropy of the Albedo Radiation Environment on the Moon* **[#8059]**
We find that albedo particles such as neutrons and photons on the lunar surface in a galactic cosmic ray environment are in general not isotropic in the upper hemisphere; moreover, the deviation from isotropy depends on the energy of the particles.

12:15 p.m. LUNCH

**Tuesday, July 10, 2012**
**RED AND BLUE TEAM DEBATE — CNS AND NON-CANCER**
**1:30 p.m. Presidents Ballroom I/II**

*Using data received from all workshop presenters, teams will debate the extent of positive progress (Blue Team), or lack of progress (Red Team), toward NASA's space radiation research goals in the area of central nervous system/non-cancer risks from space radiation.*

Red Team:
- Eleanor Blakely
- Lee Goldstein
- Jacob Raber
- Charles Limoli

Blue Team:
- Richard Britten
- William Dynan
- David Goukassian
- Greg Nelson

3:10 p.m. BREAK

**Tuesday, July 10, 2012**
**PHYSICS AND SPACE TECHNOLOGY III**
**3:30 p.m. Presidents Ballroom III/IV**

3:30 p.m. Zeitlin C. * Hassler D. M. Boettcher S. Bohm E. Burmeister S. Brinza D. E. Cucinotta F. A. Ehresmann B. Koehler J. Posner A. Reitz G. Weigle G. Wimmer-Schweingruber R. F.
*RAD Dosimetry Measurements During MSL's Cruise to Mars* **[#8080]**
The MSL spacecraft was launched to Mars on 11/25/11 and will land on 8/6/12. RAD was turned on 10 days into cruise and has been operating almost continuously. RAD has acquired five months of GCR data and has observed three significant solar events.

4:00 p.m. Sandridge C. A. *
*OLTARIS — Overview and Update on New Capabilities* **[#8047]**
The On-Line Tool for the Assessment of Radiation in Space (OLTARIS) is a web-based set of tools and models for radiation shielding analysis. The site is a design tool for those studying the effects of space radiation and advanced shielding concepts.

4:20 p.m. Plante I. * Cucinotta F. A.
*The Online Monte-Carlo Simulation of Heavy Ions Radiation Track Structure* **[#8109]**
A web interface was developed to use the Monte-Carlo simulation code RITRACKS online. The user enters the ion type and energy. The calculation of the track structure is done on the USRA cluster. After the simulation is done, the track can be visualized and downloaded.

4:40 p.m. Durante M. * Angerer O.
*The ESA Space Radiation Laboratory at GSI* **[#8050]**
ESA is supporting a space radiation research program (IBER) that is based at the SIS-18 accelerator at GSI (Darmstadt, Germany) and is in close contact with the NASA Space Radiation Health Program. Recent results of this European program will be presented.

5:05 p.m. Rusek A. * Chiang I. H. Lowenstein D. I. Sivertz M. B.
*NSRL Update* **[#8075]**
A report on new additions to the NSRL infrastruture and new developments in dosimetry, detectors, beam delivery and space radiation environment simulation.

**Wednesday, July 11, 2012**
**NSRL USER GROUP MEETING**
**7:45 a.m. Presidents Ballroom I/II**

7:45 a.m. Guida P. *
*NSRL User Group Meeting*

8:00 a.m. Rusek A. *
*NSRL User Group Meeting*

**CNS II**
**8:30 a.m. Presidents Ballroom I/II**

8:30 a.m. Britten R. A. * Davis L. K. Fellman L. Nyalwidhe J. Seemes O. J. Drake R. R.
*The Differential Susceptibility to Spatial Memory Impairment by Low (20 cGy) Doses of 1 GeV/Nucleon $^{56}$Fe Particles is Associated with Specific Changes in the Hippocampal Proteome* **[#8011]**
To help identify the processes that are altered in rats that exhibit impaired or normal spatial memory following exposure to 20 cGy of 1 GeV/u $^{56}$Fe particles, the hippocampal proteome was characterized using an unbiased proteomic profiling approach.

8:50 a.m. Raber J. * Haley G. E. Johnson L. Yeiser L.
*Early Effects of Alpha-Lipoic Acid on Cognition of Sham-Irradiated and $^{56}$Fe-Irradiated C57BL/6J Female and Male Mice* **[#8026]**
The age of mice modulates early cognitive effects of $^{56}$Fe irradiation. The antioxidant α-lipoic acid (ALA) increased the GSH/GSSG ratio, but ALA use under physiological conditions and during low dose space irradiation should be carefully evaluated.

9:10 a.m. Wang T. Tang X. Kandimalla R. Wang H. *
*Persistent DNA Damage Response Induces Long-Term Effects in Neuronal Cells Exposed to Low and High LET Radiation* **[#8101]**
Heavy ion particle induced DNA damage tracks are mitotic inheritable and mediated by Rad51. Inhibition of glycogen synthase kinase 3 (GSK3) activity enhances cell survival and synaptic activity in hippocampal neurons following irradiation.

9:30 a.m. Sharma P. Templin T. Grabham P. *
*Effects of Radiation on Human Brain Endothelial Barrier Function* **[#8096]**
Effects of radiation on blood brain barrier models using a variety of endpoints to assess barrier function: transendothelial electrical resistance, permeability, morphological effects, localization of cell adhesion, and junction proteins.

9:50 a.m. BREAK

**NON-CANCER EFFECTS**
**10:10 a.m. Presidents Ballroom I/II**

10:10 a.m. Kucik D. F. * Gupta K. Khaled S. Wu X. Yu T.
*Adhesiveness of Aortic Endothelium in Response to High-LET Radiation is Chemokine Dependent* **[#8033]**
Radiation is a risk factor for atherosclerosis, but the mechanism is unknown. We show that $^{56}$Fe increases aortic endothelial adhesiveness, which is likely to be pro-atherogenic, and that the mechanism is chemokine dependent.

10:30 a.m. Yan X. Sasi S. P. Yang Y. Lee J. Peluso M. Coelho C. Hlatky L. Morgan J. Carrozza J. Kishore R. Goukassian D. A. *
*Full Body Single Dose 0.5 Gy Proton is Beneficial Whereas Single 0.15Gy $^{56}$Fe Dose is Deleterious for Acute Myocardial Infarct Recovery up to 3 Month Post-IR* **[#8042]**
Main findings: low-dose space IR effects on the CV system are long-lasting; three months post-IR, proton and $^{56}$Fe IR does not affect heart homeostasis under normal conditions; proton IR is beneficial, whereas $^{56}$Fe IR is deleterious for post-AMI recovery.

10:50 a.m. Zheng X. Hudson F. Jaafar L. Dynan W. S. *
*Long-Term Effects of a Single Exposure of the Vertebrate Embryo to High Charge and Energy (HZE) Particle Radiation* **[#8078]**
Long-term effects of exposure to the HZE particle radiation on normal tissues remain incompletely understood. Here we investigate these effects using a vertebrate model organism, the Japanese medaka (Oryzias latipes).

11:10 a.m. Kennedy A. R. * Weissman D. Freund G. G. McDonough J. Mick R. Diffenderfer E. S. Sanzari J. K. Romero-Weaver A. L. Krigsfeld G. S. Wan X. S. Cengel K. A.
*Acute Effects of Solar Particle Event Radiation* **[#8051]**
The NSBRI Center of Acute Radiation Research (CARR) involves many different projects and investigators. The presentation will focus on new findings from the CARR investigations performed during the past year of research.

11:30 a.m. Globus R. K. * Alwood J. S. Kumar A. Limoli C. L.
*Hypothesis: Space Radiation-Induced Bone Loss as Collateral Damage* **[#8108]**
We propose that there are two major components to radiation-induced changes in bone remodeling that have the potential to lead to bone loss, impaired mechanical properties, and defective fracture healing.

11:50 a.m. MEETING ADJOURNS