

**SIXTH ANNUAL
SPACE RADIATION HEALTH INVESTIGATORS' WORKSHOP**

**Brookhaven National Laboratory
Upton, Long Island, New York**

May 2 - 5, 1995

May 2, 1995 (Tuesday)

Meeting place: Radisson Islandia Hotel, Hauppauge, Long Island

6:00 p.m. Registration
 Room Salon A

6:30 p.m. Reception
 Poolside on Lower Level

**Session I Panel Discussion on Gravitational Biology and Microgravity
 Biomedical Research
 Room Salon A**

Chairperson: G. Nelson, JPL

8:00 p.m. Responses of *C.Elegans* To Low and High LET Ionizing Radiation: Mutant
 Structure and Loss of Proliferation Control
 G. Nelson, G. Kazarians, R. Kern, and W. Schubert, JPL

8:15 p.m. Gravitational Biology Program
 E. Morey-Holton, NASA ARC

8:45 p.m. Radiation Monitoring, Environmental Monitoring and Investigational Facilities
 for the International Space Station
 D. Russo, A. S. Johnson, and T.C. Yang, NASA JSC

9:15 p.m. Why do Biomedical Experiments in Space?
 P. Todd, U. of Colorado

9:45 p.m. General Discussion

10:00 p.m. **Adjourn**

May 3, 1995 (Wednesday)

Meeting Place: Main Auditorium, Berkner Hall, Brookhaven National Laboratory (BNL)

8:00 a.m. Registration

8:30 a.m. Welcome/Opening Remarks

Session II Radiation Risk Assessment

Chairperson: V. Bond, BNL

Co-Chairperson: C. Meinhold, NCRP

8:45 a.m. The Requirement for Imparted Energy When Evaluating the Public Health Impact of Radiation Exposure
L. Wielopolski and V. P. Bond, BNL

9:00 a.m. A Fallacy in the "Proof" of the Linear, Non-Threshold Hypothesis
V. P. Bond and L. Wielopolski, BNL

9:15 a.m. Hiroshima Neutron Measurements: Discrepancy and Risk Implications
T. Straume, LLNL

9:30 a.m. Extending Japanese A-Bomb Survivor-Based Radiation Risks to Space Radiation Applications
D. Kaul, SAIC

9:45 a.m. Application of the HSEF to Assessing Radiation Risks Associated with Space Missions
M. Zaider and V. P. Bond*, Columbia U., BNL*

10:00 a.m. **Coffee Break**

10:15 a.m. Using z^2/β^2 as a Predictor of Biological Effect for Radiation Protection Purposes
S. B. Curtis, F. F. Badavi*, and J. W. Wilson*, Fred Hutchinson Cancer Research Center, NASA LaRC*

10:30 a.m. The Calculation of Radial Dose from Heavy Ions: Effects on Predictions of Biological Action Cross Sections
R. Katz, U. of Nebraska

10:45 a.m. Radiation Protection in Space - Some Methodological Issues
P. Groer, U. of Tennessee

- 11:00 a.m. Modeling Cancer Mortality Rates for Hiroshima and Nagasaki Separately
L. Peterson, Kelsey-Seybold Clinic
- 11:15 a.m. Space Radiation-Induced Cancer Risks for Mir/ISSA Orbits
B. Atwell, H. Wu*, and T.C. Yang **, Rockwell, KRUG*, and NASA JSC**
- 11:30 a.m. Risk Management Strategies During Solar Particle Events on Human Missions to Mars or the Moon
R. Turner, ANSER
- 11:45 a.m. Panel Discussion on Current Status of Radiation Risk Assessment and A-Bomb Survivor Data

D. Kaul, SAIC
T. Straume, LLNL
D. Preston, RERF
- 12:15 p.m. **Lunch Break**
- Session III Radiation Physics and Dosimetry**
- Chairperson: J. Wilson, NASA LaRC**
Co-Chairperson: J. Miller, LBL
- 1:15 p.m. Recent Results from the Joint U.S. and Russian Investigation on Space Shuttle and Mir Orbital Station
G. D. Badhwar, NASA JSC
- 2:15 p.m. Short-Range, High-LET Secondaries Produced by Trapped Protons Contribution to the LET Spectra in Low Earth Orbit
E. V. Benton, A. L. Frank, E. R. Benton, R. P. Keegan, D. Sanner, and L. A. Frigo, U. San Francisco
- 2:30 p.m. Transport Code and Database Development
F. Cucinotta*, J. L. Shinn*, H. Tai*, and J. W. Wilson*, L. Sihver**, D. Schardt**, and T. Kanai***, NASA LaRC*, GSI**, NIRS***
- 2:50 p. m. Accuracy Assessment of Galactic Cosmic Radiation Environment and Transport Models for Dose Prediction
G. D. Badhwar, F. A. Cucinotta* and M. Weyland**, NASA JSC, NASA LaRC*, and Rockwell Co.**
- 3:05 p.m. Determination of Quality Factor by NASA
J. Weber and T. Borak, CSU
- 3:20 p.m. **Coffee Break**

Session IV

Space and Atmospheric Radiation

Chairperson: G. D. Badhwar, NASA JSC

Co-Chairperson: E. V. Benton, USF

- 3:30 p.m. The Fragmentation of 510 AMeV ^{56}Fe in Polyethylene:
A Comparison Between Data and Model Calculations
C. Zeitlin*, L. Heilbronn*, J. Miller*, W. Schimmerling**,
L.W. Townsend***, and J.W. Wilson***, LBL*, USRA**,
NASA LaRC***
- 3:45 p.m. High Energy Neutrons Produced in Depth Matter
L. Heilbronn, LBL
- 4:00 p.m. The Role of Projectile Fragmentation in Heavy Ion Radiobiology
J. Miller*, L. Heilbronn*, C. Zeitlin*, W. Schimmerling**,
E.J. Ainsworth***, T.C. Yang****, LBL*, USRA**, AFRII***,
NASA JSC****
- 4:15 p.m. Biophysical Modeling of Radiation-Induced Chromosome Aberrations
H. Wu, E. Goodwin*, and T.C. Yang**. KRUG, LANL*, NASA JSC**
- 4:30 p.m. Issues in the Protection of Humans from Space Radiation
J. W. Wilson, F.A. Cucinotta, J.L. Shinn, and H. Tai, NASA LaRC
- 4:45 p.m. Radiation Safety for Future High-Altitude Commercial Aircraft
P. Goldhagen, F. Hajnal, M. Reginatto, J. W. Wilson*, J. E. Nealy*,
F. A. Cucinotta*, and J. L. Shinn*, U.S. Dept. Environmental Measurement Lab, NASA LaRC*
- 5:00 p.m. Microdosimetry of Ground Level Cosmic Rays
S. Rademacher, T. Borak, and J. Weber, CSU
- 5:15 p.m. **Adjourn**
- 7:00 p.m. **Banquet**
- 8:30 p.m. Banquet Speaker: Prof. Martin J. Fettman
Department of Pathology
Colorado State University
Title: A Personal Account of Life Sciences Research
in Space
Introduction: W. Schimmerling
- 10:00 p.m. **Adjourn**

May 4, 1995 (Thursday)

Meeting Place: Main Auditorium, Berkner Hall, BNL

Session V Cell and Molecular Radiobiology

Chairperson: T. C. Yang, NASA JSC

Co-Chairperson: B. Sutherland, BNL

- 8:30 a.m. Extracellular Matrix, Growth Factors and Radiation: The Irradiated Microenvironment
M. Barcellos-Hoff, LBL
- 9:00 a.m. The Effect of Low- and High-LET Radiations on Neural
Differentiation and Regeneration
M. Vazquez and B. V. Worgul, Columbia U.
- 9:15 a.m. Effects of Target Fragmentation of 250 MeV Protons on Survival
and Chromosomal Aberrations in Mammalian Cells
T. C. Yang, K. George, A. Tavakoli, H. Wu, and D. Miller*, NASA JSC, LLUMC*
- 9:30 a.m. Multiple Genetic Events on Mouse Chromosome 2 During
Radiation Leukemogenesis
K. Rithidech, V. P. Bond, E. P. Cronkite, and M. H. Thompson, BNL
- 9:45 a.m. Fe Ion-Induced Damage Clustering and Modulation of Mutation Frequencies and Mutant Spectra
in Human Cells by Cysteamine
A. Kronenberg*, C. Cherbonnel*, A. Chang**, J. Dahm-Daphi***, and S. Gauny**, LBL*, UC-
Berkeley**, U. Hamburg***
- 10:00 a.m. X-Irradiation-Induced Stable Alterations of the DNA Replication
Complex in Long-Term Survivors Are Linked to Pre-Existing p53 Status
E. K. Balcer-Kubiczek, L. Malkas, Q. Zhou, S. J. Meltzer, and G. H. Harrison, U. of Maryland

10:15 a.m. **Coffee Break**

Session VI Tissue and Organism Radiobiology

Chairperson: R. J. M. Fry, ORNL

Co-Chairperson: M. Bender, BNL

- 10:30 a.m. Multi-stage Biologically-based Models of Carcinogenesis
Suresh Moolgavkar, U. Washington
- 11:30 a.m. Space Radiobiological Studies with a Nonhuman Primate Model
System: Review of a 30-Year Study
A. B. Cox, USAF Armstrong Lab

- 11:45 a.m. Damage to Rabbit Retinal Photoreceptor Cells from ^{56}Fe Ions: An Interim Report on the Effect of Age at Exposure
J. T. Lett and G. R. Williams, CSU
- 12:00 p.m. TGF-b Activation in Mouse Mammary Gland After Fe Particle and Proton Irradiation: Radiation Quality Comparison
E. J. Ehrhart*, E. L. Gillette*, and M. H. Barcellos-Hoff**, CSU* and LBL**
- 12:15 p.m. Development and Testing of C3H-BT1 Cells
A. L. Lindgren, J. H. Zhang, and A. L. Andersen, Bemidji State U.
- 12:30 p.m. 155 MeV Proton Induced Mitotic Abnormalities and Micronuclei in the Rat Lens Epithelium: Effectiveness Relative to That for X-rays, ^{56}Fe Particles and Neutrons
A. L. Lindgren, A. L. Anderson, and J. O. Archaibeau, Bemidji State U.
- 12:45 p.m. **Lunch Break**

Session VII

Radiation Research Facilities

Chairperson: D. D. Joel, BNL

Co-Chairperson: J. Slater, LLUMC

- 1:30 p.m. Loma Linda Proton Accelerator
J. Slater, LLUMC
- 2:00 p.m. An Overview of the HIMAC Facility and Radiobiological Experiments at NIRS
Y. Furusawa, NIRS
- 2:30 p.m. BNL Booster Application Facility
P. Pile, BNL
- 3:00 p.m. AGS
B. Sutherland, BNL
J. Miller, LBL
- 3:30 p.m. General Discussion
- 3:40 p.m. Tour of AGS, Booster and Biomedical Facilities
- 5:30 p.m. **Adjourn**

May 5, 1995 Friday

Meeting Place: Main Auditorium, Berkner Hall, BNL

Session VIII

Radiation SCORT

Chairperson: W. Schimmerling, USRA

Co-Chairperson: J. Kiefer, Justus-Liebig-University

8:30 a.m.

USA Radiation NSCORT
A. Chatterjee, LBL

9:30 a.m.

Germany Radiation SCORT
J. Kiefer, Justus-Liebig-University, Giessen

10:00 a.m.

Japan Radiation SCORT
S. Nagaoka, NASDA

10:15 a.m.

Coffee Break

Session IX

Space Radiation Exposure Limits

Chairperson: H. Oser, ESA

Co-Chairperson: S. Nagaoka, NASDA

10:30 a.m.

Panel Discussion on International Perspectives in the Radiation
Exposure Limits for Space Station

G. Badhwar, NASA JSC, USA
R. J. Michael Fry, ORNL, USA
S. Nagaoka, NASDA, Japan
H. Oser, ESA
G. Reitz, DLR, Germany

11:45 a.m.

General Discussion

12:00 noon

Closing Remarks

12:10 p.m.

Adjourn

Program Committee

Dr. Michael A. Bender, BNL

Dr. Darrel D. Joel, BNL Dr. Jack Miller, LBL

Dr. Betsy Sutherland, BNL

Dr. Tracy C. Yang, NASA JSC (Chairman)

Dr. Victor P. Bond, BNL

Dr. Walter Schimmerling, USRA/NASA HQ