

Saturday, May 27th

Afternoon

16:00-18:30 *Registration*

18:30-19:30 **Special lecture** (chair: S.B. Curtis, USA): "Space radiation research in the new Millennium – from where we come and where we go", J. Kiefer (Germany)

19:30 *Welcome party*

Sunday, May 28th

Morning

9:00-9:45 *Opening, welcome by ASI, NASA, ISE, INFN, authorities*

Keynote lectures, chair: W. Schimmerling (USA)

9:45-10:30 "Once we know all the radiobiology we need to know, how might we use it to predict risk, reduce uncertainty, develop countermeasures, and achieve fame and fortune?", F.A. Cucinotta (USA)

10:30-11:00 *Coffee Break*

11:00-11:45 "What we can learn from heavy ion therapy for radioprotection in space", G. Kraft (Germany)

11:45-12:30 "Genomic instability, bystander effect, cytoplasmic irradiation and other phenomena that may achieve fame without fortune", E.J. Hall, C.Q. Piao, T.K. Hei (USA)

Lunch

Sunday, May 28th

Afternoon

14:00 **Round table:** *Space Radiation and Hadrontherapy: a synergistic interaction*. Chair: W. Schimmerling (USA) and U. Amaldi (Italy)

14:00-14:30 "BNL Accelerator-based radiobiology facilities", D. Lowenstein (USA)

14:30-15:00 "Research activities at the Loma Linda University and Proton Treatment Facility - an overview", G.A. Nelson (USA)

15:00-15:30 "Multidisciplinary use of High Intensity Accelerator at LNL", G. Fortuna (Italy)

15:30-16:00 "Italian Hadrontherapy Project", U. Amaldi (Italy)

16:00-16:30 *Coffee break*

16:30-17:00 "Track structure modelling in radiation biology, therapy and space applications", H. Nikjoo (UK)

17:00-17:30 "New measurements for hadrontherapy and space radiation: nuclear physics", J. Miller (USA)

17:30-18:00 "New measurements for hadrontherapy and space radiation: biology", E.A. Blakely (USA)

18:00-18:30 *Discussion*

Monday, May 29th
Morning

8:50 **NSCORT session**, chair: A.Chatterjee (USA)

8:50-9:00 "Overview of NSCORT activities", A. Chatterjee (USA)

9:00-9:30 "Microdosimetry studies", T. Borak (USA)

9:30-10:00 "DNA repair and the early development of chromosomal changes", P. Cooper (USA)

10:00-10:30 *Coffee break*

10:30-11:00 "Mutagenesis and chromosomal alterations", A. Kronenberg (USA)

11:00-11:30 "Role of the microenvironment in the radiation response of epithelial cells", M. H. Barcellos-Hoff, E.A. Blakeley (USA)

11:30-12:00 "Theoretical modeling of DNA damage and cellular responses", A. Chatterjee, W. R. Holley (USA)

12:00-12:30 *Discussion*

Lunch

Monday, May 29th
Afternoon

14:00 - Computer codes and calculations. Chair: G.Badhwar (USA)

Keynote lectures:

14:00-14:30 "Optimized shielding for space radiation protection", J. Wilson, F.A. Cucinotta, M.Y. Kim, W. Schimmerling (USA)

14:30-15:00 "The FLUKA radiation transport code and its use for space problems", A. Ferrari, P.R. Sala (Italy/Switzerland)

15:00-15.30 "Highlights of recent ESA space radiation activities", P. Nieminen (The Netherlands)

15:30-15:45 "Radiation protection using Martian surface materials in human exploration of Mars" M.-H. Y. Kim, S. A. Thibeault, J. W. Wilson, L. Heilbronn, R. L. Kiefer, J. A. Weakley, J. L. Dueber, T. Fogarty, R. Wilkins (USA)

15:45-16:00 "Overview of active methods for shielding spacecraft from energetic space radiation", L. W. Townsend (USA)

16:00-16:15 "Development of a space radiation Monte-Carlo computer simulation based on the FLUKA and ROOT codes", L. S. Pinsky, T. L. Wilson, A. Ferrari, P. Sala, F. Carminati, R. Brun (USA/Italy/Switzerland)

16:15-16:45 *Coffee break*

16:45 - Physical measurements. Chair: R.Cherubini (Italy)

- 16:45-17:00 "A reference radiation facility for dosimetry at flight altitudes and in space", A. Ferrari, A. Mitaroff, M. Silari (Switzerland)
- 17:00-17:15 "Proton irradiation facility and space radiation monitoring at the Paul Scherrer Institute", W.Hajdas, P. Buehler, A. Zehnder, R. Harboe-Sorensen (Switzerland/The Netherlands)
- 17:15-17:30 "Nuclear detecting systems at LNL and LNS: foreseen experiments to provide basic data for heavy-ion risk assessment", A. Moroni (Italy)
- 17:30-17:45 "Measurement of the depth distribution of average LET and absorbed dose inside a water - filled phantom on board space station MIR", T.Berger, M.Hajek, W.Schaffner, M.Fugger, N.Vana, M.Noll, R.Ebner, Y.Akatov, V.Shurshakov and V.Arkhangelsky (Austria/Russia)
- 17:45-18:00 "Shielded Heavy-Ion Environment Linear Detector (SHIELD) experiment: an experiment for the Radiation and Technology Demonstration (RTD) mission", M. R. Shavers, F. A. Cucinotta, J. Miller, C. Zeitlin, L. Heilbronn, J. W. Wilson, R. C. Singleterry Jr. (USA)
- 18:00-19:30 *BNL/AGS Annual Users' Meeting*
- 18:00-19:30 *Poster viewing*

Tuesday, May 30th
Morning

8:15 Biophysical models. Chair: H. Wu (USA)

Keynote lecture:

8:15-8:45 "RBE of radiations in space and the implication for space travel", A.Edwards (UK)

8:45-9:00 "Monte Carlo model of radiation breaking chromatin", A. L. Ponomarev, D. J. Brenner, R. K. Sachs, F.A. Cucinotta (USA)

9:00-9:15 "The role of promotion in carcinogenesis from protracted high-LET exposure", S. B. Curtis (USA)

9:15-9:30 "Mathematical models of radiation-induced mitotic delay: time course analysis of chromosome damage and statistics of lesions", E. Gudowska-Nowak, G. Kraft, E. Nasonova, S. Ritter, M. Scholz (Poland/Germany/Russia)

9:30-9:45 "Ion kill dosimetry", R. Katz, F.A. Cucinotta, M. Fromm, A. Chambaudet (USA/France)

9:45-10:15 *Coffee Break*

- In vivo studies. Chair: K. Ando (Japan)

Keynote lecture:

10:15-10:45 "High-dose radiation exposures: experience in Japan after the Tokaimura accident", S. Yamada, S. Akashi, T. Hirama, S. Tanosaki, H. Tsujii, I. Hayata, K. Ando, K. Kawachi, K. Maekawa (Japan)

- 10:45-11:00 "*In vivo* studies on proton induced genomic instability: shielding effects and genetic predisposition", M. Kadhim, L. M. Green, D. K. Murray, D.-T. Tran, T. A. Jones, D. Macdonald, D. Pocock, R. Dutta-Roy, M. L. Andres, E. H. Kajioka, D. S. Gridley, D. Goodhead, G.A. Nelson (UK/USA)
- 11:00-11:15 "Dose and dose-rate effects of whole-body γ -irradiation on lymphocytes, hematological variables, and cytokines", D.S. Gridley, M.J.Pecaut, M.L.Andres, R.Dutta-Roy, G.M.Miller, D.W.Kim, M.F.Moyers, X.W.Mao, A.L.Smith, T.A.Jones, G.Peterson, E.D.Zendejas and G.A.Nelson (USA)
- 11:15-11:30 "Induction and repair of HZE induced cytogenetic damage", A.L. Brooks, S. Bao, K. Rithidech, W.B. Chrisler, L. A. Couch, L.A. Braby (USA)
- 11:40 - Central nervous system. Chair: M.E.Vazquez (USA)
- 11:45-12:00 "Effects of exposure to ^{56}Fe particles on place preference and spatial learning in rats", B.M. Rabin, B. Shukitt-Hale and J. A. Joseph (USA)
- 12:00-12:15 "Possible mission compromising effects of heavy particle irradiation in space: behavioral and neuronal deficits", J. A. Joseph, G. Casadesus, B. M. Rabin, and B. Shukitt-Hale (USA)
- 12:15-12:30 "Radiation induced DNA Damage in NT-2 human neuronal cell line exposed to low fluences of 1 GeV/n Fe ions", M. E. Vazquez, L. Green (USA)

Lunch

Tuesday, May 30th

Afternoon

14:00 Cell and molecular biology. Chair: A. Kronenberg (USA) and B. Sutherland (USA)

Keynote lecture:

- 14:00-14:30 "High-LET-induced chromosomal damage: time-dependent expression", E. Nasonova, S. Ritter, E. Gudowska-Novak, St. Berger, K. Fuessel and G. Kraft (Russia/Germany/Poland)
- 14:30-14:45 "Clustered DNA damages induced by high and low LET radiation, including heavy ions", B.M. Sutherland, P.V. Bennett, H. Schenk, O. Sidorkina, J. Laval, J. Trunk, D. Monteleone, J. Sutherland (USA/France)
- 14:45-15:00 "DNA repair and tumor suppression", E. Goodwin, M. Brennehan, S. Bailey, T. Cui, G. Li, P. Hasty, A. Kurimasa, M. Turker, S. Burma, J. Meyne and D. Chen (USA)
- 15:00-15:15 "Activation of the G2-checkpoint after exposure of mammalian cells to 1 GeV/a Fe ions", Z.-C. Zeng, N. Cheong, G. Iliakis (USA)
- 15:15-15:30 "Molecular biomarkers induced by radiation exposure: application to radiation carcinogenesis, cancer chemoprevention, and biodosimetry", A.C. Miller, W.F. Blakely, E.J. Ainsworth, T.S. Seed (USA)
- 15:30-15:45 "Enhanced Green Fluorescent Protein (EGFP) for space radiation research using mammalian cells in the International Space Station", C. Baumstark-Khan, C. E. Hellweg, G. Horneck (Germany)
- 15:45-16:00 "Low-dose and low dose rate radiation attenuates apoptosis through tumor suppressor p53 response", T. Ohnishi, A. Takahashi, K. Ohnishi (Japan)

16:00-16:30 *Coffee break*

16:30- *Lake Tour/Social dinner*

Wednesday, May 31st

Morning

9:00 **ASI session:** *Space Radiation Research in Italy*. Chair: V. Cotronei (Italy)

9:15-9:30 "Radiation shielding of astronauts in interplanetary flights: the CREAM surveyor to Mars and the magnetic lens system for a spaceship", P. Spillantini , F. Taccetti , P. Papini, L. Rossi (Italy)

9:30-9:45 "The ALTEA facility on the International Space Station", R. Sparvoli (Italy)

9:45-10:00 "Radiation exposure of civilian airline crew members and associated biological effects due to the atmospheric ionizing radiation environment", G. De Angelis, T. Ballard, S. Lagorio, A. Verdecchia (Italy)

10:00-10:15 "Radiation-dependent apoptosis on cultured thyroid cells", E. Del Terra, A. Francesconi, A. Meli, F. Patamia, F.S. Ambesi-Impiombato (Italy)

10:15-10:30 "Evidence that simulated microgravity (clinostat) potentiates X-ray induced chromosomal aberrations in human lymphocytes", P. Mosesso, M. Schuber, D. Seibt, C. Schmitz, M. Fiore, A. Schinoppi, F. Palitti (Italy/Germany)

10:30-10:45 "Outer space radiation and microgravity effects on the expression of bcl-2 family genes in endometrial and mammary human cells", G. Palumbo (Italy)

10:45-11:00 "Influence of the shielding on the space radiation biological effectiveness", M. Durante (Italy)

11:00-11:30 *Coffee break*

Keynote lectures:

11:30-12:00 "Mechanistic bases for modelling space radiation risk and planning radiation protection of astronauts", A. Ottolenghi (Italy)

12:00-12:30 "An overview of recent charged-particle radiation biology studies in Italy", M. Belli (Italy)

Lunch

Wednesday, May 31st

Afternoon

14:00-15:00 *ASI Radiation Investigators' Meeting*

14:00-15:00 *Poster viewing*

15:00 Radiation Research for the International Space Station, Chair: F.A.Cucinotta (USA)

15:00-15:30 "European dosimetry activities of ISS", G. Reitz (Germany)

15:30-16:00 "Radiation measurements on the International Space Station", G. Badhwar (USA)

16:00-16:30 *Coffee break*

16:30-17:00 "Investigation of radiation environment dynamics in Russian segment of the ISS and on its trajectory and dose accumulation inside the phantoms located inside and outside station (project «Matroshka-R»)", V. Petrov (Russia)

17:00-17:30 "High LET radiobiology at NIRS-current status and future plan", K. Ando (Japan)

17:30-18:00 "The problems of estimating risks from radiation in space", R.J.M. Fry (USA)

18:00-18:15 *Workshop's closing*

Posters

Computer codes and calculations (C):

1. "Creation and utilization of a World Wide Web based Space Radiation Effects Code: SIREST", R.C. Singleterry Jr., J. W. Wilson, J.L. Shinn, R. K. Tripathi, S. A. Thibeault, A. K. Noor, F. A. Cucinotta, F.F. Badavi, C. Ken Chang, G. Qualls, M. S. Cloudsley, M. H.Y. Kim, J. H. Heinbockel, J.Norbury, S. R. Blattnig, J. Miller, C. Zeitlin, L.H. Heilbronn (USA)
2. "Neutron environments on the Martian surface", M. S. Cloudsley, J. W. Wilson, M. Y. Kim, R. C. Singleterry, R. K. Tripathi, J. H. Heinbockel, F. F. Badavi, J. L. Shinn (USA)
3. "Calculation of second cancer incidence following photon and proton radiation treatment of Hodgkin's disease", U.Schneider (Switzerland)
4. "New techniques in hadrontherapy: intensity-modulated proton beams", L. Cella, A. Lomax, R. Miralbell (Italy/Switzerland)
5. "A Monte Carlo code for a direct estimation of radiation risk", M. Biaggi, F. Ballarini, A. Ferrari, A. Ottolenghi, M. Pelliccioni (Italy)
6. "Visual assessment of the radiation distribution in the ISS Lab Module", P. B. Saganti, E.N. Zapp, J. W. Wilson, F.A.Cucinotta (USA)
7. "Monte Carlo simulation of charged particle transport in biomatter", D. Emfietzoglou, G. Papamichael, M. Moscovitch (Greece/USA)
8. "When is a Solar Particle Event large enough to be significant to astronauts in free space?" R.Turner, K. Fitzgerald (USA)

Physical measurements (P)

1. "Fragmentation of ions from Carbon to Iron at GCR-like energies", C. Zeitlin, L. Heilbronn, J. Miller, T. Murakami, A. Fukumura (USA/Japan)
2. "Simulation of the low-Earth-orbit dose rates using secondary radiations from the HZE particles at NIRS-HIMAC", H. Yasuda, M. Suzuki, K. Ando, K. Fujitaka (Japan)
3. "Integrating ion imager", J. C. Sutherland, D. C. Monteleone, J. G. Trunk (USA)
4. "Cell inactivation by Beryllium, Boron and Carbon ions at the Low-energy Irradiation Facility of the Naples University", P.Scampoli, M. Casale, M. Durante, G. Grossi, M. Pugliese, G. Gialanella (Italy)
5. "The response of tissue equivalent proportional counters to ⁵⁶Fe particles at 250, 400, 600, 740, and 1000 MeV per nucleon", T. Borak, B. Gersey, S. Guetersloh, C. Zeitlin, J. Miller (USA)
6. "Dosimetry of low-energy protons on the vertical-beam facility at the Munich accelerator", J.de Boer, J.Besserer, M.Moosburger, P.Quicken, P.Bilski, T.Kwiecien, and P.Olko (Germany/Poland)
7. "Determination of the CR-39 Response Function for iron ions using 3-D Confocal Microscopy Track Analysis", M. Fromm, F.Vaginay, D. Pusset, G. Meesen, A. Chambaudet, A. Poffijn (France/Belgium)

Biophysical models (B)

1. "Probability of hippocampus cell hits by high-LET space radiation in a low-Earth-orbit mission (STS-91)" H. Yasuda, T. Komiyama, and K. Fujitaka (Japan)
2. "Inactivation of individual cells by diverse ions at different LET values", M.V. Lokajicek, L. Judas, J. Kluson, K. Prokes (Czech Republic)
3. "Radiation-induced biological effects on crew members: a combined analysis on atmospheric flight personnel and associated cancer risks", G. De Angelis, T. Ballard, S. Lagorio, A. Verdecchia (Italy)
4. "A development of the Scholtz-Kraft model for light ions RBE calculation to account for the cell cycle kinetics", S. Chauvie, R. Cirio, M. Donetti, F. Marchetto, C. Peroni (Italy)
5. "Modeling of radiation action based on nanodosimetric event spectra", R. Schulte, V. Bashkurov, S. Shchemelinin, G. Garty, R. Chechik, A. Breskin (USA/Israel)
6. "A model of radiation-induced myelopoiesis in space", D. Esposito, M. Durante, G. Gialanella, G. Grossi, M. Pugliese, P. Scampoli, T.D. Jones (Italy/USA)

In vivo studies (V)

1. "Selective immune system augmentation and tumor growth inhibition following whole-body γ -irradiation" D.S. Gridley, G.M. Miller, E.H. Kajioka, M.L. Andres, R. Dutta-Roy, M.F. Moyers (USA)
2. "Proposal for biochemical dosimeter for prolonged space flights", A. Becciolini, S. Porciani, A. Lanini, M. Balzi, P. Faraoni (Italy)
3. "Polyamines as biochemical indicators of radiation injury", S. Porciani, A. Lanini, M. Balzi, P. Faraoni, A. Becciolini (Italy)
4. "The impact of p53 genetic background on iron particles induced mutagenesis in transgenic animals", P.Y. Chang, N. Kanazawa, L. Lutze-Mann, R. Winegar (USA/Australia)
5. "Mutation induction by heavy ion irradiation of gpt(delta) transgenic mice", F. Yatagai, T. Nohmi, M. Kusakabe, K. Masumura, A. Yoshiki, H. Yamaguchi, T. Kurobe, K. Kuniya, F. Hanaoka, Y. Yano (Japan)
6. "Cancer induction in rat skin following single or multiple doses of 1.0 GeV/nucleon ^{56}Fe ions from the Brookhaven Alternating Gradient Synchrotron", F.J. Burns, P. Zhao, G. Xu (USA)
7. "Radiation-induced cytogenetic instability *in vivo* after exposure to heavy ions", R. L. Ullrich, M. McCarthy (USA)

Central nervous system (N)

1. "Apoptosis of brain cells after *in vivo*- and *in vitro* irradiation with carbon ions", K. Nojima, N. Takai, K. Ando (Japan)

Cell and molecular biology (M)

1. "Heavy ion production of single- and double-strand breaks in plasmid DNA", S. Brons, G. Taucher-Scholz, G. Kraft (Germany)
2. "Misrejoining of DNA double-strand breaks: experiment and theory", B. Rydberg and P. K. Cooper (USA)
3. "DNA fragmentation induced in K562 cells by nitrogen ions", M. Belli, V. Dini, G. Simone, C. Signoretto, B. Stenerlow, M.A. Tabocchini (Italy)
4. "Role of the mismatch base repair and gene mutation in human tumoral cell lines exposed to low-energy light ions", L. Baggio, R. Cherubini, F. Cucinotta, S. Favaretto, S. Lora, P. Stoppa, J.R. Williams (Italy/USA)

5. "The effect of space radiation on the induction of chromosome damage", K. George, H. Wu, V. Willingham, F.A. Cucinotta (USA)
6. "High-LET radiation-induced aberrations in prematurely condensed G2-chromosomes", T. Kawata, E. Gotoh, M. Durante, H. Wu, K. George, Y. Furusawa, F.A. Cucinotta (Japan/USA/Italy)
7. "Comparison of chromosome aberration frequencies in pre- and post-flight astronaut lymphocytes irradiated *in vitro* with gamma rays", H. Wu, K. George, V. Willingham, F. A. Cucinotta (USA)
8. "Characterization of human pS2/TFF1 and ITF/TFF3, late radiation responding genes", E.K. Balcer-Kubiczek, G.H.Harrison (USA)
9. "Use of the comet assay to evaluate the UV-C induced DNA damage on FRT15: a new experimental model for monitoring radiation biological effects". A. Francesconi, E. Del Terra, A. Meli, F. Patamia, F.S. Ambesi-Impimbato (Italy)
10. "Response of thyroid follicular cells to gamma versus proton irradiation: I. Initial characterization of DNA damage, micronuclei formation, apoptosis, survival and cell cycle phase redistribution", L.M. Green, D.K. Murray, D.T. Tran, A.M. Bant, G. Kazarians, M.F. Moyers, G.A.Nelson (USA)
11. "Differential gene expression in nematodes and thyroid cells irradiated with high and low LET radiation", G.A. Nelson, L.M.Green, T.A.Jones, D.K. Murray (USA)
12. "Mechanisms of mutagenesis in human cells exposed to 55 MeV protons", S. Gauny, C. Wiese, A. Kronenberg (USA)
13. "Genomic instability in human lymphoid cells exposed to 1 GeV/amu Fe ions", A. Grosovsky, H. Bethel, K. Parks, L. Ritter, C. Giver, S. Gauny, C. Wiese, A. Kronenberg (USA)
14. "The role of adaptive response in cosmic ray exposures", N.F. Metting, E.J. Hall (USA)
15. "Effect of outer space radiation on estrogen-sensitive cells. Characterization study # 1: bcl-2 induces a senescent-like phenotype in HEC1B human endometrial carcinoma cells", E. Crescenzi, G. Palumbo (Italy)
16. "Effect of outer space radiation on estrogen-sensitive cells. Characterization study #2: 17 β -estradiol inhibits apoptosis in MCF-7 cells inducing bcl-2 expression via two estrogen responsive elements present in the coding sequence", A. Sasso, B. Perillo, G. Palumbo (Italy)
17. "Effect of space radiation on expression of apoptosis-related genes in endometrial cells", E. Crescenzi, G. Gialanella, G. Grossi, G. Palumbo, M. Pugliese, A. Sasso, P. Scampoli (Italy)
18. "Modulation of lens cell adhesion molecules by particles" , M.P.J. McNamara, K.A. Bjornstad, P.Y. Chang, W. Chou, S.J. Lockett, E.A. Blakely (USA)
19. "Chromosomal damage from model space radiation: role of cell genotype", J.R. Williams, H. Zhou, D. Cha, J. Dicello, Y. Zhang (USA)
20. "Quantitative image analysis of tissue microenvironment alterations induced by 1 Gev/amu Fe ion exposure", M.H. Barcellos-Hoff, S. Costes, D.E. Callahan, S.A. Ravani, K.D. Benson (USA)
21. "Biological dosimetry of the soft radiation components of the inner radiation belt", F. Gutermuth, J. Kiefer (Germany)
22. "Repair of radiation induced DNA double strand breaks under microgravity", H. D. Pross, A. Schmidt, M. Loebrich, J. Kiefer (Germany)
23. "Characteristics of unstable clones in control populations of WTK1 lymphoblasts and populations surviving exposure to Fe-56 ions and Cs-137 gamma- radiation", H. H. Evans, M.F. Horng, M. Ricanati, R. Jordan, J.L. Schwartz (USA)