# **CONTENTS**

# I. Plenary Talk

Recent Advances and Future Prospects for Monte Carlo Forrest B. BROWN	1
II. Computational Applications/Computational Science: Materials Science	
Chemical States of Fission Products and Actinides in Irradiated Oxide Fuels Analyzed by Thermodynamic Calculation and Post-Irradiation Examination	
	5
Hydrogen–Grain Boundary Interaction in Fe, Fe–C, and Fe–N Systems 	9
LDA+U Study on Plutonium Dioxide with Spin-Orbit Couplings 	16
Atomistic Simulations of Stress Concentration and Dislocation Nucleation at Grain Boundaries 	20
Large-Scale Simulation of Ductile Fracture Process of Microstructured Materials 	24
Density Matrix Renormalization Group and Numerical Diagonalization Study on the Quantum Spin Nanotube in Magnetic Field	
	30
Evaluation of Solute-Atom Clusters Segregated in α-Fe Chikashi SUZUKI, Tomohito TSURU and Yoshiyuki KAJI	34
Evaluation of Stress and Hydrogen Concentration at Grain Boundary of Steels Using Three-Dimensional	
Ken-ichi EBIHARA, Mitsuhiro ITAKURA, Masatake YAMAGUCHI, Hideo KABURAKI and Tomoaki SUZUDO	38
How to Combine Binary Collision Approximation and Multi-Body Potential for Molecular Dynamics Seiki SAITO, Arimichi TAKAYAMA, Atsushi M. ITO, Takahiro KENMOTSU and Hiroaki NAKAMURA	44
Quantum Monte Carlo Simulations with RANLUX Random Number Generator 	51
Kinetic Monte Carlo Annealing Simulation of Cascade Damage in α-Fe 	

Tomohito TSURU and Hideo KABURAKI 56

# III. Computational Applications/Computational Science: Fusion, Plasma

Multi-Scale Turbulence Simulation in Magnetic Fusion Plasma Jiquan LI, Kenji IMADERA, Paul HILSCHER, Yasuaki KISHIMOTO and Zhengxiong WANG	64
A New Simulation Method of Geodesic Acoustic Mode in Toroidal Plasmas by Using Band-Limited White Noise in a df Neoclassical Transport Code	
Shinsuke SATAKE, Hideo SUGAMA, Ryutaro KANNO, Takeshi IDO, Seikichi MATSUOKA and Masayuki YOKOYAMA	72
Kinetic Integrated Modeling of Plasma Heating in Tokamaks 	78
Simulating Plasma Turbulence with the Global Eulerian Gyrokinetic Code GT5D Sébastien JOLLIET and Yasuhiro IDOMURA	85
DNS of MHD Turbulent Flow with Buoyancy Shin-ichi SATAKE, Keito FURUMI, Hidenori CHIKAMASA and Tomoaki KUNUGI	90
IV. Computational Applications/Computational Science: Nuclear Fuel, Nuclear Fuel Cycle, Repository Performance	
Molecular Dynamics Study on Grain Boundary Diffusion of Actinides and Oxygen in Oxide Fuels Masahiro NISHINA, Keita YOSHIDA, Tatsumi ARIMA, Yaohiro INAGAKI, Kazuya IDEMITSU and Isamu SATO	95
Modeling of H(n,n) Recoil Proton Injection into LWR Fuel Cladding with Sequential Use of MCNP and SRIM Codes Yasushi NAUCHI and Takanori KAMEYAMA	101
V. Computational Applications/Computational Science: Nuclear Plant Analysis, Thermal Hydraulics	
Numerical Simulation of Thermal Stratification in Cold Legs by Using OpenFOAM	107
Two-Phase Flow Simulation of Gas Entrainment Phenomena in Large-Scale Experimental Model of Sodium-Cooled East Reactor	
	114
Neutron-Coupled Thermal Hydraulic Calculation of BWR under Seismic Acceleration Akira SATOU, Tadashi WATANABE, Yu MARUYAMA and Hideo NAKAMURA	120
Numerical Study on Subcooled Pool Boiling 	125
Instability Analysis in Peach Bottom NPP Using a Whole Core Thermalhydraulic-Neutronic Model with RELAP5/PARCS v2.7	
Agustín ABARCA, Teresa BARRACHINA, Rafael MIRÓ and Gumersindo VERDÚ	130

Numerical Simulation of Turbulent Flow of Coolant in a Test Blanket Module of Nuclear Fusion Reactor

Hiroyasu TANIGAWA and Masatoshi KURETA 139

# VI. Computational Applications/Monte Carlo Applications: Radiotherapy/Diagnosis, Biomedicine

Development of a Realistic Computational Breast Phantom for Dosimetric Simulations	
Andy K. W. MA and Ali A. ALGHAMDI	147
Effects of Human Model Configuration in Monte Carlo Calculations on Organ Doses from CT Examinations Fumiaki TAKAHASHI, Kaoru SATO, Akira ENDO, Koji ONO, Takayasu YOSHITAKE, Takayuki HASEGAWA, Yasushi KATSUNUMA, Nobuhiko BAN and Michiaki KAI	153
Photon Energy Spectrum Reconstruction Based on Monte Carlo and Measured Percentage Depth Dose in Accurate Radiotherapy Gui LI, Huaqing ZHENG, Guangyao SUN and Yican WU	160
Calculation of Normalised Organ and Effective Doses to Adult Reference Computational Phantoms from Contemporary Computed Tomography Scanners Jan T. M. JANSEN and Paul C. SHRIMPTON	165
Implementation of Multileaf Collimator in a LINAC MCNP5 Simulation Coupled with the Radiation Treatment Planing System PLUNC	172
Joint Application of Perl Scripts and MCNPX in Solving the Dynamic-Geometry Related Problems in Proton Beam Radiotherapy 	172
Monte Carlo Study of a New Mobile Electron Accelerator Head for Intra Operative Radiation Therapy (IORT) Anna WYSOCKA-RABIN, Przemyslaw ADRICH and Adam WASILEWSKI	181
Background Dose for Systemic Targeted Alpha Therapy Chen-Yu HUANG, Susanna GUATELLI, Bradley M. OBORN and Barry J. ALLEN	187
Geant4 Simulation to Study the Sensitivity of a MICRON Silicon Strip Detector Irradiated by a SIEMENS PRIMUS Linac 	191
Domain-Division Monte Carlo Dose Calculation Method for Particle Therapy Kenichi L. ISHIKAWA, Koji NIITA, Kazuo TAKEDA, Nobuhisa FUKUNISHI and Shu TAKAGI	197
Comparison of TITAN Hybrid Deterministic Transport Code and MCNP5 for Simulation of SPECT Katherine ROYSTON, Alireza HAGHIGHAT and Ce YI	201

Hadrontherapy: a Geant4-Based Tool for Proton/Ion-Therapy Studies

.....G. A. Pablo CIRRONE, Giacomo CUTTONE, S. Enrico MAZZAGLIA, Francesco ROMANO, Daniele SARDINA, Clementina AGODI, Andrea ATTILI, A. Alessandra BLANCATO, Marzio DE NAPOLI, Francesco DI ROSA, Pekka KAITANIEMI, Flavio MARCHETTO, Ivan PETROVIC, Aleksandra RISTIC-FIRA, Jungwook SHIN, Nikolai TARNAVSKY, Stefania TROPEA and Christina ZACHARATOU 207 Application of the Multi-Model Monte-Carlo Treatment Planning System Combined with PHITS to Proton Radiotherapy ......Hiroaki KUMADA, Takeji SAKAE, Kimiaki SAITO, Tomonori ISOBE, Takayuki HASHIMOTO and Hideyuki SAKURAI 213 Application of the Tikhonov Unfolding Method for Reconstruction of Primary X-Ray Spectra from X-Ray Equipments Development of the Efficient Modeling Method with Complicated Human Geometry for Monte-Carlo Treatment Planning System ......Hiroaki KUMADA, Kimiaki SAITO, Takeji SAKAE, Akira MATSUMURA, Takemi NAKAMURA and Koji ONO 226 Comparison of MCNP5 Dose Calculations inside the RANDO Phantom Irradiated with a MLC LinAc Photon Beam against Treatment Planning System PLUNC Construction of a Voxel Model from CT Images with Density Derived from CT Numbers ...... Mengyun CHENG, Qin ZENG, Ruifen CAO, Gui LI, Huaqing ZHENG, Shaqing HUANG, Gang SONG and Yican WU 237 Study on Microdosimetry for Boron Neutron Capture Therapy Tetsuya MUKAWA, Tetsuo MATSUMOTO and Koji NIITA 242 **VII.** Computational Applications/Monte Carlo Applications: **Reactor Physics, Radiation Shielding/Dosimetry, Accelerator** Efficient Calculation of in vivo Efficiency Curves Using Variance Reduction Techniques Jad FARAH, David BROGGIO and Didier FRANCK 247 Implementation of Transient Neutron Transport Solver in ASTERIA-FBR Toshihisa YAMAMOTO, Hiroshi ENDO, Tsugio YOKOYAMA and Masatoshi KAWASHIMA 253 Characterization of the WENDI-II REM Counter for its Application at MedAustron .....Lukas JÄGERHOFER, Eduard FELDBAUMER, Doris FORKEL-WIRTH, Christian THEIS, Helmut VINCKE, Yosuke IWAMOTO, Masayuki HAGIWARA, Daiki SATOH, Hiroshi IWASE, Hiroshi YASHIMA, Tetsuo MATSUMOTO, Akihiko MASUDA, Jun NISHIYAMA, Takashi NAKAMURA, Tatsuhiko SATO, Yoshihiro NAKANE, Hiroshi NAKASHIMA, Yukio SAKAMOTO, Atsushi TAMII and Kichiji HATANAKA 258 Kinetic Analysis of Weakly Coupled Systems Using Probability Density Function of Coupling Coefficient Obtained by Monte Carlo Method Commercial BWR Whole Core Calculations with MCNP5 ......Sho TAKANO, Akiyuki TSUCHIYA, Akiko TOISHIGAWA, Shingo FUJIMAKI and Tadashi IKEHARA 267

Simulated Neutron Response Functions of Phoswich-Type Neutron Detector and Thin Organic Liquid Scintillator	
Masashi TAKADA, Kazuaki YAJIMA, So KAMADA, Hiroshi YASUDA and Takashi NAKAMURA	274
Development of a Geometry-Coupled Visual Analysis System for MCNP	
Pengcheng LONG, Qin ZENG, Tao HE, Junjun ZHANG, Dongchuan YING, Shaoheng ZHOU and Yican WU	280
Design of Accelerator-Based Solutions to Produce <sup>99</sup> Mo Using Lowly-Enriched Uranium	
Frédéric STICHELBAUT and Yves JONGEN	284
Improvement of Neutronics Calculation Methods for Fast Reactors	
Toshikazu TAKEDA	289
High Performance Parallel Monte Carlo Transport Computations for ITER Fusion Neutronics Applications Arkady SERIKOV, Ulrich FISCHER and Dennis GROSSE	294
Calculation of Pellet Radial Power Distributions with Monte Carlo and Deterministic Codes	
Motomu SUZUKI, Toru YAMAMOTO and Tetsuo NAKATA	301
Benchmark Calculations of Sodium-Void Experiments with Uranium Fuels at the Fast Critical Assembly FCA Masahiro FUKUSHIMA, Yasunori KITAMURA, Teruhiko KUGO, Tsuyoshi YAMANE, Masaki ANDOH, Go CHIBA, Makoto ISHIKAWA and Shigeaki OKAJIMA	306
Micro-Scale Dose Distribution of Microplanar X Rays from Synchrotron Radiation: Measurement and Monte Carlo Calculation	
Nobuteru NARIYAMA, Keiji UMETANI, Kunio SHINOHARA, Takeshi KONDOH, Ai KURIHARA and Manabu FUKUMOTO	312
A Conceptual Design Study for Active Nondestructive Assay System by Photon Interrogation for Uranium-Bearing Waste with MVP Code and Evaluated Photonuclear Data	
	318
Analysis of Sample Worth for Dy <sub>2</sub> O <sub>3</sub> , Ho <sub>2</sub> O <sub>3</sub> , Er <sub>2</sub> O <sub>3</sub> and Tm <sub>2</sub> O <sub>3</sub> Measured at KUCA by MVP with Recent Version of ENDF and JENDL	
Takanori KITADA, Kosuke SHIMOZATO, Koichi IEYAMA, Hidemasa OKOCHI and Akio YAMAMOTO	330
Multi-Group Constants Generation System for 3D-Core Simulation Using a Continuous Energy Monte Carlo Technique	
	334
Important Remarks on Latest Multigroup Libraries Chikara KONNO, Kosuke TAKAKURA, Keitaro KONDO, Seiki OHNISHI, Kentaro OCHIAI	
and Satoshi SATO	341
Benchmark Test of JENDL-4.0 Based on Integral Experiments at JAEA/FNS	
Chikara KONNO, Kosuke TAKAKURA, Masayuki WADA, Keitaro KONDO, Seiki OHNISHI, Kentaro OCHIAI and Satoshi SATO	346

The Application of the Monte Carlo Code FLUKA in Radiation Protection Studies for the Large Hadron Collider ......Giuseppe BATTISTONI, Francesco BROGGI, Markus BRUGGER, Mauro CAMPANELLA, Massimo CARBONI, Anton EMPL, Alberto FASSÒ, Ettore GADIOLI, Francesco CERUTTI, Alfredo FERRARI, Anna FERRARI, Maria Vittoria GARZELLI, Mattias LANTZ, Andrea MAIRANI, M. MARGIOTTA, Cristina MORONE, Silvia MURARO, Katia PARODI, Vincenzo PATERA, Maurizio PELLICCIONI, Lawrence PINSKY, Johannes RANFT, Stefan ROESLER, Sofia ROLLET, Paola R. SALA, Mario SANTANA, Lucia SARCHIAPONE, Massimiliano SIOLI, George SMIRNOV, Florian SOMMERER, Christian THEIS, Stefania TROVATI, Rosaria VILLARI, Heinz VINCKE, Helmut VINCKE, Vasilis VLACHOUDIS, Joachim VOLLAIRE and Neil ZAPP 358 Comparison of Photon and Electron Absorbed Fractions in Voxel-Based and Simplified Phantoms for Small Animals Akram MOHAMMADI, Sakae KINASE and Kimiaki SAITO 365 Analyses of Assay Data of LWR Spent Nuclear Fuels with a Continuous-Energy Monte Carlo Code MVP and JENDL-4.0 for Inventory Estimation of  $^{79}\text{Se},\,^{99}\text{Tc},\,^{126}\text{Sn}$  and  $^{135}\text{Cs}$ Jun INAGAWA, Tsutomu OKAMOTO, Nobuo SHINOHARA, Satoru KANEKO and Kensuke SUZUKI 369 Conceptual Radiation Shielding Design of Superconducting Tokamak Fusion Device by PHITS Atsuhiko M. SUKEGAWA, Hiromitsu KAWASAKI and Koichi OKUNO 375 Radiation Protection Studies for ESS Superconducting Linear Accelerator and Hakan HAHN 382 Monte Carlo Simulation of the Prompt Dose Environment in the National Ignition Facility during Low Yield D-T Shots Monte-Carlo Based Numerical Modeling and Simulation of Criticality Conditions Occurrence in Natural Reactor Zone 9 in Oklo Deposit (Gabon) Simulation of GEM-TPC Prototype for the Super-FRS Beam Diagnostics System at FAIR ------Matti KALLIOKOSKI 401 Numerical Tools for the Evaluation of Super-Compacted Radioactive Waste Residues Stephan SCHNEIDER, Holger TIETZE-JAENSCH and Dirk BOSBACH 406 Computing Acceleration for a Pin-by-Pin Core Analysis Method Using a Three-Dimensional Direct Response Matrix Method Radiation Transport Calculation Using PHITS Code for Radiation Heat Load and Damage to Superconducting Radioactive Isotope Beam Separator BigRIPS at RIKEN Tetsuya OHNISHI, Kensuke KUSAKA and Toshiyuki KUBO 416 Modelling of Impurity Activation in the RBMK Reactor Graphite Using MCNPX ......Rita PLUKIENĖ, Artūras PLUKIS, Andrius PUZAS, Vidmantas REMEIKIS, Grigorijus DUŠKESAS and Darius GERMANAS 421

Some Considerations in Devising Effective SCALE6/MAVRIC Models for Large Shielding Applications Bojan PETROVIC and David HARTMANGRUBER 427

### VIII. Computational Applications/Monte Carlo Applications: Other Applications (Radiation Device, Space & Aviation, etc.)

Fluence-to-Dose Conversion Coefficients for Muons and Pions Calculated Based on ICRP Publication 103 Using the PHITS Code Tatsuhiko SATO, Akira ENDO and Koji NIITA 432 New Approach to Alpha Spectrum Analysis: Iterative Monte Carlo Simulations and Fitting Simulation of Gamma-Ray Irradiation of Lettuce Leaves in a <sup>137</sup>Cs Irradiator Using MCNP Jongsoon KIM, Rosana G. MOREIRA and Leslie A. BRABY 442 New Hybrid Monte Carlo Methods for Efficient Sampling: from Physics to Biology and Statistics Elena AKHMATSKAYA and Sebastian REICH 447 Large-Eddy Simulation of Plume Dispersion within a Regular Array of Cubic Buildings Molecular Dynamics Simulation System for Structural Analysis of Biomolecules by High Performance Computing Implementation of a Forced Collision Method in the Estimation of Deposit Energy Distribution with the PHITS Code Applicability of Finite Element Method to Collapse Analysis of Steel Connection under Compression A New Approach for Building an Atomic Model from a Three-Dimensional Electron Microscopy Data Atsushi MATSUMOTO 486 Multiphase Fluid Simulations on a Multiple GPGPU PC Using Unsplit Time Integration VSIAM3 Integrated Super Computational Prediction of Liquid Droplet Impingement Erosion Jun ISHIMOTO, Shinji AKIBA, Kazuhiro TANJI and Kazuo MATSUURA 498 Modeling Radiation Chemistry in the Geant4 Toolkit ......Mathieu KARAMITROS, Alfonso MANTERO, Sébastien INCERTI, Werner FRIEDLAND, Gérard BALDACCHINO, Philippe BARBERET, Mario BERNAL, Riccardo CAPRA, Christophe CHAMPION, Ziad EL BITAR, Ziad FRANCIS, Paul GUÈYE, Anton IVANCHENKO, Vladimir IVANCHENKO, Hisaya KURASHIGE, Barbara MASCIALINO, Philippe MORETTO, Petteri NIEMINEN, Giovanni SANTIN, Hervé SEZNEC, Hoang N. TRAN, Carmen VILLAGRASA and Christina ZACHARATOU 503

Seismic Structural Response Analysis Considering Fault-Structure System: Application to Nuclear Power Plant Structures ..... Pher Errol B. QUINAY, Tsuyoshi ICHIMURA, Muneo HORI, M. L. L. WIJERATHNE and Akemi NISHIDA 516 Effects of Secondary Neutron Beam Generated in Radiotherapy on Electronic Medical Devices ...... Tomonori ISOBE, Hiroaki KUMADA, Kenta TAKADA, Takayuki HASHIMOTO, Haruko HASHII, Koichi SHIDA, Kiichi TADANO, Toshioh FUJIBUCHI, Masahiro HANMURA, Hideyuki SAKURAI and Takeji SAKAE 524 Development of an Atmosphere-Soil-Vegetation Model for Investigation of Radioactive Materials Transport in the **Terrestrial Biosphere** .....Genki KATATA, Haruyasu NAGAI, Leiming ZHANG, Andreas HELD, Dominique SERÇA and Otto KLEMM 530 Kinetic Monte Carlo Simulations of Initial Process of Solute Atom Cluster Formations Based on ab initio Data Base Direct Numerical Simulation of Turbulent Channel Flow with Deformed Bubbles Direct Numerical Simulation of MHD Turbulent Flows with High-Pr Heat Transfer ------Yoshinobu YAMAMOTO and Tomoaki KUNUGI 550 Development of Coupled Modeling System for Regional Water Cycle and Material Transport in the Atmospheric, Terrestrial, and Oceanic Environment Evaluation of the Effects of Gamma Irradiation from a <sup>9</sup>Be Neutron Source in Digital ASIC's with GEANT4 and José M. QUESADA 568 Elastic-Plastic Connection Model Describing Dynamic Interactions of Component Connections ------Akemi NISHIDA, Fumimasa ARAYA, Noriyuki KUSHIDA, Makoto KONDO, Michiya SAKAI and Yuzo SHIOGAMA 576 Monte Carlo Simulation of Neutrons, Protons, Ions and Alpha Particles Involved in Soft Errors in Advanced Memories Frédéric WROBEL and Frédéric SAIGNE 582 IX. Computer Science/Information Technology SimpleGeo - New Developments in the Interactive Creation and Debugging of Geometries for Monte Carlo Simulations .....Christian THEIS, Karl Heinz BUCHEGGER, Eduard FELDBAUMER, Doris FORKEL-WIRTH, Lukas JÄGERHOFER, Stefan ROESLER and Helmut VINCKE 587 Fault-Tolerant Mechanism of Both Job Execution and File Transfer for Integrated Nuclear Energy Simulation 

Spatio-Temporal Mapping -A Technique for Overview Visualization of Time-Series Datasets- 	603
Large Scale Numerical Simulation for Superfluid Turbulence	609
X. High Performance Computing	
Large-Scale Computation of Welding Residual Stress Akihiro KAWAGUCHI, Shinsuke ITOH, Masahito MOCHIZUKI and Masashi KAMEYAMA	613
Performance Evaluations of Advanced Massively Parallel Platforms Based on Gyrokinetic Toroidal Five- Dimensional Eulerian Code GT5D	
Yasuhiro IDOMURA and Sébastien JOLLIET	620
3D Neutron Transport and HPC: A PWR Full Core Calculation Using PENTRAN SN Code and IBM BLUEGENE/P Computers	
Tanguy COURAU and Glenn SJODEN	628
Full-Scale 3D Vibration Simulator for an Entire Nuclear Power Plant on the Simple Orchestration Application Framework	
Guehee KIM, Kohei NAKAJIMA, Naoya TESHIMA, Takayuki TATEKAWA, Yoshio SUZUKI and Hiroshi TAKEMIYA	634
Multiple-GPU Scalability of Phase-Field Simulation for Dendritic Solidification 	639
Development of a High-Performance Eigensolver on a Peta-Scale Next-Generation Supercomputer System 	643
Large-Scale FE Analysis of Steel Building Frames Using E-Simulator	
	651
Parallelization of Gyrokinetic PIC Code for MHD Simulation	
Hiroshi NAITOU, Hiroki HASHIMOTO, Yusuke YAMADA, Shinji TOKUDA and Masatoshi YAGI	657
On-the-Fly Computing on Many-Core Processors in Nuclear Applications	663
Towards Scalable Parallelism in Monte Carlo Particle Transport Codes Using Remote Memory Access Paul K. ROMANO, Benoit FORGET and Forrest B. BROWN	670
Massively Parallel Monte Carlo: Experiences Running Nuclear Simulations on a Large Condor Cluster James TICKNER, Greg HITCHEN, Joel O'DWYER, Greg ROACH and Josef UHER	676
A Study of Released Radionuclide in the Coastal Area from a Discharge Pipe of Nuclear Fuel Reprocessing Plant in Rokkasho, Aomori, Japan	
	682

HPC Challenges for Deterministic Neutronics Simulations Using APOLLO3<sup>®</sup> Code

Christophe CALVIN 700

# XI. Theory for Monte Carlo Simulation

Spectral Analysis of Stochastic Noise in Fission Source Distributions from Monte Carlo Eigenvalue Calculations David P. GRIESHEIMER and Brian R. NEASE 706 A Monte Carlo Method for Calculation of the Dynamic Behaviour of Nuclear Reactors Mart L. SJENITZER and J. Eduard HOOGENBOOM 716 A Priori Efficiency Calculations for Monte Carlo Applications in Neutron Transport Mart L. SJENITZER and J. Eduard HOOGENBOOM 722 An Auto-Importance Sampling Method for Deep Penetration Problems Multi LI, Chunyan LI, Zhen WU, Zhi ZENG and Rui QIU 732 "K-effective of the World" and Other Concerns for Monte Carlo Eigenvalue Calculations Monte Carlo Simulation of Fully Markovian Stochastic Geometries Monte Carlo Simulation of Fully Markovian Stochastic Geometries Monte Carlo Dominance Ratio Calculation Using the Noise Propagation Matrix Thomas M. SUTTON, Paul K. ROMANO and Brian R. NEASE 749

# XII. Physics Modeling in Monte Carlo Simulation

Particle-Gamma and Particle-Particle Correlations in Nuclear Reactions Using Monte Carlo Hauser-Feshbach Model	
	757
Comparison between Energy Straggling Strategy and Continuous Slowing Down Approximation in Monte Carlo Simulation of Secondary Electron Emission of Insulating Materials	
Maurizio DAPOR	762
FLUKA Realistic Modeling of Radiation Induced Damage	
Alberto FASSO, Alfredo FERRARI, George SMIRNOV, Florian SOMMERER and Vasilis VLACHOUDIS	769
Evaluation of the Statistical Error in the Results of Calculations of Full-Scale Three-Dimensional Model of VVER- 1000 by Means of the Monte Carlo Method	
Mikhail A. KALUGIN, Dmitry S. OLEYNIK, Denis A. SHKAROVSKY and Eugenia A. SUKHINO-KHOMENKO	776
Evaluation of the CANDU 6 Neutron Characteristics in View of Application of the Resonance Dependent Scattering Kernel in MCNP(X)	
Ron DAGAN, Björn BECKER and Dan ROUBTSOV	782

INCL Intra-Nuclear Cascade and ABLA De-Excitation Models in Geant4

.....Pekka KAITANIEMI, Alain BOUDARD, Sylvie LERAY, Joseph CUGNON and Davide MANCUSI 788

Implementation of Photonuclear Reactions in the Monte Carlo Transport Code TRIPOLI-4 and Its First Validation in Waste Package Field

Odile PETIT, Nicolas HUOT and Cédric JOUANNE 798

### XIII. Monte Carlo Code Development, Verification, Experiments & Benchmarks: Neutron-Photon

Estimate of Photonuclear Reaction in a Medical Linear Accelerator Using a Water-Equivalent Phantom Toshioh FUJIBUCHI, Satoshi OBARA, Hitoshi SATO, Masaru NAKAJIMA, Nozomi KITAMURA, Tomoharu SATO, Hiroaki KUMADA, Takeji SAKAE and Tatsuya FUJISAKI 803 Review of Hybrid (Deterministic/Monte Carlo) Radiation Transport Methods, Codes, and Applications at Oak Ridge National Laboratory John C. WAGNER, Douglas E. PEPLOW, Scott W. MOSHER and Thomas M. EVANS 808 Hybrid and Parallel Domain-Decomposition Methods Development to Enable Monte Carlo for Reactor Analyses John C. WAGNER, Thomas M. EVANS, Douglas E. PEPLOW and John A. TURNER 815 Progress and Applications of MCAM: Monte Carlo Automatic Modeling Program for Particle Transport Simulation Guozhong WANG, Jian XIONG, Pengcheng LONG, Dianxi WANG, Kai ZHAO, Qin ZENG, Ligin HU,

Dongchuan YING, Junjun ZHANG, Akio SAGARA, Teruya TANAKA and Takeo MUROGA 821

Higher Order  $\alpha$  Mode Eigenvalue Calculation by Monte Carlo Power Iteration

Reduction

Comparison of the Monte Carlo Adjoint-Weighted and Differential Operator Perturbation Methods	
Brian C. KIEDROWSKI and Forrest B. BROWN	336

Toshihiro YAMAMOTO 826

Estimation of Sample Reactivity Worth with Differential Operator Sampling Method Yasunobu NAGAYA and Takamasa MORI 842

A New Prototype Display Tool for the Monte Carlo Particle Transport Code TRIPOLI-4

------Francois-Xavier HUGOT and Yi-Kang LEE 851

Monte Carlo Shielding Calculations for a Spent Fuel Transport Cask with Automated Monte Carlo Variance

Mitsufumi ASAMI, Hidenori SAWAMURA and Kazuya NISHIMURA 860

Efficiency Improvement of Local Power Estimation in the General Purpose Monte Carlo Code MCNP

Derk VAN VEEN and J. Eduard HOOGENBOOM 866

Application and Validation of Particle Transport Code PHITS in Design of J-PARC 1 MW Spallation Neutron Source

Masahide HARADA, Fujio MAEKAWA, Kenichi OIKAWA, Shin-ichiro MEIGO, Hiroshi TAKADA and Masatoshi FUTAKAWA 872

Systematic Uncertainty Due to Statistics in Monte Carlo Burnup Codes: Application to a Simple Benchmark with TRIPOLI-4-D

Emeric BRUN, Eric DUMONTEIL and Fausto MALVAGI 879

# XIV. Monte Carlo Code Development, Verification, Experiments & Benchmarks: Photon-Electron

Monte Carlo Code for the Damage of Bio-Molecules Irradiated by X-Ray Free Electron Lasers: Incorporation of Election Impact Ionization Processes

Kengo MORIBAYASHI 893

#### Recent Improvements in Geant4 Electromagnetic Physics Models and Interfaces

 Wladimir IVANCHENKO, John APOSTOLAKIS, Alexander BAGULYA, Haifa Ben ABDELOUAHED, Rachel BLACK, Alexey BOGDANOV, Helmut BURKHARD, Stéphane CHAUVIE, Pablo CIRRONE, Giacomo CUTTONE, Gerardo DEPAOLA, Francesco DI ROSA, Sabine ELLES, Ziad FRANCIS, Vladimir GRICHINE, Peter GUMPLINGER, Paul GUÈYE, Sébastien INCERTI, Anton IVANCHENKO, Jean JACQUEMIER, Anton LECHNER, Francesco LONGO, Omrane KADRI, Nicolas KARAKATSANIS, Mathieu KARAMITROS, Rostislav KOKOULIN, Hisaya KURASHIGE, Michel MAIRE, Alfonso MANTERO, Barbara MASCIALINO, Jakub MOSCICKI, Luciano PANDOLA, Joseph PERL, Ivan PETROVIC, Aleksandra RISTIC-FIRA, Francesco ROMANO, Giorgio RUSSO, Giovanni SANTIN, Andreas SCHAELICKE, Toshiyuki TOSHITO, Hoang N. TRAN, Laszlo URBAN, Tomohiro YAMASHITA and Christina ZACHARATOU 898

A GPU-Based Track-Repeating Algorithm for Dose Calculation for Photon Radiotherapy

Pablo YEPES 904

Monte Carlo Simulation of a HP-Ge Pulse Height Spectrum over the Entire Energy Range ......Dora SOMMER, Uwe REICHELT, Kai HELBIG, Detlev DEGERING, Jürgen HENNIGER

and Matthias KÖHLER 908

### XV. Monte Carlo Code Development, Verification, Experiments & Benchmarks: Hadron, Other particles

The PTSim and TOPAS Projects, Bringing Geant4 to the Particle Therapy Clinic

Takashi AKAGI, Tsukasa ASO, Bruce FADDEGON, Akinori KIMURA, Naruhiro MATSUFUJI, Teiji NISHIO, Chihiro OMACHI, Harald PAGANETTI, Joseph PERL, Takashi SASAKI, Daren SAWKEY, Jan SCHÜMANN, Jungwook SHIN, Toshiyuki TOSHITO, Tomohiro YAMASHITA and Hajime YOSHIDA 912

Validation of New Geant4 Electromagnetic Physics Models for Ion Therapy Applications Toshiyuki TOSHITO, Alexander BAGULYA, Anton LECHNER, Vladimir IVANCHENKO, Michel MAIRE, Takashi AKAGI and Tomohiro YAMASHITA 918

Benchmarking of PHITS on Pion Production for Medium-Energy Physics

......Norihiro MATSUDA, Yosuke IWAMOTO, Hiroshi IWASE, Yukio SAKAMOTO, Hiroshi NAKASHIMA and Koji NIITA 927

Recent Developments in Pre-Equilibrium and De-Excitation Models in Geant4 .....José M. QUESADA, Vladimir IVANCHENKO, Anton IVANCHENKO, Miguel A. CORTÉS-GIRALDO, Gunter FOLGER, Alex HOWARD and Dennis WRIGHT 936

Benchmark of Spallation Models

Mexander KONOBEYEV, Sylvie LERAY, Guenter MANK, Alberto MENGONI, Rolf MICHEL, Naohiko OTUKA and Yair YARIV 942

FLUKA Capabilities and CERN Applications for the Study of Radiation Damage to Electronics at High-Energy Hadron Accelerators

 Giuseppe BATTISTONI, Vittorio BOCCONE, Francesco BROGGI, Markus BRUGGER, Mauro CAMPANELLA, Massimo CARBONI, Francesco CERUTTI, Anton EMPL, Alberto FASSÒ, Alfredo FERRARI, Anna FERRARI, Ettore GADIOLI, Maria Vittoria GARZELLI, Daniel KRAMER, Mattias LANTZ, Elias LEBBOS, Andrea MAIRANI, Annarita MARGIOTTA, Alessio MEREGHETTI, Cristina MORONE, Silvia MURARO, Katia PARODI, Vincenzo PATERA, Maurizio PELLICCIONI, Lawrence PINSKY, Johannes RANFT, Ketil ROEED, Stefan ROESLER, Sofia ROLLET, Paola R. SALA, Mario SANTANA, Lucia SARCHIAPONE, Massimiliano SIOLI, George SMIRNOV, Florian SOMMERER, Christian THEIS, Stefania TROVATI, Roberto VERSACI, Rosaria VILLARI, Heinz VINCKE, Helmut VINCKE, Vasilis VLACHOUDIS, Joachim VOLLAIRE and Neil ZAPP 948

Radiation Transport Calculation Using PHITS Code for the Activation of BigRIPS Separator at RIKEN Radioactive Isotope Beam Factory and Comparison with the Measurement