

International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021)

Online
3 – 7 October 2021

Volume 1 of 3

ISBN: 978-1-7138-8631-0

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2021) by American Nuclear Society
All rights reserved.

Printed with permission by Curran Associates, Inc. (2024)

For permission requests, please contact American Nuclear Society
at the address below.

American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526
USA

Phone: (800) 323-3044
(708) 352-6611
Fax: (708) 352-0499

www.ans.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

ANS M&C 2021

October 3–7, 2021

1 Monday, October 4, 2021

3 Advanced Discretization Methods for Particle Transport I

- 4 Two-Dimensional Spherical (r, θ) Bilinear Discontinuous Discretization for Atmospheric Transport—*Daniel T. Wakeford (LANL), James S. Warsa (LANL)*
- 14 Discontinuous-Galerkin Discretization of the Energy-Dependent Fokker-Planck Operator—*Kyle S. Beling (Univ. of New Mexico), James S. Warsa (LANL), Anil K. Prinja (Univ. of New Mexico), David A. Dixon (LANL)*
- 24 Discontinuous Galerkin Variable Eddington Factor Methods—*Samuel Olivier (Univ. of California–Berkeley), Terry S. Haut (LLNL), Ben C. Yee (LLNL)*
- 34 A Finite Volume Method for the Fermi Pencil-Beam Equation—*Antonios G. Mylonakis (Chalmers Univ. of Technology), Mohammad Asadzadeh (Chalmers Univ. of Technology)*

45 Monte Carlo Methods

- 46 Solving Eigenvalue Transport Problems with Negative Weights and Regional Cancellation—*Hunter Belanger (CEA Saclay), Davide Mancusi (CEA Saclay), Andrea Zoia (CEA Saclay)*
- 56 Weighted Delta Tracking Performance Evaluation in the Presence of Localized Heavy Absorbers—*Valeria Raffuzzi (Univ. of Cambridge), Eugene Shwageraus (Univ. of Cambridge), Lee Morgan (AWE)*
- 66 Woodcock Delta Tracking with Arbitrary Sampling Parameters in Fission and Fusion Reactor Models—*Valeria Raffuzzi (Univ. of Cambridge), Eugene Shwageraus (Univ. of Cambridge), Lee Morgan (AWE)*
- 76 Impact of Sampling Strategies in the Polynomial Chaos Surrogate Construction for Monte Carlo Transport Applications—*Gianluca Geraci (Sandia), Aaron J. Olson (Sandia)*

87 Massively Parallel Algorithms

- 88 Enabling Large-Scale Depletion in Serpent 2 Monte Carlo Code by Collision-Based Domain Decomposition—*Ana Jambrina (LUT Univ.), Manuel García (Karlsruhe Institute for Technology), Jaakko Leppänen (VTT Technical Research Centre of Finland)*
 - 100 An Asynchronous GPU-Enabled Cross-Section Lookup Algorithm for Monte Carlo Transport Simulations—*Alicia Klinvex (Naval Nuclear Laboratory), Paul E. Burke (Georgia Institute of Technology), Kyle E. Remley (Naval Nuclear Laboratory), Neale Petrillo (Naval Nuclear Laboratory), David P. Griesheimer (Naval Nuclear Laboratory), Adam Bird (ANSWERS Software Service, Jacobs)*
 - 110 Domain Decomposed Random Ray Neutron Transport on GPU-Based Systems—*John R. Tramm (ANL), Andrew R. Siegel (ANL)*
 - 122 Artificial Neural Network Performance Models for Parallel Particle Transport Calculations—*J. Dillon Herring (Texas A&M Univ.), W. Daryl Hawkins (Texas A&M Univ.), Marvin L. Adams (Texas A&M Univ.)*
- ### 133 High Performance Computing for Reactor Analysis
- 134 GPU Acceleration of the Prototype Pinwise Core Analysis Code Vangard—*Seoyoon Jeon (Seoul Nat'l Univ.), Hyunsik Hong (Seoul Nat'l Univ.), Namjae Choi (Seoul Nat'l Univ.), Han Gyu Joo (Seoul Nat'l Univ.)*
 - 146 Parallel Computing in CASMO5—*Joshua Hykes (Studsvik Scandpower), Rodolfo Ferrer (Studsvik Scandpower)*
 - 155 Development and Performance Simulations of the MPACT-AGREE Code Coupling Interface for MAGNOX Reactors—*Cole Gentry (ORNL), Volkan Seker (Univ. of Michigan), Brian J. Ade (ORNL), Andrew J. Conant (ORNL), Nicholas P. Luciano (ORNL), Kang Seog Kim (ORNL), Benjamin S. Collins (ORNL), Thomas Downar (Univ. of Michigan)*
 - 166 Fast Power Reactor Simulation Employing a GPU-Based Continuous-Energy Monte Carlo Method—*Namjae Choi (Seoul Nat'l Univ.), Kyung Min Kim (Seoul Nat'l Univ.), Jaekw Im (Seoul Nat'l Univ.), Han Gyu Joo (Seoul Nat'l Univ.)*

- 177 Advanced Discretization Methods for Particle Transport II**
- 178 The Limited Linear Source Approximation of the Method of Characteristics for Mitigating Negative Sources—*Sooyoung Choi (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan)*
- 188 The Legendre Polynomial Axial Expansion Method—*Nicholas F. Herring (Univ. of Michigan), Benjamin S. Collins (ORNL), Thomas J. Downar (Univ. of Michigan)*
- 199 Linear Source Approximation of Angle Dependent Axial Source for Three-Dimensional Neutron Transport—*Jiwon Choe (Ulsan Nat'l Institute of Science and Technology), Deokjung Lee (Ulsan Nat'l Institute of Science and Technology)*
- 209 Spatial Adaptive Mesh Refinement Applied to the Slice Balance Approach—*Michael W. Hackmack (Naval Nuclear Laboratory)*
- 219 Monte Carlo and Hybrid Methods for Particle Transport**
- 220 A Hybrid Monte Carlo-FDSA Method for k-Eigenvalue Problem—*Jiahao Chen (NC State Univ.), Jason Hou (NC State Univ.), Kostadin Ivanov (NC State Univ.)*
- 230 Error Quantification for Improved Deterministic Truncation of Monte Carlo Method—*Inhyung Kim (KAIST), Inyup Kim (KAIST), Yonghee Kim (KAIST)*
- 239 General Formulation of Functional Expansion Tallies for Regular 2D Geometries in Serpent 2 Monte Carlo Code—*Ana Jambrina (LUT Univ.), Jaakko Leppänen (VTT Technical Research Centre of Finland)*
- 249 Functional Expansion Tally-Based Shannon-Fisher Complexity Metric for Fission Source Convergence Analysis in Serpent 2 Monte Carlo Code—*Ana Jambrina (LUT Univ.), Jaakko Leppänen (VTT Technical Research Centre of Finland)*
- 257 Transport in Stochastic Media I**
- 258 Theory and Generation Methods for N-ary Stochastic Mixtures with Markovian Mixing Statistics—*Aaron Olson (Sandia), Shawn Pautz (Sandia), Dan Bolintineanu (Sandia), Emily Vu (Univ. of Michigan)*
- 270 Benchmark Comparisons of Monte Carlo Algorithms for One-Dimensional N-ary Stochastic Media—*Emily H. Vu (Univ. of Michigan), Patrick S. Brantley (LLNL), Aaron J. Olson (Sandia), Brian C. Kiedrowski (Univ. of Michigan)*
- 281 Amnesia Radius Versions of Conditional Point Sampling for Radiation Transport in 1D Stochastic Media—*Emily H. Vu (Univ. of Michigan), Aaron J. Olson (Sandia)*
- 292 Markovian Binary Mixtures: Benchmarks for the Albedo Problem—*Coline Larmier (CEA Saclay), Eugene d'Eon (NVIDIA), Andrea Zoia (CEA Saclay)*
- 303 Framework Development for Reactor Analysis**
- 304 A Simple Reactor Core Simulator Based on VTT's Kraken Computational Framework—*Ville Valtavirta (VTT Technical Research Centre of Finland), Riku Tuominen (VTT Technical Research Centre of Finland)*
- 314 Molten Salt Reactor Depletion Techniques in the ADDER Reactor Depletion and Fuel Management Analysis Code—*A. G. Nelson (ANL), G. J. Y. Chee (Univ. of Illinois-Urbana-Champaign), M. G. Jarrett (ANL)*
- 324 Development of a General MPI Coupling Interface for Multi-Physics Analysis—*A. Abarca (NC State Univ.), M. Avramova (NC State Univ.), K. Ivanov (NC State Univ.)*
- 334 Modernization of ORIGEN Library Creation in the SCALE Computer Code—*S. Hart (ORNL), W. Wieselquist (ORNL), A. Holcomb (ORNL)*
- 345 Transport in Stochastic Media II**
- 346 Using Deep Neural Networks to Predict Material Types in Conditional Point Sampling Applied to Markovian Mixture Models—*Warren L. Davis IV (Sandia), Aaron Olson (Sandia), Gabriel Popoola (Sandia), Dan Bolintineanu (Sandia), Theron Rodgers (Sandia), Emily Vu (Sandia)*
- 358 Multilevel Iteration Method for Binary Stochastic Transport Problems—*Dmitriy Y. Anistratov (NC State Univ.)*
- 368 The Nonclassical Simplified P_2 and P_3 Equations with Anisotropic Scattering—*Robert K. Palmer (The Ohio State Univ.), Richard Vasques (The Ohio State Univ.)*
- 379 Advanced Iteration Methods for Particle Transport I**
- 380 Diffusion Synthetic Acceleration for Arbitrary-Order Discontinuous Finite Elements on Polygons—*Michael W. Hackmack (Naval Nuclear Laboratory)*
- 390 Heterogeneous Preconditioning in Thermal Radiative Transfer—*Ben S. Southworth (LANL)*
- 397 Variations on Diffusion-Based Synthetic Acceleration for Multigroup S_N Transport—*James S. Warsa (LANL), Joseph M. Coale (NC State Univ.), Dmitriy Y. Anistratov (NC State Univ.), Jae H. Chang (LANL)*
- 404 Multilevel Second-Moment Methods with Group Decomposition for Multigroup Transport Problems—*Dmitriy Y. Anistratov (NC State Univ.), Joseph M. Coale (NC State Univ.), James S. Warsa (LANL), Jae H. Chang (LANL)*

415 Time Dependent and Radiative Transfer Methods

- 416 Continuous Energy Coarse Mesh Transport Method for Time-Dependent Neutron Transport Problems—*Dingkang Zhang (Georgia Institute of Technology), Farzad Rahnema (Georgia Institute of Technology)*
- 424 Step Change in the Fuel Density During k -Power Iteration for Time-Dependent Neutron Transport—*Yasushi Nauchi (Central Research Institute of Electric Power Industry)*
- 434 Monte Carlo Compton Scattering in the Optically Thin Limit: Stabilizing the Temperature in Thermal Radiation Transport when Scatters Are Rare—*Brooks E. Kinch (LANL), Mathew A. Cleveland (LANL)*
- 444 Monte Carlo Thermal Radiation Transport with Nonlinear Elimination—*Adam Q. Lam (LLNL), Todd S. Palmer (Oregon State Univ.), Thomas A. Brunner (LLNL)*

455 Reduced-Order Models in Nuclear Science and Engineering

- 456 Surrogate Modeling of Criticality Experiments with Mixed Qualitative and Quantitative Factors—*Daniel Siefman (LLNL), William Zywiec (LLNL), Catherine Percher (LLNL), David Heinrichs (LLNL)*
- 466 Proper Orthogonal Decomposition-Based Nonlinear Acceleration for Fuel Depletion Calculations—*Colin R. Brennan (Univ. of Texas–Austin), Kevin T. Clarno (Univ. of Texas–Austin)*
- 479 Projection-Based Parametric Model Order Reduction for Transport Simulation Based on Affine Decomposition of the Operators—*Patrick Behne (Texas A&M Univ.), Jean Ragusa (Texas A&M Univ.), Mauricio Tano (Texas A&M Univ.)*
- 489 A Non-Intrusive Reduced Order Model for Neutronic Transient Analyses of the Alfred Reactor—*Nicolo Abrate (Politecnico di Torino), Sandra Dulla (Politecnico di Torino), Nicola Pedroni (Politecnico di Torino), Piero Ravetto (Politecnico di Torino)*

499 Posters

- 500 Consistent Temperature and Intensity Calculations from Deterministic Phonon Transport—*Nicholas H. Whitman (Oregon State Univ.), Todd S. Palmer (Oregon State Univ.), P. Alex Greaney (Univ. of California - Riverside), Dmitriy Y. Anistratov (NC State Univ.)*
- 510 A Hybrid Deterministic-Stochastic Method for the Calculation of Dose Rate in Reactor Dismantling Operations—*Ettore Guadagni (CEA), Yannick Pénéliou (CEA), Jean Michel Létang (Univ. de Lyon), François-Xavier Hugot (CEA), Cindy Le Loirec (CEA)*

- 520 Radiation Shielding Calculations at VTT Centre for Nuclear Safety Using the Serpent 2 Monte Carlo Code—*Jaakko Leppänen (VTT Technical Research Centre of Finland), Mika Jokipii (VTT Technical Research Centre of Finland)*
- 530 Neutronics Simulation of the Molten Salt Reactor Experiment with SCALE/Shift and Serpent/PARCS—*Jin Li (Univ. of Michigan), Shai Kinast (Univ. of Michigan), Volkan Seker (Univ. of Michigan), Jipu Wang (Univ. of Michigan), Andrew Ward (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan), Thomas Downar (Univ. of Michigan), Ugur Mertuyrek (ORNL)*
- 540 A Novel Monte Carlo Leakage Correction for Serpent 2—*Ville Valtavirta (VTT Technical Research Centre of Finland), Jaakko Leppänen (VTT Technical Research Centre of Finland)*
- 549 Direct Calculation of Safety-Related Parameters for Coupled Transients Using Monte Carlo Neutronics Plus Subchannel Thermal-Hydraulics—*Diego Ferraro (Karlsruhe Institute for Technology), Manuel García (Karlsruhe Institute for Technology), Ville Valtavirta (VTT Technical Research Centre of Finland), Uwe Imke (Karlsruhe Institute for Technology), Riku Tuominen (VTT Technical Research Centre of Finland), Jaakko Leppänen (VTT Technical Research Centre of Finland Ltd), Victor Sanchez-Espinoza (Karlsruhe Institute for Technology)*
- 559 Multigroup Cross-Section Generation for Versatile Test Reactor Experiments Analysis—*Alisha Kasam-Griffith (ANL), Adam Nelson (ANL), Florent Heidet (ANL)*
- 572 Validation of RAPID's Algorithm for Control Rods Movement Using the JSI TRIGA Reactor—*Valerio Mascolino (Virginia Tech), Alireza Haghghat (Virginia Tech), Anže Pungercič (Jožef Stefan Institute), Luka Snoj (Jožef Stefan Institute)*
- 583 Modelling of the OPEN100 Reactor with the Serpent-2 Code—*Anže Mihelčič (Jožef Stefan Institute), Anže Pungercič (Jožef Stefan Institute), Dusan Čalič (Jožef Stefan Institute), Luka Snoj (Jožef Stefan Institute)*
- 593 Improvements on Power Calibration and Core Monitoring at the Penn State Breazeale Reactor with MCNP—*Gokhan Corak (Penn State Univ.), William J. Walters (Penn State Univ.)*
- 603 An Adaptation of the Coarse Mesh Transport (COMET) Method for Improved Parallelism Targeting GPU Architectures—*Paul Burke (Georgia Institute of Technology), Farzad Rahnema (Georgia Institute of Technology), Ding kang Zhang (Georgia Institute of Technology)*
- 611 Monte Carlo Scalability on Extreme Memory Computing Nodes—*David P. Griesheimer (Naval Nuclear Laboratory), Peter S. Dobreff (Naval Nuclear Laboratory), Roberto Gomez (Pittsburgh Supercomputing Center)*

- 621 Benchmarking a Pronghorn Model of the Natural Convection Shutdown Heat Removal Test Facility Against STAR-CCM+—*Sebastian Schunert (INL), Ramiro Freile (Texas A&M Univ.), Logan Harbour (Texas A&M Univ.), Paolo Balestra (INL)*
- 631 Recent Advances of the FENNECS NEutroniCS Code for Safety Assessment of (v)SMR, Generation IV and Other Innovative Concepts—*A. Seubert (Gesellschaft für Anlagen- und Reaktorsicherheit), J. Bousquet (Gesellschaft für Anlagen- und Reaktorsicherheit), R. Henry (Gesellschaft für Anlagen- und Reaktorsicherheit)*
- 641 Development of an OpenFOAM Interface for ENRICO—*Lance Bullerwell (NC State Univ.), Patrick Shriwise (ANL), Paul Romano (ANL), Ron Rahaman (ANL), Jason Hou (NC State Univ.)*
- 651 Modeling of Koeberg Power Plant: Generation of Nominal and Perturbed Nuclear Data With Polaris for PARCS Simulations—*Pascal Rouxelin (NC State Univ.), Agustin Abarca (NC State Univ.), Maria Avramova (NC State Univ.), Margaret Mkhosi (Centre for Nuclear Safety and Security), Ian Korir (Centre for Nuclear Safety and Security)*
- 661 Analysis of Rod Ejection Accident in Cycle 23 of Koeberg NPP with PARCS and CTF/PARCS—*A. Abarca (NC State Univ.), C. Takasugi (NC State Univ.), R. Tshipuke (NC State Univ.), P. Rouxelin (NC State Univ.), M. Avramova (NC State Univ.), M. Mkhosi (Centre for Nuclear Safety and Security), I. Korir (Centre for Nuclear Safety and Security)*
- 672 Implementation of Dynamic Monte Carlo Simulation in iMC and Multi-Physics Analysis on Advanced Fuel Element—*HyeonTae Kim (KAIST), Yonghee Kim (KAIST)*
- 680 Control Rod History Effect Assessment in a Soluble Boron-Free S-PWR—*P. Devaux (CEA), M. Guyot (CEA), J.-F. Vidal (CEA)*
- 690 PARAGON2/ANC Analysis of BEAVRS Benchmark Reactor Core—*Mohamed Ouisloumen (Westinghouse Electric Co.), Ho Q. Lam (Westinghouse Electric Co.), Jie P. Lu (Westinghouse Electric Co.)*
- 700 Validation of the High-Resolution Code nTRACER Against VVER-1000 Hot Zero Power Measurements—*Marianna Papadionysiou (Paul Scherrer Institut), Seongchan Kim (Seoul Nat'l Univ.), Mathieu Hursin (Paul Scherrer Institut), Alexander Vasiliev (Paul Scherrer Institut), Hakim Ferroukhi (Paul Scherrer Institut), Han Gyu Joo (Seoul Nat'l Univ.), Andreas Pautz (Paul Scherrer Institut)*
- 710 FRENDY/MG: A Multi-Group Cross Section Generation Module Using ACE Pointwise Cross Sections—*Akio Yamamoto (Nagoya Univ.), Tomohiro Endo (Nagoya Univ.), Basma Foad (Nagoya Univ.), Go Chiba (Hokkaido Univ.), Kenichi Tada (Japan Atomic Energy Agency)*
- 721 Towards an Efficient and Stable Hybrid Transport-Depletion Sequence Using Reduced-Order Solutions at Substeps—*Andrew Johnson (Georgia Institute of Technology), Dan Kotlyar (Georgia Institute of Technology)*
- 728 Comparative Study for Load-Follow Operations of the Holos Microreactor—*Sooyoung Choi (Univ. of Michigan), Shai Kinast (Univ. of Michigan), Claudio Filippone (HolosGen), Brendan Kochunas (Univ. of Michigan)*
- 738 Validation of the GeN-Foam Model of the CROCUS Experimental Reactor—*Tom Mager (École Polytechnique Fédérale de Lausanne), Carlo Fiorina (Ecole Polytechnique Federale de Lausanne), Mathieu Hursin (Paul Scherrer Institut), Andreas Pautz (Paul Scherrer Institut)*
- 748 Development of a Syntactic Validation Capability for the Use of MCNP—*Peter J. Kowal (Rensselaer Polytechnic Institute), Jonathan A. Eugenio (Rensselaer Polytechnic Institute), Kurt A. Dominesey (Rensselaer Polytechnic Institute), Wei Ji (Rensselaer Polytechnic Institute), Robert A. Lefebvre (ORNL), Forrest B. Brown (LANL)*
- 758 Monte Carlo Analysis of Sub-Pin Resolved Power Behaviour in Modern BWR Assembly Designs—*Mathieu Hursin (Paul Scherrer Institut), Alexander Vasiliev (Paul Scherrer Institut), Dimitri Rochman (Paul Scherrer Institut), Abdelhamid Dokhane (Paul Scherrer Institut), Hakim Ferroukhi (Paul Scherrer Institut)*
- 768 Operational Characteristics of Low-Enriched Moderated and Unmoderated Space Nuclear Propulsion Reactors—*Matt Krecicki (Georgia Institute of Technology), Dan Kotlyar (Georgia Institute of Technology)*
- 778 Development of a Griffin Reactor Physics Analysis Code Model for the Versatile Test Reactor—*Nicolas Martin (INL), Ryan Stewart (INL), Zhiwen Xu (INL), Sam Bays (INL)*
- 788 New Route in TRIPOLI-4[®] for Radiation Dosimetry Calculations Using ICRP 110 Voxel Phantoms—*Yi-Kang Lee (CEA), François-Xavier Hugot (CEA), Yue Jin (CEA)*
- 798 3-D Monte Carlo vs S_N Deterministic Radiation Transport Methods Supporting an Optimized Neutron Imaging Source at the Utah TRIGA Reactor—*Michael J. Hartos (Univ. of Utah), Meng-Jen Wang (Univ. of Utah), Glenn E. Sjoden (Univ. of Utah)*
- 808 On the Creation of the New ENDF/B-VIII.0 Covariance Library for SCALE Applications With AMPX—*F. Bostelmann (ORNL), A. M. Holcomb (ORNL), D. Wiarda (ORNL), W. A. Wieselquist (ORNL)*
- 819 Sensitivity Analysis and Its Convergence Through Monte Carlo Calculations for the UAM GEN-III Benchmark: Application to Power Distributions—*P. Lopez (Univ. Grenoble-Alpes), A. Bidaud (Univ. Grenoble-Alpes)*

- 829 Revisiting the Lockwood Albedo Measurements for Validation of the Integrated Tiger Series Electron-Photon Transport Code—*Rowdy Davis (Univ. of New Mexico), Ronald P. Kensek (Sandia), Christopher M. Perfetti (Univ. of New Mexico), Aaron Olson (Sandia)*
- 840 Uncertainty Quantification and Sensitivity Analysis of PWR FA Decay Heat by STREAM/RAST-K—*Jaerim Jang (Ulsan Nat'l Institute of Science and Technology), Chidong Kong (Ulsan Nat'l Institute of Science and Technology), Bamidele Ebiwonjumi (Ulsan Nat'l Institute of Science and Technology), Yunki Jo (Ulsan Nat'l Institute of Science and Technology), Alexey Cherezov (Ulsan Nat'l Institute of Science and Technology), Deokjung Lee (Ulsan Nat'l Institute of Science and Technology)*
- 849 Acceleration of Nodal Diffusion Calculations Using Machine Learning-Driven Generation of Homogenized Macroscopic Cross-Sections—*Siarhei Dzianisau (Ulsan Nat'l Institute of Science and Technology), Jiwon Choe (Ulsan Nat'l Institute of Science and Technology), Alexey Cherezov (Ulsan Nat'l Institute of Science and Technology), Deokjung Lee (Ulsan Nat'l Institute of Science and Technology)*
- 859 Developing Covert Cognizance (C^2) for Industrial Control Systems—*Arvind Sundaram (Purdue Univ.), Hany S. Abdel-Khalik (Purdue Univ.)*
- 867 Application of Deep Neural Networks for Coarse Mesh Turbulence Modeling in Reactor Transients Analysis—*Yang Liu (ANL), Rui Hu (ANL), Prasanna Balaprakash (ANL), Acacia Brunett (ANL), Aleksandr Obabko (ANL)*
- 877 Numerical Investigation of Solidification of Corium in an Initially Emptied Vertical Pipe—*Alex Pegarkov (Carleton Univ.), Shawn Somers-Neal (Carleton Univ.), Abubaker Alatrash (Carleton Univ.), Edgar Matida (Carleton Univ.), Vinh Tang (Carleton Univ.), Tarik Kaya (Carleton Univ.)*
- 886 Validation of the Resonant Scattering Treatment in the Different APOLLO3[®] Self-Shielding Models—*Jean-François Vidal (CEA), Madeleine Gilly (CEA)*
- 896 A Phase Field Model for Hydrothermal Corrosion in Silicon Carbide—*Anant Raj (NC State Univ.), Jacob Eapen (NC State Univ.)*
- 901 Phononica: A Phonon Dynamics Simulator—*Anant Raj (NC State Univ.), Jacob Eapen (NC State Univ.)*

905 Tuesday October 5, 2021

- 907 Advanced Discretization Methods for Particle Transport III**
- 908 Unifying the Finite Element and Nodal Expansion Methods Under the Weighted Residuals Framework—*Matt Kabelitz (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan)*
- 918 Spatial Discretization Error Estimators on Three Realistic Geometry Case Studies—*Nathan H. Hart (LANL), Yousry Y. Azmy (NC State Univ.)*
- 927 Two-Dimensional Source Estimation Problems Using an ADO-Nodal Solution to the Adjoint Transport Equation—*C. B. Pazinato (Instituto Federal de Educação), L. B. Barichello (Universidade Federal do Rio Grande do Sul)*
- 937 Extending Gout's Wachspress Finite Elements on Regular Hexagons to Higher Orders—*David Labeurthre (CEA), Ansar Calloo (CEA), Romain Le Tellier (CEA)*
- 947 Monte Carlo Algorithms**
- 948 Algorithm for Free Gas Elastic Scattering Without Rejection Sampling—*Elliott Biondo (ORNL), Vladimir Sobes (Univ. of Tenn., Knoxville), Andrew Holcomb (ORNL), Steven Hamilton (ORNL), Thomas Evans (ORNL)*
- 960 Conditional Point Sampling Implementation for the GPU—*Luke J. Kersting (Sandia), Aaron Olson (Sandia), Kerry Bossler (Sandia)*
- 969 Efficient Scoring Algorithm for Local Differential Operator Tallies in Large Models—*David P. Griesheimer (Naval Nuclear Laboratory), Gabriel Kooreman (Naval Nuclear Laboratory)*
- 978 Probability Distribution Functions of the Number of Scattering Collisions in Electron Slowing Down—*Brian C. Franke (Sandia), Anil K. Prinja (Univ. of New Mexico)*
- 989 Reduced-Order Models for Reactor Analysis**
- 990 Physics-Informed Deep Learning Neural Network Solution to the Neutron Diffusion Model—*Mohamed H. Elhareef (Virginia Commonwealth Univ.), Zeyun Wu (Virginia Commonwealth Univ.), Yu Ma (Sun Yat-sen Univ.)*
- 1002 Improving Whole-Core Calculations by Bayesian Inference from Single-Assembly Measured Reactivity Weights—*P.-L. Alzieu (CEA), G. Truchet (CEA), J. Tommasi (CEA)*
- 1013 Investigation Into the Use of Machine Learning Assisted Prediction of Nodal Parameters for Reduced Order Neutronic Simulation Models—*Madhumitha Ravichandran (MIT), Cole A. Gentry (ORNL), Matteo Bucci (MIT)*

- 1023 Improved Rational Approximation for Spatially-Dependent Resonance Self-Shielding in CASMO5—*Rodolfo Ferrer (Studsvik Scandpower), Joshua Hykes (Studsvik Scandpower)*
- 1033 Material Motion Corrections for Transport Simulations**
- 1034 Issues in Thermal Radiative Transport with Material Motion—*N. A. Gentile (LLNL)*
- 1044 CRKSPH-Compatible Discretization of the SUPG and SAAF Transport Equations—*Brody R. Bassett (LLNL), J. Michael Owen (LLNL)*
- 1054 Frequency-Dependent Material Motion Benchmarks for Radiative Transfer—*Ryan G. McClarren (Univ. of Notre Dame), N. A. Gentile (LLNL)*
- 1062 A Variable Eddington Factor Method with Different Spatial Discretization for the Radiative Transfer Equation and the Hydrodynamics/Radiation-Moment Equations—*Jijie Lou (Texas A&M Univ.), Jim E. Morel (Texas A&M Univ.)*
- 1072 An Implicit-Explicit Time Differencing Scheme for Neutron Transport in Moving Materials—*Erin J. Davis (LANL)*
- 1083 Advanced Iteration Methods for Particle Transport II**
- 1084 Fourier Analysis of Coarse Mesh Finite Difference and Linear Diffusion Acceleration for Spatially Heterogeneous Systems—*Zackary Dodson (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan), Edward Larsen (Univ. of Michigan)*
- 1095 Arbitrary-Level Hierarchical CMFD Acceleration for Diffusion Eigenvalue Problems—*Michael W. Hackemack (Naval Nuclear Laboratory)*
- 1103 Convergence Acceleration Aspects in the Solution of P_n Neutron Transport Eigenvalue Problem—*N. Abrate (Politecnico di Torino), B. D. Ganapol (Univ. of Arizona), S. Dulla (Politecnico di Torino), P. Saracco (INFN), P. Ravetto (Politecnico di Torino), A. Zoia (CEA)*
- 1113 Investigating Mixed FEM SP_n as a Synthetic Acceleration for the DFE Transport Equation—*Atyab A. Calloo (Polytechnique Montréal), Alain Hébert (Polytechnique Montréal)*
- 1123 Modeling and Simulations in High Energy-Density Physics and Plasma Physics**
- 1124 Reduced-Order Models for Thermal Radiative Transfer Based on POD-Galerkin Method and Low-Order Quasidiffusion Equations—*Joseph M. Coale (NC State Univ.), Dmitriy Y. Anistratov (NC State Univ.)*
- 1134 Exact Results on Intrinsic Gradients in the Compression of Heat—*F. W. Doss (LANL)*
- 1143 Implicit Methods with Reduced Memory for Thermal Radiative Transfer—*Dmitriy Y. Anistratov (NC State Univ.), Joseph M. Coale (NC State Univ.)*
- 1153 A Coupled Radiation-Diffusion and Kinetic Plasma Physics Solver—*Hans Hammer (LANL), HyeonKae Park (LANL), Luis Chacón (LANL), William Taitano (LANL), Steven Anderson (LANL), Andrei Simakov (LANL)*
- 1163 Benchmark-Quality Solutions for Particle Transport Problems**
- 1164 Nyström Method Applied to the Non-Homogeneous Transport Equation—*Luana Lazzari (Universidade Federal do Rio Grande do Sul), Esequia Sauter (Universidade Federal do Rio Grande do Sul), Fábio Souto de Azevedo (Universidade Federal do Rio Grande do Sul)*
- 1174 On the Solution of Systems of Linear Equations Arising Within the ADO Method for Solving Two-Dimensional Problems in Anisotropic Scattering Media—*Karine Rui (Universidade Federal do Rio Grande do Sul), Liliane Basso Barichello (Universidade Federal do Rio Grande do Sul), Rudnei Dias da Cunha (Universidade Federal do Rio Grande do Sul)*
- 1184 Numerical Caseology by Lagrange Interpolation for the 1D Neutron Transport Equation in a Slab—*B. D. Ganapol (Univ. of Arizona)*
- 1194 A Variation on the Response Matrix Approach for a Slab Illuminated by a Neutron Beam—*B. D. Ganapol (Univ. of Arizona)*
- 1203 Reactor Analysis and Applications I**
- 1204 Implementation of Generalized Incore Detector Responses in MPACT—*Erik Walker (ORNL), Shane Stimpson (ORNL), Benjamin Collins (ORNL), Andrew Godfrey (ORNL), James Eller (ORNL)*
- 1215 Multi-Reactor, Multicycle Optimization of Core Reload Design for an SMR Power Plant—*Ben Lilley (Oregon State Univ.), Todd S. Palmer (Oregon State Univ.)*
- 1223 Revisiting the Calculation of Non-Fundamental Flux Modes in a CANDU Reactor—*Alain Hébert (Polytechnique Montréal)*
- 1230 Innovative Multiple Energy Grid Deterministic Method to Treat Core-Reflector Interfaces—*Fiona Desplats (CEA), Pascal Archier (CEA), Jean-François Vidal (CEA), Jean-Marc Palau (CEA), Roland Lenain (CEA), Emiliano Masiello (CEA)*

1241 General Transport Methods

- 1242 A Low-Rank Method for the Discrete Ordinate Transport Equation Compatible With Transport Sweeps—*Zhuogang Peng (Univ. of Notre Dame), Ryan G. McClarren (Univ. of Notre Dame)*
- 1252 Heterogeneity, Hyperparameters, and GPUs: Towards Useful Transport Calculations Using Neural Networks—*Michael M. Pozulp (LLNL), Patrick S. Brantley (LLNL), Todd S. Palmer (Oregon State Univ.), Jasmina L. Vujic (Univ. of California–Berkeley)*
- 1262 An Accelerated Characteristics Method Including a Spatial Polynomial Expansion for Cross Sections—*A. Gammicchia (CEA Saclay), S. Santandrea (CEA Saclay), S. Dulla (Politecnico di Torino)*
- 1272 Solving Neutron Transport Problems With Sharp Boundary and Interior Layers Using the Shishkin Mesh—*Tseelmaa Byambaakhuu (The Ohio State Univ.), Dean Wang (The Ohio State Univ.)*

1283 Computational Methods for High Energy-Density Physics

- 1284 Exploring Compton Scattering Options for Thermal Radiative Transfer—*Andrew Tili (LANL)*
- 1294 BICS: Full Boltzmann Implicit Compton Solve—*Carolyn McGraw (LANL), Andrew Tili (LANL), James Warsa (LANL)*
- 1304 Nonlinear Diffusion Synthetic Acceleration of Thermal Radiative Transfer—*Milan Holec (LLNL), Ben S. Southworth (LANL), Terry S. Haut (LLNL), Ben C. Yee (LLNL)*
- 1314 A New Scheme for Solving High-Order DG Discretizations of Thermal Radiative Transfer Using the Variable Eddington Factor Method—*Ben C. Yee (LLNL), Samuel S. Olivier (Univ. of California–Berkeley), Ben S. Southworth (LANL), Milan Holec (LLNL), Terry S. Haut (LLNL)*

1325 Mathematical Methods

- 1326 Neutron Transport Problems with Nonlinear Temperature Feedback—*Dean Wang (The Ohio State Univ.), Firas Abdullatif (The Ohio State Univ.)*
- 1336 Perturbation Response Function Generation Method in Multigroup Transport Problems—*Farzad Rahnema (Georgia Institute of Technology), Dingkang Zhang (Georgia Institute of Technology)*
- 1345 Criticality Benchmarking: Beyond K^{eff} —*J.-Ch. Sublet (IAEA), A. C. Kahler (Kahler Nuclear Data Services), C. Jouanne (CEA)*
- 1352 Extension of Shmakov's Simple Back and Forth Neutron Transport Model to Multi-Regions—*B. Ganapol (Univ. of Arizona), D. Heinrichs (LLNL)*

1363 Computational Methods for Reactor Analysis I

- 1364 Selection of the Optimal Higher Order Method for the Two-Step Pinwise Core Calculation—*Hyunsik Hong (Seoul Nat'l Univ.), Han Gyu Joo (Seoul Nat'l Univ.)*
- 1374 HDMR-Based Flux Reconstruction Method—*P. M. Bokov (South African Nuclear Energy Corp.), D. Botes (South African Nuclear Energy Corp.), R. H. Prinsloo (South African Nuclear Energy Corp.), D. I. Tomašević (South African Nuclear Energy Corp.)*
- 1384 Development of an Embedded Scheme for Improved Nodal Diffusion Solutions—*R. H. Prinsloo (South African Nuclear Energy Corp.), S. A. Groenewald (South African Nuclear Energy Corp.), D. I. Tomašević (South African Nuclear Energy Corp.)*
- 1394 Development of a High-to-Low Informing Scheme for Core Neutronics Calculations Based on NEAMS Tools—*Kan Ni (NC State Univ.), Jason Hou (NC State Univ.), Maria Avramova (NC State Univ.)*

1405 Wednesday October 6, 2021

1407 Applications of Machine Learning for Transport Simulations

- 1408 Perturbed Dynamic Mode Decomposition Acceleration of Source Iteration for Fixed-Source Neutron Transport Problems—*Nickolas J. Adamowicz (Univ. of Michigan)*
- 1418 ²³³U Nuclear Data Evaluation Using Machine Learning Generated Cross Sections—*Pedro Vicente-Valdez (Univ. of California–Berkeley), Lee Bernstein (Univ. of California–Berkeley), Massimiliano Fratoni (Univ. of California–Berkeley)*
- 1427 Reduced Models for Nuclear Data in Transport Problems—*B. Whewell (Univ. of Notre Dame), Ryan G. McClarren (Univ. of Notre Dame)*
- 1437 Simulated Annealing for Group Structure Optimization—*Thomas Saller (LANL)*

1447 Sensitivity Analysis

- 1448 Computation of Sobol' Indices Using Embedded Variance Deconvolution—*James M. Petticrew (Atomic Weapons Establishment), Aaron J. Olson (Sandia)*
- 1458 Differential Operator Sampling Sensitivity Coefficients of Brossa Fission Model Parameters in CGMF—*Brian C. Kiedrowski (Univ. of Michigan), Austin L. Carter (Univ. of Michigan), Robert J. Fonti (Univ. of Michigan), Patrick Talou (LANL)*
- 1468 Computation of the Time Integral Terms for GPT Burnup Sensitivity Calculations when Dealing with Short Lived Nuclides—*Nicolas Linden (CEA), Aimé Tsilanizara (CEA), Jean Tommasi (CEA)*

- 1478 Stochastic Method for Reactivity Sensitivities Computation to High-Energy Nuclear Parameters—*Elias Vandermeersch (CEA), Pierre Tamagno (CEA), Cyrille De Saint Jean (CEA)*
- 1489 Reactor Analysis and Applications II**
- 1490 Evaluation of Reactor Pulse Experiments—*I. Švajger (Jožef Stefan Institute), L. Snoj (Jožef Stefan Institute)*
- 1500 Fast Reactor Depletion Methods in LUPINE—*Scott Palmtag (NC State Univ.), William C. Dawn (NC State Univ.), Chase Lawing (NC State Univ.)*
- 1508 Fuel Salt Compressibility Effects in Molten Salt Fast Reactors—*Jun Shi (Univ. of California–Berkeley), Massimiliano Fratoni (Univ. of California–Berkeley)*
- 1517 Frequency Domain Analysis of HTR-Like Microreactors—*Shai Kinast (Nuclear Research Center Negev/Univ. of Michigan), Doron Sivan (Ben-Gurion Univ. of the Negev), Sooyoung Choi (Univ. of Michigan), Claudio Filippone (HolosGen), Brendan Kochunas (Univ. of Michigan)*
- 1529 Neutron Fluctuations – A Homage to Lénárd Pál (1925–2019) I**
- 1530 Lénárd Pál – His Time, His Professional Life, and Reminiscences of a Collaboration—*I. Pázsit (Chalmers Univ. of Technology)*
- 1540 The Contribution of Erwin Schroedinger to the Calculation of the Extinction Probability and its Comparison with the Work of Lénárd Pál—*M. M. R. Williams (Imperial College of Science, Technology, and Medicine)*
- 1545 Pál-Bell Theory: Beyond the Neutron Number Distribution—*Anil K. Prinja (Univ. of New Mexico), Patrick F. O'Rourke (LANL)*
- 1555 Towards a More Realistic Analysis of Neutron Clustering—*Thomas M. Sutton (Rensselaer Polytechnic Institute)*
- 1567 Neutron Fluctuations – A Homage to Lénárd Pál (1925–2019) II**
- 1568 Theoretical Derivation of Unique Combination-Number for Higher Order Neutron Correlation Factors Based on Pál-Bell Equation—*Tomohiro Endo (Nagoya Univ.), Akio Yamamoto (Nagoya Univ.)*
- 1577 Approximation of Neutron Counting Probability Distributions From Moments Using Polynomial Expansions—*Philippe Humbert (CEA)*
- 1587 The Two Point Feynman- α Theory: A Practical Point of View on Ex-Core Detectors—*Chen Dubi (Nuclear Research Center Negev/Ben Gurion Univ.), Eshed Magali (Nuclear Research Center Negev)*
- 1602 Application of Stochastic Neutron Transport Theory to Nuclear Data Evaluation Using Subcritical Neutron Multiplicity Counting Experiments—*John Mattingly (NC State Univ.), Alexander R. Clark (LANL), Jeffrey A. Favorite (LANL)*
- 1613 Reactor Analysis Using Machine Learning**
- 1614 On the Use of Machine Learning (Neural Networks) to Deepen Numerical Validation of Neutronic Calculations: Basics and Application to an APOLLO3-SFR Scheme—*J.-M. Palau (CEA/DES), G. Rimpault (CEA/DES)*
- 1624 Acceleration of Multi-Objective Optimisation Calculations for Nuclear Burnup Studies Using Intra-Optimisation Objective Expansion—*D. J. Brennan (Univ. of Cambridge), G. T. Parks (Univ. of Cambridge)*
- 1634 Application of Reinforcement Learning Optimisation Methodology to BWR Assemblies—*Majdi I. Radaideh (MIT), Benoit Forget (MIT), Koroush Shirvan (MIT)*
- 1644 Estimation of the Axial Neutron Flux Profiles in the SAFARI-1 Core Using Artificial Neural Networks—*L. E. Moloko (South African Nuclear Energy Corp.), P. M. Bokov (South African Nuclear Energy Corp.), K. N. Ivanov (NC State Univ.)*
- 1655 Uncertainty Quantification**
- 1656 Impact of Covariances Estimation on Uncertainty Propagation in Reactor Core Simulations—*Gregory Kyriakos Delipei (NC State Univ.), Kaiyue Zeng (NC State Univ.), Jason Hou (NC State Univ.)*
- 1666 Uncertainty Quantification Study of Fuel Rod Performance with FRAPCON/FRAPTRAN for the OECD/NEA LWR Uncertainty Analysis in Modelling Benchmark—*G. Delipei (NC State Univ.), A. Abarca (NC State Univ.), M. Avramova (NC State Univ.), K. Ivanov (NC State Univ.)*
- 1676 High to Low Methodology for Gap Heat Transfer in an Uncertainty Quantification Framework for Depletion—*J. Fustero (NC State Univ.), G. K. Delipei (NC State Univ.), A. Abarca (NC State Univ.), A. Bennett (Framatome), M. Avramova (NC State Univ.), K. Ivanov (NC State Univ.)*
- 1688 Inverse Uncertainty Quantification of a MOOSE-based Melt Pool Model for Additive Manufacturing—*Ziyu Xie (NC State Univ.), Wen Jiang (INL), Congjian Wang (INL), Xu Wu (NC State Univ.)*

1699 Computational Methods for Reactor Analysis II

- 1700 Preliminary Implementation and Application of an Electrical Equivalent Circuit for Neutron Diffusion Modeling—*Naiki Kaffezakis (Georgia Institute of Technology), Dan Kotlyar (Georgia Institute of Technology)*
- 1709 Preliminary Investigation of Arbitrary CAD Geometry and Unstructured Mesh with 2D Method of Characteristics in MPACT—*Kyle Vaughn (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan)*
- 1719 Development of Estimation Method for Prompt Neutron Decay Constant Using Dynamic Mode Decomposition—*Fuga Nishioka (Nagoya Univ.), Yuhei Fukui (Nagoya Univ.), Tomohiro Endo (Nagoya Univ.), Akio Yamamoto (Nagoya Univ.), Masao Yamanaka (Kyoto Univ.), Cheol Ho Pyeon (Kyoto Univ.)*
- 1729 A Transport Corrected SP3 Solver Development with Nodal Expansion Method—*Yuchao Xu (NC State Univ.), Jason Hou (NC State Univ.), Kostadin Ivanov (NC State Univ.)*

1741 Neutron Fluctuations – A Homage to Lénárd Pál (1925–2019) III

- 1742 New Paradigm in Neutron Fluctuation Analysis: Extracting the Statistics of Discrete Detection Events from Time-Resolved Signals of Fission Chambers—*Lajos Nagy (Budapest Univ. of Technology and Economics), Yasunori Kitamura (Kyoto Univ.), Imre Pázsit (Chalmers Univ. of Technology), Máté Szieberth (Budapest Univ. of Technology and Economics)*
- 1752 Experimental Demonstration of Neutron Fluctuation Analysis Based on the Continuous Signal of Fission Chambers: Neutron Multiplicity and Reactor Noise Measurements—*M. Szieberth (Budapest Univ. of Technology and Economics), L. Nagy (Budapest Univ. of Technology and Economics), G. Klujber (Budapest Univ. of Technology and Economics), Y. Kitamura (Kyoto Univ.), T. Misawa (Kyoto Univ.), I. Barth (Budapest Univ. of Technology and Economics), I. Pázsit (Chalmers Univ. of Technology)*

1763 Mathematical Modeling Using Machine Learning

- 1764 Advanced Transient Diagnostic with Ensemble Digital Twin Modeling—*Edward Chen (NC State Univ.), Linyu Lin (NC State Univ.), Nam T. Dinh (NC State Univ.)*
- 1773 Integration of Neural Networks With Numerical Solution of PDEs to Uncover Hidden Physics—*A. S. Iskhakov (NC State Univ.), N. T. Dinh (NC State Univ.)*
- 1782 Application of Deep Learning Networks to Surrogate Modeling of Crud Deposition—*B. Andersen (NC State Univ.), A. Godfrey (ORNL), J. Hou (NC State Univ.), D. Kropaczek (ORNL)*

- 1792 A Multi-Level Feature Extraction and Denoising Approach to Detect Subtle Variations in Industrial Control Systems—*Arvind Sundaram (Purdue Univ.), Yeni Li (Purdue Univ.), Hany S. Abdel Khalik (Purdue Univ.)*

1799 Dimensionality Reduction and Inference

- 1800 A Comprehensive Framework to Improve Predictions by Integrating Inverse Uncertainty Quantification and Quantitative Validation—*Ziyu Xie (NC State Univ.), Xu Wu (NC State Univ.)*
- 1811 Advanced Information Criteria Applied to IDA Benchmark Problems: Reducing the Degree of Freedom in Bayesian Approaches—*J.-M. Palau (CEA/DES), P. Tamagno (CEA/DES), A. Rizzo (CEA/DES)*
- 1821 Calibration of Pellet Cladding Gap Heat Transfer Model for PWR, BWR and VVER Fuel Rod Transient Uncertainty Analysis—*G. Delipei (NC State Univ.), A. Abarca (NC State Univ.), M. Avramova (NC State Univ.), K. Ivanov (NC State Univ.)*
- 1831 Non-Intrusive Alternative to Generalized Linear Least-Squares Methodology for Criticality Safety Applications—*Jeongwon Seo (Purdue Univ.), Dongli Huang (Purdue Univ.), Ugur Mertuyrek (ORNL), Hany S. Abdel-Khalik (Purdue Univ.)*

1839 Advanced Acceleration and Models for Reactor Analysis

- 1840 S2 Consistent Analytic CMFD Acceleration for Method of Characteristics—*Yoshiki Oshima (Nagoya Univ.), Akio Yamamoto (Nagoya Univ.), Tomohiro Endo (Nagoya Univ.)*
- 1850 Implementation of Coarse Mesh Finite Difference Acceleration Scheme for Irregular Geometry—*Albert Hsieh (Univ. of Michigan), Yeon Sang Jung (ANL), Chang-ho Lee (ANL), Won Sik Yang (Univ. of Michigan)*
- 1859 Triangular Geometry Model for Ants Nodal Neutronics Solver—*M. Hirvensalo (VTT Technical Research Centre of Finland), A. Rintala (VTT Technical Research Centre of Finland), V. Sahlberg (VTT Technical Research Centre of Finland)*
- 1869 Performance and Stability of Triangle-Based Quadratic Nodal Expansion Methods with Quasi-Diffusion Approach—*M. Rizki Oktavian (Purdue Univ.), Yunlin Xu (Purdue Univ.)*
- 1879 The CORTEX Project—Combining Reactor Modelling and Machine Learning for Core Monitoring I
- 1880 Understanding the Neutron Noise Induced by Fuel Assembly Vibrations in Linear Theory—*C. Demazière (Chalmers Univ. of Technology), A. Rouchon (CEA), A. Zoia (CEA)*

1891 Development of a Neutron Noise Simulator for Hexagonal Geometries—*A. Vidal-Ferràndiz (Univ. Politècnica de València), A. Carreño (Univ. Politècnica de València), D. Ginestar (Univ. Politècnica de València), G. Verdú (Univ. Politècnica de València)*

1901 Reactor Physics Benchmarks

1902 Status of the OECD/NEA TVA Watts Bar 1 Benchmark and Monte Carlo Modeling of the “Zero Power Physics Test” Exercise—*T. Albagami (NC State Univ.), P. Rouxelin (NC State Univ.), A. Abarca (NC State Univ.), M. Avramova (NC State Univ.), K. Ivanov (NC State Univ.)*

1911 Verification of MPACT and VERA-CS for the APR1400 Benchmark—*Kaitlyn Barr (Univ. of Michigan), Sooyoung Choi (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan)*

1924 Preliminary Results of the NEA FHR Benchmark Phase I-A and I-B (Fuel Element 2-D Benchmark)—*B. Petrovic (Georgia Institute of Technology), K. Ramey (Georgia Institute of Technology), I. Hill (OECD/Nuclear Energy Agency), E. Losa (Research Centre Rez), M. Elswawi (PNNL), Z. Wu (Virginia Commonwealth Univ.), C. Lu (Virginia Commonwealth Univ.), J. Gonzalez (McMaster Univ.), D. Novog (McMaster Univ.), G. Chee (Univ. of Illinois–Urbana-Champaign), K. Huff (Univ. of Illinois–Urbana-Champaign), M. Margulis (Univ. of Cambridge), N. Read (Univ. of Cambridge), E. Shwageraus (Univ. of Cambridge)*

1935 Time-Stepping and Acceleration Methods for Multiphysics Simulations

1936 Multiple Balance Time-Discretization: A Robust Second-Order Method for Multi-Physics Simulations—*Ilham Variansyah (Univ. of Michigan), Edward W. Larsen (Univ. of Michigan), William R. Martin (Univ. of Michigan)*

1946 Anderson Acceleration Applied To Multiphysics Simulation of Boiling Water Reactors Using VERA—*Jesse P. Jones (ORNL), Benjamin S. Collins (ORNL), Mehdi Asgari (ORNL)*

1952 Application of the Adaptive Residual Balance Method on an APOLLO3® – THEDI Coupling and Comparison with Anderson Acceleration—*Robin Delvaux (CEA), Cyril Patricot (CEA)*

1962 A Multilevel Projective Method and Residual Balance Algorithm for Circulating Fuel Reactor Kinetics—*Aaron J. Reynolds (Oregon State Univ.), Todd S. Palmer (Oregon State Univ.)*

1981 Cross-Section Generation for Reactor Analysis

1982 Implementation of a Resonance Calculation Using Energy Spectrum Expansion Method Into Heterogeneous Transport Calculation Code GALAXY-Z—*Kazuya Yamaji (Mitsubishi Heavy Industries), Hiroki Koike (Mitsubishi Heavy Industries), Koichi Ieyama (Mitsubishi Heavy Industries), Daisuke Sato (Mitsubishi Heavy Industries), Akio Yamamoto (Nagoya Univ.), Satoshi Takeda (Osaka Univ.)*

1992 Dynamic Construction of Physical Probability Tables for Resonant Mixture—*Emeline Rosier (CEA), Li Mao (CEA), Luiz Leal (Institut de Radioprotection et de Surete Nucleaire)*

2002 Iterative Local Spatial Self-Shielding Method of MC²-3 for Particulate Fuel Modeling—*Hansol Park (ANL), Won Sik Yang (Univ. of Michigan), Changho Lee (ANL)*

2015 The CORTEX Project—Combining Reactor Modelling and Machine Learning for Core Monitoring II

2016 Comparison of Neutron Noise Solvers Based on Numerical Benchmarks in a 2-D Simplified UOX Fuel Assembly—*P. Vinai (Chalmers Univ. of Technology), H. Yi (Chalmers Univ. of Technology), A. Mylonakis (Chalmers Univ. of Technology), C. Demazière (Chalmers Univ. of Technology), B. Gasse (Univ. Paris-Saclay), A. Rouchon (Univ. Paris-Saclay), A. Zoia (Univ. Paris-Saclay), A. Vidal-Ferràndiz (Univ. Politècnica de València), D. Ginestar (Univ. Politècnica de València), G. Verdú (Univ. Politècnica de València), T. Yamamoto (Kyoto Univ.)*

2026 Deep Learning-Based Anomaly Detection in Nuclear Reactor Cores—*Thanos Tasakos (National Technical Univ. of Athens), George Ioannou (National Technical Univ. of Athens), Vasudha Verma (Paul Scherrer Institut), Georgios Alexandridis (National Technical Univ. of Athens), Abdelhamid Dokhane (Paul Scherrer Institut), Andreas Stafylopatis (National Technical Univ. of Athens)*

2038 Detection and Localisation of Multiple In-Core Perturbations with Neutron Noise-Based Self-Supervised Domain Adaptation—*A. Durrant (Univ. of Lincoln), G. Leontidis (Univ. of Lincoln), S. Kollias (Univ. of Lincoln), L. A. Torres (Univ. Politecnica de Madrid), C. Montalvo (Univ. Politecnica de Madrid), A. Mylonakis (Chalmers Univ. of Technology), C. Demazière (Chalmers Univ. of Technology), P. Vinai (Chalmers Univ. of Technology)*

2048 Feature Extraction and Identification Techniques for the Alignment of Perturbation Simulations with Power Plant Measurements—George Ioannou (National Technical Univ. of Athens), Thanos Tasakos (National Technical Univ. of Athens), Antonios Mylonakis (Chalmers Univ. of Technology), Georgios Alexandridis (National Technical Univ. of Athens), Christophe Demaziere (Chalmers Univ. of Technology), Paolo Vinai (Chalmers Univ. of Technology), Andreas Stafylopatis (National Technical Univ. of Athens)

2061 Thursday October 7, 2021

2063 Numerical Methods for Multiphysics Simulations

2064 Robust Relaxation-Free Multiphysics Simulations via Power-Iteration-Level-Coupled CMFD Acceleration in MPACT—Qicang Shen (Univ. of Michigan), Sooyoung Choi (Univ. of Michigan), Brendan Kochunas (Univ. of Michigan)

2074 Frequency Transform Method for Transient Analysis of Nuclear Reactors—Miriam A. Kreher (MIT), Samuel Shaner (C-Zero), Benoit Forget (MIT), Kord Smith (MIT)

2083 Reduced-Order Modeling of Coupled Neutronics and Fluid Dynamics in the Zero-Power Molten Salt Fast Reactor—Petér German (Texas A&M Univ.), Mauricio E. Tano (Texas A&M Univ.), Jean C. Ragusa (Texas A&M Univ.)

2092 The NILO-CMFD Method for Iteratively Solving Multiphysics Neutron Transport - Thermal Hydraulic Problems—Nickolas J. Adamowicz (Univ. of Michigan), Annalisa Manera (Univ. of Michigan), Edward W. Larsen (Univ. of Michigan)

2103 Dynamic Effects and Stability Analysis of Core Modeling

2104 Stability Analysis of Spatial Discretisation in Burn-Up Calculations—P. Cosgrove (Univ. of Cambridge), N. Adamowicz (Univ. of Michigan)

2114 Modeling of the Dynamic Reactivity Effect on Account of Periodical Fluctuation in Fuel Medium—A. Cherezov (Ulsan Nat'l Institute of Science and Technology), D. Lee (Ulsan Nat'l Institute of Science and Technology)

2124 Recent Advances in the Stability Analysis of Burn-Up Calculations—N. Adamowicz (Univ. of Michigan), P. Cosgrove (Univ. of Cambridge)

2133 Solving Advection Problems with Isotopic Evolution with SCALE/ORIGEN—Jin Whan Bae (ORNL), Benjamin R. Betzler (ORNL), William A. Wieselquist (ORNL)

2145 Computational Fluid Dynamics

2146 Implicit Shock Fitting for Multimaterial Shock Dynamics Using a High-Order Space-Time Discontinuous Finite-Element Method—R. Nourgaliev (LLNL), A. Corrigan (U.S. Naval Research Laboratory), A. Kercher (U.S. Naval Research Laboratory), S. Wopschall (LLNL), P. Greene (LLNL)

2157 Analysis of Unstable Structures in a Low-Reynolds, Horizontal Channel for Supercritical Fluid Flows—R. Barney (Univ. of California, Davis), R. Nourgaliev (LLNL), J.P. Delplanque (Univ. of California, Davis), R. McCallen (LLNL)

2167 Computational Fluid Dynamics Mesh Generation of the PSBT Benchmark Subchannels for Use with Nek5000—David Holler (NC State Univ.), Nilay Atul Kulkarni (NC State Univ.), Maria Avramova (NC State Univ.)

2177 Numerical Modeling of an In-Vessel Flow Limiter Using an Immersed Boundary Approach—Georis Billo (CEA), Michel Belliard (CEA), Pierre Sagaut (Aix-Marseille Univ.)

2187 Computational Methods for Reactor Analysis III

2188 Multigroup Material Cross-Sections Generation with SCALE 6.2.3 for Deterministic Neutron Transport Calculations: Application to a PWR Fuel Element Analysis—Antonella Labarile (Universitat Politècnica València), Arturo Vivancos (Universitat Politècnica València), Álvaro Bernal (Nuclear Safety Council), Teresa Barrachina (Universitat Politècnica València), Rafael Miró (Universitat Politècnica de València), Gumersindo Verdú (Universitat Politècnica de Valencia)

2198 Best Estimate Schemes in Lattice Calculations for Industrial Cases, With the Help of a New Leakage Synthetic Algorithm—B. Vezzoni (Framatome), S. Santandrea (CEA), L. Graziano (Framatome), I. Zmijarevic (CEA)

2208 A Group-Dependent Equivalent Dancoff Factor Cell Method Applied to AIC Control Rod Calculations—Li Mao (CEA), Igor Zmijarevic (CEA), Richard Sanchez (CEA), Nicolas Gerard Castaing (CEA)

2219 Fuel Assembly Analyses With Resonance Calculation Using Energy Spectrum Expansion Method—Ryoichi Kondo (Nagoya Univ.), Tomohiro Endo (Nagoya Univ.), Akio Yamamoto (Nagoya Univ.), Satoshi Takeda (Osaka University), Hiroki Koike (Mitsubishi Heavy Industries), Kazuya Yamaji (Mitsubishi Heavy Industries), Daisuke Sato (Mitsubishi Heavy Industries)

2231 Modeling and Analysis of Multi-Physics Simulations

2232 Simplified Thermal Expansion Modeling for Liquid Metal-Cooled Fast Reactors—William C. Dawn (NC State Univ.), Scott Palmtag (NC State Univ.)

2241 First Approach to Analyse Control Rod Withdrawal Transient in SFR With a Multi-Physics Methodology—*Marlène Jeannin (CEA), Vincent Pascal (CEA), Victor Blanc (CEA), Jean-Baptiste Droin (CEA), Laurent Buiron (CEA), Pablo Rubiolo (LPSC)*

2251 Coupled Multiphysics Multiscale Transient Simulations of the Mk1-FHR Reactor Using Finite Volume Capabilities of the MOOSE Framework—*Guillaume Giudicelli (INL), Alexander Lindsay (INL), Paolo Balestra (INL), Robert Carlsen (INL), Javier Ortensi (INL), Derek Gaston (INL), Mark DeHart (INL), Abdalla Abou-Jaoude (INL), April J. Novak (ANL)*

2263 Multi-Objective Genetic Algorithm for Fast Reactor Reloading Optimization with Approximate Fitness Evaluation—*Michael Jarrett (ANL), Florent Heidet (ANL)*

2273 Computational Methods for Thermal-Hydraulics

2274 Development of a Thermal Hydraulic Model for the Versatile Test Reactor Using the CTF Subchannel Code—*Cole Takasugi (NC State Univ.), Nicolas Martin (INL), SuJong Yoon (INL), Samuel Bays (INL), Maria Avramova (NC State Univ.), Kostadin Ivanov (NC State Univ.)*

2284 Development of Whole-Core Steady-State Thermal Hydraulic Model for Annular Fuel Type Small Modular Fluoride-Salt-Cooled Reactors—*Sriram Chandrasekaran (Georgia Institute of Technology), Srinivas Garimella (Georgia Institute of Technology)*

2294 A Coarse-Mesh-Based OpenFOAM Solver for Thermal-Hydraulic Simulation of Fuel Elements in a Thermal Propulsion Reactor—*J. C. Wang (Georgia Institute of Technology), D. Kotlyar (Georgia Institute of Technology)*

2304 Nodal Integral Methods in Curvilinear Coordinates Applied to Quadrilateral Elements—*Ibrahim Jarrah (Univ. of Illinois-Urbana-Champaign), Rizwan-uddin (Univ. of Illinois-Urbana-Champaign)*

2315 Nuclear Data Methods

2316 Mitigation of Depletion Effects From Angular Dependency of Multigroup Resonance Cross Sections—*Seungug Jae (Seoul Nat'l Univ.), Hansol Park (Univ. of Michigan), Han Gyu Lee (Seoul Nat'l Univ.), Han Gyu Joo (Seoul Nat'l Univ.)*

2325 Spatially Dependent Resonance Self-Shielding Capability for Non-Uniform Temperature Profile in SCALE-6.3 XSPROC-BONAMI—*Kang Seog Kim (ORNL), Andrew M. Holcomb (ORNL), William A. Wieselquist (ORNL)*

2332 Temperature Interpolation of the Phonon Distribution for Accurate Preparation of the Thermal Neutron Scattering Law—*Amelia Trainer (MIT), Benoit Forget (MIT)*

2342 Improvement of the SCALE-XSPROC Capability for High-Temperature Gas-Cooled Reactor Analysis—*Kang Seog Kim (ORNL), Andrew M. Holcomb (ORNL), Friederike Bostelmann (ORNL), Dorothea Wiarda (ORNL), Brandon R. Langley (ORNL), William A. Wieselquist (ORNL)*

2351 Multi-Physics Simulations of Reactor Systems

2352 Multiphysics Simulation of Uranium-Nitride Fueled Lead-Cooled Fast Reactor—*Khaldoon A. Al-Dawood (NC State Univ.), William C. Dawn (NC State Univ.), Scott Palmtag (NC State Univ.)*

2362 Multiphysics Modeling of Fast Liquid-Fuel Molten Salt Reactor Using STARCCM+—*Yeongshin Jeong (MIT), Koroush Shirvan (MIT)*

2372 Coupling Methodologies within WIMS for Multi-Physics Fuel Performance Modelling—*Peter Smith (Jacobs Nuclear), Brendan Tollit (Jacobs Nuclear), Alan Charles (Jacobs Nuclear), Jean Lavarenne (Jacobs Nuclear), William Poole (Jacobs Nuclear), Magda Stefanowska (Jacobs Nuclear)*

2382 Multiphysics Simulation of the Molten Salt Fast Reactor Using Griffin and Pronghorn—*Paolo Balestra (INL), Abdalla Abou-Jaoude (INL), Nicolas Martin (INL), Sebastian Schunert (INL), Andrew Hermosillo (Texas A&M Univ.), Yaqi Wang (INL)*

2398 Author Index