Benjamin R. Betzler Ph.D.

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SUMMARY

Outcome-focused nuclear engineer with demonstrated experience and performance on successful R&D programs for a variety of sponsors. Experience collaborating with and leading diverse multi-organization teams and communicating with sponsors and staff. Recognized expertise in reactor analysis and design, with specialized knowledge of advanced reactor systems, Monte Carlo radiation transport methods, and additive manufacturing in the nuclear industry. Leadership roles include leader of the Oak Ridge National Laboratory Research and Test Reactor Physics Group.

EDUCATION

University of Michigan, Ann Arbor, MI, 2014
Doctor of Philosophy, Nuclear Engineering and Radiological Sciences (Fission)
Dissertation title: *Calculating Alpha Eigenvalues and Eigenfunctions with a Markov Transition Rate Matrix Monte Carlo Method*
Advisor: William R. Martin

University of Michigan, Ann Arbor, MI, 2010
Master of Science in Engineering, Nuclear Engineering and Radiological Sciences

University of Michigan, Ann Arbor, MI, 2008
Bachelor of Science in Engineering, Nuclear Engineering and Radiological Sciences

PROFESSIONAL EXPERIENCE

Oak Ridge National Laboratory, May 2014 – present
Senior R&D Staff and Group Lead, Research & Test Reactor Physics, Oct. 2020 – present
Supervisor: Robert E. Grove, Section Head, Nuclear Modeling & Simulation

- Directed the DOE-NE Transformational Challenge Reactor Program, coordinating with industry and regulatory partners to demonstrate additive manufacturing technologies.
- Coordinated iterative design and analysis for High Flux Isotope Reactor (HFIR) fuel.
- Advised on molten salt reactor source term analyses and flow modeling with SCALE.

R&D Staff, Jan. 2019 – Sep. 2020
Supervisor: William A. Wieselquist, Group Leader, Neutronics, Apr. 2020 – Sep. 2020
Germina Ilas, Team Lead, Neutronics, Jan. 2019 – Mar. 2020

- Led the design and analysis thrust of the DOE-NE Transformational Challenge Reactor Program, collaborating with material science, facility & licensing, and reactor design staff to design a nuclear reactor using additive manufacturing technologies.
- Collaborated in an interlaboratory effort to analyze Molten Salt Breeder Reactor dose and define specifications for a Molten Salt Reactor Experiment transient benchmark.
- Developed reactor physics and fuel cycle models of the Molten Salt Demonstration Reactor for safeguards, source term, off gas system, and isotope production analyses.
- Collaborated on advanced low-enriched uranium dispersion fuel design optimization and analyses with Shippingport reactor fuel.
- Advised on the development and deployment of automated optimization tools for HFIR low-enriched uranium (LEU) fuel design.
- Advised on the implementation of neural networks for fuel cycle simulation, ORIGEN reactor library interpolation, and accelerating inverse depletion methods.
- Led high-fidelity as-built reactor physics analysis in support of HFIR fuel characterization and operations.

PROFESSIONAL EXPERIENCE (CONTINUED)

Oak Ridge National Laboratory (*continued*), May 2014 – present
Associate R&D Staff, May 2016 – Dec. 2018
Supervisor: Germina Ilas, Team Lead, Neutronics, May 2018 – Dec. 2018
Kevin T. Clarno, Group Leader, Reactor Physics, Mar. 2018 – Apr. 2018
Stephen M. Bowman, Group Leader, Reactor Physics, Retired Feb. 2018

- Led a multidisciplinary team of nuclear and mechanical engineers to design a reactor built using advanced manufacturing techniques.
- Led a multi-laboratory effort to develop the DOE-NE Molten Salt Reactor Campaign modeling and simulation plan, communicating with industry, academia, laboratory staff, and leadership in other DOE-NE programs.
- Calculated fuel salt content and developed models of molten salt reactor fueling, storage, and processing systems for safeguards characterization and analysis.
- Developed molten salt reactor neutronics and fuel cycle analysis tools for the SCALE code package, leading the integration in ORIGEN, NEWT, and TRITON.
- Coordinated the modeling and simulation effort of the DOE-NE Molten Salt Reactor Campaign, supporting dose estimation, dynamic modeling, and chemistry modeling.
- Developed design optimization tools and performed design studies of a HFIR low-enriched uranium core with the Shift Monte Carlo tool.
- Collaborated with Transatomic Power Corporation to perform neutronic and fuel cycle analysis and design optimization for their molten salt reactor design.

Postdoctoral Research Associate, May 2014 – Apr. 2016
Supervisor: Stephen M. Bowman, Group Leader, Reactor Physics

- Performed depletion and criticality analysis of boiling water reactor spent fuel assemblies with different operating conditions for burnup credit analysis.
- Performed core design and analysis of a prismatic fluoride salt–cooled advanced demonstration reactor concept using Serpent and PARCS.
- Developed tools and performed neutronic analysis for fast and thermal spectrum molten salt reactors to characterize them for the fuel cycle options campaign.
- Designed a small nuclear rocket engine using accident tolerant fuel in KENO and performed optimization studies on packing fractions, fuel loads, and core geometry.
- Performed depletion simulation, neutronic analysis, and developed Python scripts in support of the HFIR LEU conversion program and HFIR operations.
- Tested the depletion and lattice physics performance of SCALE modules (TRITON, Polaris, NEWT, and KENO) for light water reactor geometries.
- Developed a Python script and built TRITON inputs to automatically generate the 1,470 ORIGEN cross section libraries released with updated versions of SCALE.

University of Michigan, *Research Assistant*, Aug. 2008 – Apr. 2014
Advisor: William R. Martin, Professor

- Simulated the Fort St. Vrain gas-cooled reactor with MCNP, using RELAP5 to analyze thermal hydraulic feedback. Wrote Python scripts for writing and updating MCNP and RELAP5 inputs, including high-fidelity models of TRISO particle fuel.
- Modeled $\sim$20 Fort St. Vrain pulsed neutron and other startup experiments with MCNP and performed sensitivity studies on design parameter uncertainties.

Los Alamos National Laboratory, *Research Assistant*, Summer 2012
Advisor: Brian C. Kiedrowski, Research Scientist, X Division

- Wrote a research Monte Carlo code in MATLAB to calculate α eigenvalues and eigenfunctions of infinite media using a transition rate matrix method akin to the fission matrix method. This method improves upon the k-α iteration in MCNP.

PROFESSIONAL EXPERIENCE (CONTINUED)

Oak Ridge National Laboratory, *Research Assistant (NESLS)*, Summer 2010
Mentor: Daniel L. Pinkston, Nuclear Engineer, High Flux Isotope Reactor

- Calculated heat deposited in the HFIR reactivity control system with MCNP to investigate causes of control cylinder clad corrosion, spalling, and failure.
- Analyzed the burnup of control cylinder absorbers and cladding with ORIGEN and determined the axial heat flux distribution with simple heat transfer models.

LEADERSHIP & PROGRAMMATIC ROLES

National Technical Director, 2021
DOE-NE Transformational Challenge Reactor Program

Research and Test Reactor Physics Group Leader, 2020 – present
ORNL Nuclear Modeling and Simulation Development and Deployment Section

Molten Salt Reactor Application Drivers ORNL Lead, 2019 – present
DOE-NE Nuclear Energy Advanced Modeling and Simulation Program

Design Thrust Lead, 2018 – 2021
DOE-NE Transformational Challenge Reactor Program

ORIGEN Libraries Product Owner, 2018 – 2020
Oak Ridge National Laboratory SCALE Development Team

Modeling and Simulation Technical Area Lead, 2017 – 2019
DOE-NE Molten Salt Reactor Campaign

TEACHING EXPERIENCE

Oak Ridge National Laboratory

University of Michigan Senior Design Project Advisor, 2020 – 2021

- Advised Team Large Burrito (Kayce Duggan, Braden Saltus & Reid Sobota) on microreactor core design and analysis, 2020 – 2021.

SCALE Training Team Member, Aug. 2015 – present

- Lectured for week-long SCALE reactor physics, depletion, and sensitivity and uncertainty courses to colleagues in academia and industry (10 courses with $\sim$10 students per course).
- Held SCALE molten salt reactor analysis tools workshop at Georgia Tech in 2020 ($\sim$15 students).
- Lectured for SCALE workshop at M&C 2017 ($\sim$20 students).
- Answered questions on SCALE help regarding reactor physics tools and data.

University of Michigan Educational Ambassador, 2018 – 2019

- Participated in recruitment and outreach visits on behalf of the laboratory.

University of Michigan

Guest Lecturer, Fall 2013

- Taught a few guest classes for senior-level nuclear reactor theory ($\sim$35 students).

Graduate Student Instructor, Fall 2012

- Graded, held office hours, and lectured a few classes for senior-level nuclear reactor theory ($\sim$35 students).

Relevant Coursework

- Graduate level course in teaching engineering at a university level, Fall 2012.

RESEARCH MENTORING EXPERIENCE

Oak Ridge National Laboratory

Research Mentor, May 2015 – present

- Robert F. Kile, graduate research assistant, co-advised on system and safety simulations for the Transformational Challenge Reactor, 2019 – 2020.
- Pedro J. Vicente Valdez, Graduate Research Assistant, advised on SCALE/TRITON MSR capability testing and molten salt reactor processing modeling, 2019.
- Jin Whan Bae, Postmaster's Research Associate, advised on LWR fuel cycle simulation, reactor physics analysis of the High Flux Isotope Reactor, and Molten Salt Reactor sensitivity and uncertainty analysis, 2019 – 2020.
- Sarah E. Creasman, University of Tennessee Master's Candidate, co-advised on source term analysis of the Molten Salt Demonstration Reactor, 2018 – 2019.
- Ilham Variansyah, University of Michigan Ph.D. Candidate, advised on Monte Carlo methods for α-eigenvalue and time-dependent problems, 2018 – present.
- Briana D. Hiscox, Postmaster's Research Associate, advised on gas-cooled fast reactor benchmarking and design optimization methods development, 2018 – 2020.
- Ilham Variansyah, Graduate Research Assistant, advised on design optimization method development and implementation for HFIR LEU designs, 2018.
- Andrei Rykhlevskii, Graduate Research Assistant, advised on fast spectrum molten salt reactor neutronic and fuel cycle analysis with SCALE/TRITON and Serpent, 2018.
- Naiki A. Kaffezakis, Undergraduate Research Assistant, co-advised on SCALE and Serpent modeling and simulation of the High Flux Isotope Reactor, 2018.
- Ilham Variansyah, Graduate Research Assistant, co-advised on MCNP modeling and Shift depletion simulation for High Flux Isotope Reactor LEU designs, 2017.
- Jennifer R. Hedgecoth, U.S. Navy Midshipman Bowman Scholar, advised on MCNP modeling of pebble-bed high temperature molten salt reactors, 2017.
- Brianna M. Kaufmann, U.S. Navy Midshipman Bowman Scholar, advised on fuel depletion and shuffling for pebble-bed high temperature molten salt reactors, 2017.
- Zachary G. Skirpan, U.S. Navy Midshipman Bowman Scholar, advised on fuel cycle modeling and simulation for the molten salt breeder reactor, 2017.
- Łukasz Koszuk, Graduate Research Assistant, co-advised on automating the generation of cross section library group structures for advanced reactors, 2016 – 2017.
- Abdalla Abou Jaoude, Graduate Research Assistant, co-advised on MCNP modeling and VESTA depletion simulations of High Flux Isotope Reactor LEU designs, 2015.

Thesis Committee Member, 2020 – present

- Ilham Variansyah, University of Michigan Ph.D., A Robust Second-Order Multiple Balance Method and α-Weighted Multigroup Constants for Time-Dependent Nuclear Reactor Simulations, 2020.

University of Michigan

Research Mentor, Fall 2010 – Fall 2012

- Timothy P. Burke, Undergraduate Research Assistant, mentored on MCNP microsphere particle modeling of the Fort St. Vrain gas-cooled reactor.
- Wilson N. Pappo, Undergraduate Research Assistant, mentored on fuel data analysis for the Fort St. Vrain gas-cooled reactor.

FUNDING AWARDS & ROLES

Regenerating Missing Experimental Parameters with Data-Assimilation Methods for MSRE Transient Benchmark Development and Evaluation, 2021 – 2024
DOE Nuclear Energy University Program, Mission Supporting: Nuclear Energy
Principal Investigator: Z. Wu (Assistant Professor, Virginia Commonwealth University)
With: M. Fratoni (UC-Berkeley), **B. R. Betzler**, T. Fei (ANL), and K. Harris (Flibe Energy)

BWXT Advanced Nuclear Reactor (BANR), 2021 – 2028
DOE Advanced Reactor Demonstration Program, Risk Reduction for Future Demonstrations
Principal Investigator: BWXT Advanced Technologies, LLC
With: A. T. Nelson and **B. R. Betzler**

Modeling and Uncertainty Analysis of Molten Salt Reactor Nuclear Material Accounting Methods for Safeguards by Design, 2019 – 2022
DOE Nuclear Energy University Program, Fuel Cycle Research & Development
Principal Investigator: W. J. Walters (Assistant Professor, Pennsylvania State University)
With: A. T. Lintereur (PSU), A. M. Johnson (PSU), **B. R. Betzler**, and L. G. Worrall

Fundamental Studies of Materials Degradation in Molten Chloride Salts, 2017 – 19
Oak Ridge National Laboratory Laboratory Directed R&D (LDRD)
Principal Investigator: S. S. Raiman
With: J. W. McMurray, C. W. Abney, R. T. Mayes, J. R. Keiser, **B. R. Betzler**

Molten Salt Reactor Neutronics Tools, 2016
Department of Energy Technology Commercialization Fund
Principal Investigator: **B. R. Betzler**
With: J. J. Powers, N. R. Brown, and B. T. Rearden

Optimization and Assessment of the Neutronics and Fuel Cycle Performance of the Transatomic Power Molten Salt Reactor Design, 2016
Gateway for Accelerated Innovation in Nuclear (GAIN), DOE Office of Nuclear Energy NE Voucher Program Request for Assistance
Principal Investigator: L. C. Dewan (Transatomic Power Corporation)
With: **B. R. Betzler**, J. J. Powers, and A. Worrall

AWARDS

American Nuclear Society Early Career Reactor Physicist, 2020
For excellence and leadership in applied reactor physics research and development for advanced reactor designs.

UT-Battelle Mission Support Award, 2019
For distinguished performance and dedication in determining the causes of the first fuel element failure in 52 years of HFIR operation (Team)

American Nuclear Society Local Section Meritorious Award, 2017
Best Section Management – Oak Ridge/Knoxville Local Section (accepted as Chair)

Best Team Paper, 2015 MeV Summer School
Future Experimentation: Sensitivity Analysis and Uncertainty Quantification to Optimize Design and Implementation

Best Paper in Reactor Physics, 2010 ANS Student Conference
MCNP5 Analysis of the Fort St. Vain High-Temperature Gas-Cooled Reactor

American Nuclear Society Student Design Competition Finalist, 2010
Irradiation of Food Using Spent Nuclear Fuel

Kikuchi Scholarship, 2006
Merit-based Scholarship

PROFESSIONAL AFFILIATIONS & SERVICE

American Nuclear Society, 2013 – present
Executive Committee Member, Reactor Physics Division, 2020 – 2023
Technical Program Committee Member, Reactor Physics Division, 2018 – 2023

American Chemical Society, 2019 – present
Member, Nuclear Chemistry & Technology Division, 2019 – present

OECD Nuclear Energy Agency International Benchmark Program, 2021 – present
Technical Reviewer, ICSBEP/SINBAD/IRPhEP

Oak Ridge/Knoxville American Nuclear Society, 2015 – present
Vice Chair, Chair & Immediate Past Chair, 2016 – 2019
Secretary, 2015 – 2016

Oak Ridge National Laboratory, 2019 – present
Review Committee Member, Transformational Nucl. Science & Technology Initiative, 2019

Conference & Workshop Organization Activities, 2015 – present
Technical Program Committee Member, Mathematics & Computation (M&C), 2021
Asst. Technical Program Chair, American Nuclear Society Annual Mtg., 2021
Asst. General Chair, International High-Level Radioactive Waste Management, 2019
Session Chair (& Organizer[†]*),* 2015 – present

- Dynamic Effects and Stability Analysis of Core Modeling, M&C, 2021
- Materials,[†] AI/ML Technologies for Advanced Reactors Virtual Workshop, 2021
- Reactor Physics of Advanced Reactors–II,[†] American Nucl. Society Annual Mtg., 2021
- Transformational Challenge Reactor–I&II,[†] American Nuclear Society Winter Mtg., 2020
- Transformational Challenge Reactor,[†] American Nuclear Society Annual Mtg., 2020
- Innovation: Additive Manufacturing Panel, Young Professional's Congress, 2019
- Advanced Reactors–Small Module Reactors & Components, GLOBAL, 2019
- Molten Salt Reactors–I&II, American Nuclear Society Annual Mtg., 2019
- Molten Salt Reactor (MSR) Research at Universities, 4th Annual MSR Workshop, 2018
- Fast Reactors and Molten Salt Reactors, GLOBAL, 2017
- Reactor Physics, Mathematics & Computation (M&C), 2015

Editorial & Review Activities, 2016 – present
Guest Editor, 2021 – present

- Nuclear Science and Engineering: Transformational Challenge Reactor, 2021 – 2022

Conference Paper & Summary Reviewer, 2019 – present

- Mathematics & Computation (M&C) Conference, 2021
- International Congress on Advances in Nuclear Power Plants (ICAPP), 2020
- PHYSOR Reactor Physics Conference, 2020
- GLOBAL International Nuclear Fuel Cycle Conference, 2019
- American Nuclear Society Mathematics & Computation Division, 2019 – present
- American Nuclear Society Reactor Physics Division, 2019 – present

Journal Reviewer, 10 reviews p.a., 2016 – present

- Journal of Nuclear Engineering, 1 review p.a., 2021 – present
- Environmental Science and Technology, 1 review p.a., 2020 – present
- Progress in Nuclear Energy, 3 reviews p.a., 2020 – present
- International Journal of Energy Research, 1 review p.a., 2019 – present
- Nuclear Science and Engineering, 2 reviews p.a., 2018 – present
- Annals of Nuclear Energy, 4 reviews p.a., 2018 – present
- Nuclear Engineering and Technology, 1 review p.a., 2018 – present
- Nuclear Engineering and Design, 1 review p.a., 2016 – present

RESEARCH INTERESTS

Reactor physics and fuel cycle methods development and analysis for advanced reactor systems: molten salt reactors, microreactors, gas-cooled reactors, nuclear thermal propulsion reactors, fast burst reactor systems, and accelerator-driven subcritical systems. Numerical methods for solving neutron transport problems: Monte Carlo transport, α-eigenvalue methods, time-dependent transport, and matrix methods and applications of Markov processes. Advanced manufacturing technology development for nuclear industry applications. Design optimization methods, code verification and validation, dose and shielding, and applications of neutron importance.

RECENT PARTNERSHIPS

National Laboratory

F. Heidet, B. Feng, A. Bergeron, Y. Cao & T. Fei (Argonne National Laboratory); S. C. Wilson (Los Alamos National Laboratory); N. T. Shoman (Sandia National Laboratory); C. J. Jesse & N. V. Smith (Idaho National Laboratory)

University

W. J. Walters (Penn State); M. Fratoni (Berkeley); K. D. Huff (Illinois); W. R. Martin (Michigan); N. R. Brown & V. Sobes (UTK); C. M. Perfetti (UNM); Z. Wu (VCU)

Industry

BWXT; Flibe Energy; Framatome; Kairos Power

SKILLS

Environments: Mac, Linux, Windows
Programming Languages: working knowledge of Python and Fortran, basic knowledge of C++, Java, HTML, JavaScript, and Perl
Transport Software: MCNP, SCALE (KENO, TRITON, NEWT, ORIGEN, Polaris), Shift, VESTA, Serpent, OpenMC, GenPMAXS, PARCS
Documentation & Analysis: LaTeX, gnuplot, MATLAB/Octave, MS Office
Other: USA Hockey Level 4 coaching certification

PUBLICATIONS SUMMARY & LIST

Author or coauthor of more than 120 peer-reviewed publications, with more than
- 25 peer-reviewed journal articles,
- 90 peer-reviewed conference proceedings and summaries, and
- 60 technical reports

More than 50 contributed[†] and 25 invited[‡] presentations at conferences, workshops, meetings, and universities
Use links provided below or view publications at Google Scholar

BOOK CHAPTERS

◇ **B. R. Betzler**, "Additive Manufacturing in the Nuclear Reactor Industry," in E. Greespan(Ed.), *Encyclopedia of Nuclear Energy: Advanced Nuclear Reactor Concepts Under R&D*, **1**(3), Elsevier, pp. 851–863 (2021). doi: 10.1016/B978-0-12-819725-7.00106-9

REFEREED JOURNAL ARTICLES

◇ A. Talamo, A. Bergeron, S. Mohanty, P. Vegendla, F. Heidet, B. J. Ade, **B. R. Betzler**, and K. A. Terrani, "Serpent and MCNP Calculations of the Energy Deposition in the Transformational Challenge Reactor," *Nucl. Sci. Eng.*, (accepted).

◇ **B. R. Betzler**, B. J. Ade, P. K. Jain, A. J. Wysocki, P. C. Chesser, W. M. Kirkland, M. S. Cetiner, A. Bergeron, F. Heidet, and K. A. Terrani, "Conceptual Design of the Transformational Challenge Reactor," *Nucl. Sci. Eng.*, (accepted).

- V. Sobes, B. D. Hiscox, E. L. Popov, R. K. Archibald, C. D. Hauck, **B. R. Betzler**, and K. A. Terrani, "AI-based Design of a Nuclear Reactor Core," *Sci. Rep.*, **11**, 19646, (2021). doi: 10.1038/s41598-021-98037-1
- E. E. Davidson, G. Radulescu, S. C. Wilson, K. R. Smith, J. Yang, and **B. R. Betzler**, "Reactor Cell Neutron Dose for the Molten Salt Breeder Reactor Conceptual Design," *Nucl. Eng. Des.*, **383**, 111381, (2021). doi: 10.1016/j.nucengdes.2021.111381
- L. R. Cornejo, **B. R. Betzler**, K. G. Myhre, and J. McFarlane, "Modeling Molybdenum-99 Production in Molten Salt Reactors," *Nucl. Eng. Des.*, **379**, 111243, (2021). doi: 10.1016/j.nucengdes.2021.111243
- R. F. Kile, A. J. Wysocki, **B. R. Betzler**, and N. R. Brown, "Transformational Challenge Reactor Safety Analysis to Inform Core Design Decisions," *Nucl. Eng. Des.*, **376**, 111122, (2021). doi: 10.1016/j.nucengdes.2021.111122
- B. J. Ade, **B. R. Betzler**, A. J. Wysocki, M. S. Greenwood, P. C. Chesser, K. A. Terrani, P. K. Jain, J. R. Burns, B. D. Hiscox, J. D. Rader, J. J. W. Heineman, F. Heidet, A. Bergeron, J. W. Sterbentz, T. V. Holschuh, N. R. Brown, and R. F. Kile, "Candidate Core Designs for the Transformational Challenge Reactor," *J. Nucl. Eng.*, **2**(1), pp. 74–85 (2021). doi: 10.3390/jne2010008
- **B. R. Betzler**, D. Chandler, T. M. Evans, G. G. Davidson, S. C. Wilson, and S. W. Mosher, "As-Built Modeling and Simulation of the High Flux Isotope Reactor," *J. Nucl. Eng.*, **2**(1), pp. 28–34 (2021). doi: 10.3390/jne2010003
- K. A. Terrani, B. C. Jolly, M. P. Trammell, G. Vasudevamurthy, D. P. Schappel, B. J. Ade, G. W. Helmreich, H. Wang, A. Marquez Rossy, **B. R. Betzler**, and A. T. Nelson, "Architecture and Properties of TCR Fuel Form," *J. Nucl. Mater.*, 152781, (2021). doi: 10.1016/j.jnucmat.2021.152781
- U. Mertyurek, M. A. Jessee, and **B. R. Betzler**, "Lattice Physics Calculations Using the Embedded Self-Shielding Method in Polaris, Part II: Benchmark Assessment," *Ann. Nucl. Energy*, **150**, 107829, (2021). doi: 10.1016/j.anucene.2020.107829
- **B. R. Betzler**, B. J. Ade, A. J. Wysocki, P. K. Jain, P. C. Chesser, M. S. Greenwood, and K. A. Terrani, "Transformational Challenge Reactor Preconceptual Core Design Studies," *Nucl. Eng. Des.*, **367**, 110781, (2020). doi: 10.1016/j.nucengdes.2020.110781
- B. W. Dixon, E. A. Hoffman, B. Feng, E. E. Davidson, R. Hays, A. Worrall, J. Hansen, T. Fei, H. Hiruta, J. L. Peterson-Droogh, F. Ganda, **B. R. Betzler**, T. K. Kim, and T. Taiwo, "Reassessing Methods to Close the Nuclear Fuel Cycle," *Ann. Nucl. Energy*, **147**, 107652, (2020). doi: 10.1016/j.anucene.2020.107652
- D. Chandler, **B. R. Betzler**, E. E. Davidson, and G. Ilas, "Modeling and Simulation of a High Flux Isotope Reactor Representative Core Model for Updated Performance and Safety Basis Assessments," *Nucl. Eng. Des.*, **366**, 110752, (2020). doi: 10.1016/j.nucengdes.2020.110752
- I. Variansyah, **B. R. Betzler**, and W. R. Martin, "Multigroup Constant Calculation with Static α-eigenvalue Monte Carlo for Time-Dependent Neutron Transport Simulations," *Nucl. Sci. Eng.*, **194**(11), pp. 1025–1043 (2020). doi: 10.1080/00295639.2020.1743578
- M. S. Greenwood, **B. R. Betzler**, A. L. Qualls, J. S. Yoo, and C. Rabiti, "Demonstration of the Advanced Dynamic System Modeling Tool TRANSFORM in a Molten Salt Reactor Application via a Model of the Molten Salt Demonstration Reactor," *Nucl. Technol.*, **206**(3), pp. 478–504 (2020). doi: 10.1080/00295450.2019.1627124
- **B. R. Betzler**, F. Heidet, B. Feng, C. Rabiti, T. Sofu, and N. R. Brown, "Modeling and Simulation Needs for Molten Salt Reactor Licensing," *Nucl. Eng. Des.*, **355**, 110308, (2019). doi: 10.1016/j.nucengdes.2019.110308
- **B. R. Betzler**, D. Chandler, D. H. Cook, E. E. Davidson, and G. Ilas, "Design Optimization Methods for High-Performance Research Reactor Core Design," *Nucl. Eng. Des.*, **352**, 110167, (2019). doi: 10.1016/j.nucengdes.2019.110167

- E. E. Davidson, **B. R. Betzler**, R. Gregg, and A. Worrall, "Modeling a Fast Spectrum Molten Salt Reactor in a Systems Dynamics Fuel Cycles Code," *Ann. Nucl. Energy*, **133**, pp. 409–424 (2019). doi: 10.1016/j.anucene.2019.05.011
- D. Chandler, **B. R. Betzler**, D. H. Cook, G. Ilas, and D. G. Renfro, "Neutronic and Thermal-Hydraulic Feasibility Studies for High Flux Isotope Reactor Conversion to Low-Enriched Uranium Silicide Dispersion Fuel," *Ann. Nucl. Energy*, **130**, pp. 277–292 (2019). doi: 10.1016/j.anucene.2019.02.037
- M. S. Greenwood and **B. R. Betzler**, "Modified Kinetic Model for Neutron Precursors and Fission Product Behavior for Fluid-Fueled Molten Salt Reactors," *Nucl. Sci. Eng.*, **193**(4), pp. 417–430 (2019). doi: 10.1080/00295639.2018.1531619
- **B. R. Betzler**, B. C. Kiedrowski, W. R. Martin, and F. B. Brown, "Calculating α Eigenvalues and Eigenfunctions with a Markov Transition Rate Matrix Monte Carlo Method," *Nucl. Sci. Eng.*, **192**(2), pp. 115–152 (2018). doi: 10.1080/00295639.2018.1497397
- **B. R. Betzler**, S. Robertson, E. E. Davidson (née Sunny), J. J. Powers, A. Worrall, L. Dewan, and M. Massie, "Fuel Cycle and Neutronic Performance of a Spectral Shift Molten Salt Reactor Design," *Ann. Nucl. Energy*, **119**, pp. 396–410 (2018). doi: 10.1016/j.anucene.2018.04.043
- E. E. Davidson (née Sunny), **B. R. Betzler**, D. Chandler, and G. Ilas, "Heat Deposition Analysis for the High Flux Isotope Reactor's HEU and LEU Core Models," *Nucl. Eng. Des.*, **322**, pp. 563–576 (2017). doi: 10.1016/j.nucengdes.2017.06.040
- **B. R. Betzler**, D. Chandler, E. E. Davidson (née Sunny), and G. Ilas, "High Fidelity Modeling and Simulation for a High Flux Isotope Reactor Low-Enriched Uranium Core Design," *Nucl. Sci. Eng.*, **187**(1), pp. 81–99 (2017). doi: 10.1080/00295639.2017.1292090
- A. L. Qualls, **B. R. Betzler**, N. R. Brown, J. J. Carbajo, M. S. Greenwood, R. E. Hale, T. J. Harrison, J. J. Powers, K. R. Robb, J. W. Terrell, A. J. Wysocki, J. C. Gehin, and A. Worrall, "Pre-Conceptual Design of a Fluoride High Temperature Salt-Cooled Engineering Demonstration Reactor: Motivation and Overview," *Ann. Nucl. Energy*, **107**, pp. 144–155 (2017). doi: 10.1016/j.anucene.2016.11.021
- N. R. Brown, **B. R. Betzler**, J. J. Carbajo, A. J. Wysocki, M. S. Greenwood, C. A. Gentry, and A. L. Qualls, "Pre-Conceptual Design of a Fluoride High Temperature Salt-Cooled Engineering Demonstration Reactor: Core Design and Safety Analysis," *Ann. Nucl. Energy*, **103**, pp. 49–59 (2017). doi: 10.1016/j.anucene.2017.01.003
- **B. R. Betzler**, J. J. Powers, and A. Worrall, "Molten Salt Reactor and Fuel Cycle Modeling and Simulation with SCALE," *Ann. Nucl. Energy*, **101**, pp. 489–503 (2017). doi: 10.1016/j.anucene.2016.11.040
- **B. R. Betzler**, B. C. Kiedrowski, F. B. Brown, and W. R. Martin, "Calculating Infinite-medium α-eigenvalue Spectra with Monte Carlo using a Transition Rate Matrix Method," *Nucl. Eng. Des.*, **295**, pp. 639–644 (2015). doi: 10.1016/j.nucengdes.2015.07.052
- **B. R. Betzler**, W. R. Martin, B. C. Kiedrowski, and F. B. Brown, "Calculating α Eigenvalues of One-Dimensional Media with Monte Carlo," *J. Comput. Theor. Transp.*, **43**(1-7), pp. 38–49 (2014). doi: 10.1080/00411450.2014.909851

REFEREED FULL CONFERENCE PAPERS

- **B. R. Betzler**, J. W. Bae, D. Chandler, G. Ilas, E. E. Davidson, "Reactor Physics Characteristics of High Flux Isotope Reactor Core Designs with Low-Enriched Uranium Fuels," *Proc. PHYSOR 2022 – Making Virtual a Reality: Advancements in Reactor Physics to Leap Forward Reactor Operation and Deployment*, (submitted).
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- **B. R. Betzler**, "Additive Manufacturing–Enabled Agile Design: The Transformational Challenge Reactor," *Japan Atomic Energy Agency Fifth Symposium on US-Japan Nuclear Energy Research Cooperation*, Washington, DC, USA, Nov. (2021).‡
- **B. R. Betzler**, "Additive Manufacturing in the Nuclear Industry," *ARPA-E Converting UNF Radioisotopes into Energy (CURIE) Workshop*, Oak Ridge, TN, USA, Jul. (2021).‡
- **B. R. Betzler**, "Intersect Between Reactor Design and Modeling & Simulation," *2021 Modeling, Experimentation & Validation Summer School*, *Holistic Innovation: Integrating methods, experiments, and people to advance nuclear technology*, Argonne National Laboratory, Argonne, IL, USA, Jul. (2021).‡
- **B. R. Betzler**, "Machine Learning and Artificial Intelligence in Research Reactor Design," *American Nuclear Society Annual Meeting*, *Reactor Physics Division Panel Session: Machine Learning and Artificial Intelligence in Reactor Physics and Design*, Jun. (2021).‡
- **B. R. Betzler**, "Advanced Reactor Research at Oak Ridge National Laboratory," *Consortium of Nuclear Security Technologies (CONNECT) Seminar*, University of Texas at San Antonio, San Antonio, TX, USA, Jun. (2021).‡
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- ◇ **B. R. Betzler** and B. J. Ade, "Transformational Challenge Reactor: Agile Core Design with Advanced Modeling and Simulation," *SCALE Users' Group Workshop Plenary*, Oak Ridge National Laboratory, Oak Ridge, TN, USA, Jul. (2020).‡❀
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