RACHEL N. SLAYBAUGH

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EDUCATION

Ph.D.	**University of Wisconsin–Madison** Nuclear Engineering and Engineering Physics, with a certificate in Energy Analysis and Policy	2011
M.S.	**University of Wisconsin–Madison** Nuclear Engineering and Engineering Physics	2008
B.S.	**Pennsylvania State University** Nuclear Engineering	2006

RESEARCH EXPERIENCE

University of California, Berkeley Jan. 2014 - Present
Assistant Professor of Nuclear Engineering *Berkeley, CA*

- Researching numerical methods for neutral particle transport with an emphasis on supercomputing and advanced architectures
- Specialization in deterministic, Monte Carlo, and Hybrid methods
- Applications in reactor design, shielding, and nuclear security and nonproliferation
- Design Emphasis in Computational Science and Engineering Affiliated Faculty member
- Applied Science & Technology Faculty member

Bettis Laboratory Mar. 2012 - Aug. 2014
Senior Engineer in the Shield Design and Development group *West Mifflin, PA*

- Implemented the Forward-Weighted Consistent Adjoint Driven Importance Sampling (FW-CADIS) method for variance reduction in Monte Carlo; accredited method for use in shield design
- Developed new Resonance Factor variance reduction method for streaming through materials with space and energy self-shielding
- Built two software tools in support of using FW-CADIS for shield design
- Scientific Software Development Committee: leader in developing internal website for sharing software carpentry tools and resources

University of Wisconsin–Madison Sept. 2006 - Nov. 2011
Research Assistant / Rickover Fellow *Madison, WI*

- Researched "Acceleration Methods for Massively Parallel Deterministic Transport": added parallelization in the energy domain, an advanced eigenvalue solver, and a new multigrid in energy preconditioner to Denovo, developed at Oak Ridge National Lab
- Developed two Monte Carlo source sampling methods for arbitrarily shaped plasma sources; the sources are generated directly from plasma physics data

Forschungszentrum Karlsruhe (KIT) May 2008 - Dec. 2008
Visiting Researcher *Karlsruhe, Germany*

- Learned about the Rigorous 2 Step method for Monte Carlo geometry conversion while working in the Reactor Safety group
- Helped group incorporate the Direct Accelerated Geometry Monte Carlo (DAGMC) library into MCNP workflow

Penn State Breazeale Reactor Aug. 2003 - Apr. 2006
Reactor Operator *University Park, PA*

- NRC licensed Reactor Operator for TRIGA Mark III reactor
- Analyzed core burn-up anomaly; calibrated gamma irradiation facilities

TEACHING EXPERIENCE

University of California, Berkeley Jan. 2014 - Present
Assistant Professor of Nuclear Engineering *Berkeley, CA*

- Founder, Nuclear Innovation Bootcamp, since Summer 2016
- NE 255, Numerical Simulations for Radiation Transport (graduate-level)
- NE 250, Nuclear Reactor Theory (graduate-level)
- NE 155, Introduction to Numerical Simulations for Radiation Transport (senior-level elective)
- NE 198, Faculty sponsor for class in which Berkeley students do hands-on science experiments with students in under-served elementary schools in Oakland
- NE 24, Putting the Science in Computational Science (Freshman seminar)

Software Carpentry Scientific Computing Workshops
Instructor *Berkeley, CA*

- Jan. 14-15, 2016: git; Berkeley Institute for Data Science
- July 16, 2015: shell; École Polytechnique Fédérale Lausanne
- July 1-2, 2015: shell and Python; for underrepresented minority students; UC, Berkeley
- June 11, 2015: Python; Oak Ridge National Laboratory
- Jan. 5-6, 2015: version control; for women only; University of Colorado, Boulder
- Apr. 14-15, 2014: introductory material, version control, object oriented concepts in Python; for women only; Lawrence Berkeley National Laboratory

Bettis Laboratory Mar. 2012 - Aug. 2014
Senior Engineer in the Shield Design and Development group *West Mifflin, PA*

- Qualified instructor for Bettis Reactor Engineering School (BRES), an internal school for new DOE-Naval Reactors employees
- Co-taught BRES Shielding course Fall 2012, 2013, and Spring 2013

University of Pittsburgh Fall 2012, Spring 2013
Adjunct Professor *Pittsburgh, PA*

- Co-taught Introduction to Nuclear Engineering (ENGR 1700), which covers theory / basic nuclear engineering, basics of nuclear power reactors, and nuclear power reactor operations
- Co-taught *new* course Nuclear Chemistry and Radiochemistry (ENGR 2112): responsible for nuclear astrophysics and migration of radionuclides through the environment

SELECTED PRESENTATIONS

R.N. Slaybaugh. "Advanced Solvers and Innovation for Penetrating Radiation" Keynote Speaker, SPIE Penetrating Radiation Technical Event. 8 Aug. 2017. (invited)

R.N. Slaybaugh. "Advancing Solvers and Challenges for Nuclear Innovative." Lawrence Berkeley National Laboratory, IBT Seminar. 12 May 2017. (invited)

R.N. Slaybaugh. "Advancing Reactors with Advanced Solvers and Innovative Programs." Electric Power Research Institute. Research Meeting. 13 Feb 2017. (invited)

R.N. Slaybaugh. "Nuclear and Innovating the Clean Energy Landscape." French Nuclear Energy Society Young Generation Workshop. Video Meeting. 28 Sept. 2016. (invited)

R.N. Slaybaugh. "Nuclear Innovation: Concept to Execution." PHYSOR 2016. Sun Valley, ID. 2 May 2016. (invited)

R.N. Slaybaugh. "The Opportunity of Global Nuclear Innovation." 49th Japan Atomic Industrial Forum (JAIF) Annual Conference. Tokyo, Japan. 12 April 2016. (invited)

R.N. Slaybaugh. "Exascaling Nuclear Innovation." Keynote speaker, Conference on Data Analysis 2016. Santa Fe, NM. 4 March 2016. (invited)

R.N. Slaybaugh. "Hybrid Transport Methods for Shielding Challenges." Idaho National Laboratory seminar. Idaho Falls, ID. 20 Nov. 2015. (invited)

K.L. Rowland, R.N. Slaybaugh. "Developments in the GPU-accelerated WARP Monte Carlo Neutron Transport Code." Workshop sur l'utilisation des accélérateurs (GPUs, MICs) pour les simulations Monte-Carlo. École Polytechnique, Saclay, France. 10 July 2015.

R.N. Slaybaugh, S.C. Wilson. "Solving Shielding Challenges: Self-Shielding and Strong Anisotropies." Oak Ridge National Laboratory Summer Intern Series. Oak Ridge, TN. 11 Jun. 2015. (invited)

R.N. Slaybaugh. "Hybrid Methods for Shielding Challenges: Self-Shielding and Strong Anisotropies." Colorado School of Mines NE Program Graduate Colloquium. Golden, Colorado. 7 Jan. 2015. (invited)

R.N. Slaybaugh. "Computational Methods and Software Development in Nuclear Engineering Research." Tea at Berkeley Institute for Data Science. Berkeley, CA. 4 Dec. 2014. (invited)

R.N. Slaybaugh. "The PyNE Software Library: A Framework for ENSDF?" Nuclear Data Week Meeting. Brookhaven National Laboratory. 6 Nov. 2014.

R.N. Slaybaugh. "The Resonance Factor Method: Accelerating Monte Carlo in the Presence of Space and Energy Self-Shielding." Reactor Physics Methods and Analysis Group Seminar. Areva Headquarters, Paris, France. 27 June 2014.

R.N. Slaybaugh, T.M. Evans, P.P.H. Wilson, S.C. Wilson. "Radiation Transport: Computational Methods and Real-World Use." NC State Univ. NE Dept. Graduate Colloquium. Raleigh, NC. 8 Nov. 2012. (invited)

R. Slaybaugh, M. Arbidze, S. Lamichhane, D. O'Connor. "An Evaluation of European Union Energy Policies." UW–Madison Center for World Affairs and the Global Economy Seminar. Madison, WI. 11 May 2011.

R.N. Slaybaugh. "Krylov Methods and JFNK." UW—Madison Radiation Hydrodynamics Meeting. Madison, WI. 16 Dec. 2010. (invited)

R.N. Slaybaugh, T.M. Evans, G.G. Davidson. "Parallel Algorithms for Fixed-Source and Eigenvalue Problems." 2010 SIAM Annual Meeting. Pittsburgh, PA. 12-16 July 2010.

COMPUTER SKILLS

Languages	C++, Python, Fortran 90/95/2003
Versioning and Testing	git, svn, cvs, CTest, GoogleTest, nose
Tools	EC2, Doxygen, LaTeX, MathCAD, Mathematica, shell, vim, bash, Emacs, Jupyter, Trilinos, LAPACK, MPI, Valgrind
Nuclear Software	Exnihilo, ADVANTG, MCNP, Serpent, SCALE, PyNE

HONORS AND AWARDS

American Nuclear Society (ANS) Young Member Excellence Award	2014
ANS Presidential Citation	2014
Rickover Fellowship	2008-2011
Second Place, 2011 ANS Winter Meeting Poster Session	2011
Selected participant, Modeling Experimentation and Validation Reactor Physics School	Jul. 2011
Selected participant, Energy Hub conference Poster Session	2011
Everitt P. Blizard Memorial Scholarship, ANS	2010-2011
ANS Mathematics and Computation Division Best Summary + Presentation Award	Nov. 2010
Graduate Scholarship, ANS	2009-2010
Selected participant, Lindau Meeting of Nobel Laureates in Physics	2008
Second Place, 2007 ANS Winter Meeting Poster Session	Nov. 2007
Best Paper, Health Physics Track, 2007 ANS Student Conference	2007
Tau Beta Pi Honor Society	2006
Alpha Nu Sigma Honor Society	2005

PROFESSIONAL SERVICE

Nuclear Energy Advisory Committee, Appointed Member, 2016-2017

Special Government Employee, Advanced Research Projects Agency Energy, 2017-present

Senior Fellow of the Breakthrough Institute, 2017-present

Point of Contact between Nuclear Lawrence Berkeley National Laboratory and the Gateway for Accelerated Innovation at, 2017-present

American Nuclear Society, National Level

Math and Comp. Division	Chair Rotation 2016-2019; Exec. Comm. 2013-2016
Rad. Protection and Shielding Div.	Exec. Comm. 2015-2018
Young Members Group	Exec. Comm. 2014-2017
NEED Comm.	Chair 2013-2015, Vice Chair 2010-2013
Professional Divisions Comm.	Vice Chair 2012-2016
Student Sections Comm.	Chair 2010-2013, Vice Chair 2009-2010
Professional Women in ANS	Chair 2008-2010, Vice Chair 2006-2008
Board of Directors	Student Member 2007-2009
Other committee service	Membership, Bylaws and Rules, Public Info., 2013 Nominating Comm., 2014 Special Selection Comm. for Nominating Comm. Candidates

Software and Computing

Berkeley Institute for Data Science (http://bids.berkeley.edu/)	Senior Fellow; Advisory Board Member
The Hacker Within, UCB and UW (http://thehackerwithin.github.io/berkeley/)	Faculty Advisor 2014-present; Co-founder 2009
Berkeley Research Computing (http://research-it.berkeley.edu/programs/berkeley-research-computing)	User Advisory Group 2016-present
Python for Nuclear Engineering (http://pyne.io/)	Contributor
Software Carpentry (http://software-carpentry.org/)	Instructor since 2013
Data Carpentry (http://www.datacarpentry.org/)	Instructor since 2016

Berkeley Computing and Computer Science Education Committee	2014-present

Energy and Science

SIAM	Member 2009-present
UCB–ANS	Faculty Advisor 2014-present
Nuclear Engineering Student Delegation	Co-Vice Chair 2010, Selected participant 2009
UW–Energy Hub	Conference Speaker Chair 2009, Founding Member 2007, liaison to Collegiate Energy Association 2008-2010

SELECTED PUBLICATIONS

"Eigenvalue Solvers for Modeling Nuclear Reactors on Leadership Class Machines." *Nuclear Science and Engineering.* (Submitted 2017)

James E. Bevins, R.N. Slaybaugh. "Gnowee: A Metaheuristic Optimization Algorithm for Solving Engineering Problems Containing Continuous and Discrete Design Parameters." *IEEE Transactions on Evolutionary Computation.* (Submitted 2017)

Jeffery B. Greenblatt, Nicholas R. Brown, Rachel Slaybaugh, Theresa Wilks, Emma Stewart, and Sean T. McCoy. "The Future of Low-Carbon Electricity." *Annual Review of Environment and Resources.* **42** (Nov 2017).
`http://www.annualreviews.org/doi/10.1146/annurev-environ-102016-061138`

Ryan M. Bergmann, Kelly L. Rowland, Nikola Radnović, Rachel N. Slaybaugh, Jasmina L. Vujić. "Performance and Accuracy of Criticality Calculations Performed Using WARP, A Framework for Continuous Energy Monte Carlo Neutron Transport in General 3D Geometries on GPUs." *Annals of Nuclear Energy.* (accepted 2017)

Leah E. Morgan, Madicken Munk, Brett Davidheiser-Kroll, Nicholas H. Warner, Sanjeev Gupta, Rachel Slaybaugh, Patrick Harkness, Darren F. Mark. "Instrumentation development for planetary in situ $^{40}Ar/^{39}Ar$ geochronology," *Geostandards and Geoanalytical Research.* (Accepted 2017)

R. Vasques and K. Krycki and R. N. Slaybaugh. "Nonclassical Particle Transport in 1-D Random Periodic Media," *Nuclear Science and Engineering.* **185** (2017) 16-35.

S.C. Wilson and R.N. Slaybaugh. "Improved Monte Carlo Variance Reduction for Space and Energy Self-Shielding," *Nuclear Science and Engineering.* **179** (2015) 22-41.
`https://arxiv.org/abs/1502.04749`

R.N. Slaybaugh, T.M. Evans, G.G. Davidson, and P.P.H. Wilson. "Multigrid in energy preconditioner for Krylov solvers," *Journal of Computational Physics.* **242** (2013) 405-419.
`https://arxiv.org/abs/1612.00907`

G.G. Davidson, T.M. Evans, J.J. Jarrell, S.P. Hamilton, T.M. Pandy, and R.N. Slaybaugh, "Massively Parallel, Three-Dimensional Transport Solutions for the k-Eigenvalue Problem," *Nuclear Science and Engineering.* **177** (2014) 111-125.

T.M. Evans, A.S. Stafford, R.N. Slaybaugh, and K.T. Clarno. "Denovo–A new three-dimensional parallel discrete ordinates code in SCALE." *Nuc. Tech.* **171** (2010) 171-200.

R.N. Slaybaugh, P.P.H. Wilson, L.A. El-Guebaly, and E.P. Marriott. "Three-Dimensional Neutron Source Models for Toroidal Fusion Energy Systems." *Fusion Engineering and Design.* **84** (2009) 1774-1778.

Refereed Conference Proceedings

I. Makine, R. Vasques, and R.N. Slaybaugh. "Exact Transport Representations of the Classical and Nonclassical Simplified P_N Equations." 25th International Conference on Transport Theory, Monterey, CA, 16-20 October 2017.

R. Vasques and R. N. Slaybaugh. "Simplified P_N Equations For Nonclassical Transport With Isotropic Scattering." International Conference on Mathematics & Computational Methods Applied to Nuclear Science & Engineering, Jeju, South Korea, 2017. [invited]
`https://arxiv.org/abs/1610.04314`

Kelly L. Rowland, Ryan M. Bergmann, Rachel N. Slaybaugh, Jasmina L. Vujić. "Delta-tracking in the GPU-accelerated WARP Monte Carlo Neutron Transport Code." International Conference on Mathematics & Computational Methods Applied to Nuclear Science & Engineering, Jeju, South Korea, 2017. [invited]

Richard Vasques, Rachel Slaybaugh, Kai Krycki, "Nonclassical Particle Transport in the 1-D Diffusive Limit." Proceedings of the 2016 ANS June Meeting in New Orleans, LA, June 2016. Transactions vol. 114.
`https://arxiv.org/abs/1601.02495`

M. Munk, R.N. Slaybaugh, Tara M. Pandya, Seth R. Johnson, T. M. Evans, "FW/CADIS-Ω: An Angle-Informed Hybrid Method for Deep-Penetration Radiation Transport." Proceedings of the PHYSOR 2016 Meeting in Sun Valley, ID, May 2016.
`https://arxiv.org/abs/1612.00793`

J. Bevins, R. Slaybaugh, L. Bernstein, E. Henry, W. Dunlop, "Targeted Modification of Neutron Energy Spectra for National Security Applications." Proceedings of the 2016 Hardened Electronics And Radiation Technology Technical Interchange Meeting in Monterey, CA, April 2016.

J. Bevins, R. Slaybaugh, L. Bernstein, W. Dunlop, E. Henry, "Application of Metaheuristic Optimization Methods for Neutron Spectral Shaping Applications." Proceedings of the Conference on Data Analysis 2016 in Santa Fe, NM, March 2016.

K.L. Rowland, R.N. Slaybaugh, R.M. Bergmann, and J. Vujić, "Implementing delta-tracking in a GPU-accelerated Monte Carlo neutron transport," Proceedings of Frontiers in Computational Physics: Energy Sciences in Zurich, Switzerland, June 2015.

L. Bernstein, D. Brown, et al. "Nuclear Data Needs and Capabilities for Applications." White Paper. Lawrence Berkeley National Laboratory, May 27-29 2015.

R.N. Slaybaugh, T.M. Evans, G.G. Davidson, and P.P.H. Wilson, "Rayleigh Quotient Iteration with a Multigrid in Energy Preconditioner for Massively Parallel Neutron Transport," Proceedings of Joint International Conference on Mathematics and Computation, Supercomputing in Nuclear Applications, and the Monte Carlo Method in Nashville, TN, April 2015.
`https://arxiv.org/abs/1702.02111`

M. Munk, L. Morgan, R. Slaybaugh, B. Davidheiser-Kroll, K. van Bibber, and D. Mark, "Design and Feasibility Study of a Compact Neutron Source for Extraterrestrial Geochronology Applications," Proceedings of Joint International Conference on Mathematics and Computation, Supercomputing in Nuclear Applications, and the Monte Carlo Method in Nashville, TN, April 2015.

Elliott Biondo, Anthony Scopatz, Matthew Gidden, Rachel Slaybaugh, and Cameron Bates. "Quality Assurance within the PyNE Open Source Toolkit," Proceedings of the 2014 ANS Winter Meeting in Anaheim, CA, November 2014. Transactions vol. 111.

Cameron Bates, Elliott Biondo, Kathryn Huff, and et al. "PyNE Progress Report," Proceedings of the 2014 ANS Winter Meeting in Anaheim, CA, November 2014. Transactions vol. 111.

S.C. Wilson and R.N. Slaybaugh. "Monte Carlo Importances in the Presence of Space and Energy Self-Shielding," Proceedings of the 2013 ANS Winter Meeting in Washington, DC, Nov 2013. Transactions vol. 109.

R.N. Slaybaugh and S.C. Wilson. "Deterministic Parameter Study for Fixed-Source Calculations Using FW-CADIS," Proceedings of the 2013 ANS Annual Meeting in Atlanta, GA, June 2013. Transactions vol. 108.

R.N. Slaybaugh, T.M. Evans, G.G. Davidson, and P.P.H. Wilson. "Rayleigh Quotient Iteration in 3D, Deterministic Neutron Transport," Proceedings of the PHYSOR 2012 Meeting in Knoxville, TN, April 2012.

P.J. Snouffer, R.N. Slaybaugh, and P.P.H. Wilson. "Criticality Benchmark Comparisons for DAGMC," Proceedings of the 2011 ANS Annual Meeting in Hollywood, FL, June 2011. Transactions vol. 104.

G.G. Davidson, T.M. Evans, J.J. Jarrell, and R.N. Slaybaugh, "Massively Parallel, Three-Dimensional Transport Solutions for the k-Eigenvalue Problem," Proceedings of the International Conferences on Mathematics and Computational Methods Applied to Nuclear Science and Engineering in Rio de Janeiro, RJ, Brazil, May 2011.

G.G. Davidson, T.M. Evans, R.N. Slaybaugh, and C.G. Baker. "Massively Parallel Solutions to the k-Eigenvalue Problem," Proceedings of the 2010 ANS Winter Meeting in Las Vegas, NV, Nov 2010. Transactions vol. 103. [winner of Mathematics and Computation Division "Best Summary + Presentation" award]

T.M. Evans, G.G. Davidson, and R.N. Slaybaugh. "Three-Dimensional Full Core Power Calculations for Pressurized Water Reactors," Proceedings of the 2010 Scientific Discovery through Advanced Computing (SciDAC) Conference. Chattanooga, TN, 11-15 July, 2010. Oak Ridge National Laboratory.

R.N. Slaybaugh, "Scouting Programs for Educational Outreach," Proceedings of the 2009 ANS Winter Meeting in Washington, DC, Nov 2009. Transactions vol. 101.

R.N. Slaybaugh, E.P. Marriott, P.P.H. Wilson, and L. El-Guebal, "A Study of the Effects of Source Sampling Methods on ARIES-RS NWL Profiles," Proceedings of the ARIES-Pathways Project Meeting, 28-29 May 2008, Madison WI.

R.N. Slaybaugh, M.L. Williams, D. Ilas, D.E. Peplow, B.L. Kirk, T.L. Nichols, Y.Y. Azmy, and M.P. Langer, "Radiation Treatment Planning Using Discrete Ordinates Codes," Proceedings of the 2007 ANS Annual Meeting in Boston, MA, June 2007. Transactions vol. 96.

R. Slaybaugh. "Strengths and Weaknesses of Nuclear Engineering Education," presented at 2007 ANS Annual Meeting in Boston, MA, June 2007. Transactions vol. 96.

Other Works

James Bevins, Youdong Zhang, and Rachel Slaybaugh. "Coeus." Software. (released 2017) `https://github.com/SlaybaughLab/Coeus`

James Bevins, Youdong Zhang, and Rachel Slaybaugh. "Gnowee." Software. (released 2017) `https://github.com/SlaybaughLab/Gnowee`

Slaybaugh, Rachel. "Reproducible Computational Science on High Performance Computers." *The Practice of Reproducible Research, Case Studies and Lessons from the Data-Intensive Sciences*, edited by Justin Kitzes, Daniel Turek, and Fatma Deniz, UC Press, 2017.
`https://www.practicereproducibleresearch.org/case-studies/slaybaugh.html`

Ryan M. Bergmann, Kelly L. Rowland, Nikola Radnović, Rachel N. Slaybaugh, Jasmina L. Vujić. "WARP." Software (released 2017) `https://github.com/SlaybaughLab/warp`