

RACHEL N. SLAYBAUGH

slaybaugh@berkeley.edu ◊ (570) · 850 · 3385

Department of Nuclear Engineering ◊ University of California, Berkeley

4173 Etcheverry Hall MC 1730 ◊ Berkeley, CA 94720

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 <i>Assistant Professor of Nuclear Engineering</i> | Jan. 2014 - Present <i>Berkeley, CA</i> |
|--|--|

- 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 <i>Senior Engineer in the Shield Design and Development group</i> | Mar. 2012 - Aug. 2014 <i>West Mifflin, PA</i> |
|---|--|

- 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 <i>Research Assistant / Rickover Fellow</i> | Sept. 2006 - Nov. 2011 <i>Madison, WI</i> |
|---|--|

- 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) <i>Visiting Researcher</i> | May 2008 - Dec. 2008 <i>Karlsruhe, Germany</i> |
|--|---|

- 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*Reactor Operator*

Aug. 2003 - Apr. 2006

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*Assistant Professor of Nuclear Engineering*

Jan. 2014 - Present

Berkeley, CA

- NE 255, Numerical Simulations for Radiation Transport (graduate-level)
- Organized inaugural Nuclear Innovation Bootcamp, Summer 2016
- 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*Senior Engineer in the Shield Design and Development group*

Mar. 2012 - Aug. 2014

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*Adjunct Professor*

Fall 2012, Spring 2013

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. "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, T.M. Evans, and S.W. Mosher. “Improved Hybrid Modeling of Used Fuel Storage Facilities.” DOE-NE MPACT meeting. Oak Ridge, TN. 24-26 Mar. 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.N. Slaybaugh. “Acceleration Methods for Massively Parallel Deterministic Transport.” KAPL Employment Meeting. Niskayuna, NY. 30 Aug. 2011. (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.
- R.N. Slaybaugh. “MC21—Jaguar Coupling for Variance Reduction.” KAPL Physics Forum. Niskayuna, NY. July 2009.

COMPUTER SKILLS

| | |
|-------------------------------|--|
| Languages | C++, Python, Fortran 90/95/2003 |
| Versioning and Testing | git, svn, cvs, CTest, GoogleTest, nose |
| Tools | EC2, Doxygen, L ^A T _E X, 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. Blizzard 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-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 |
| 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 |
| 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 |

SELECTED PUBLICATIONS

- 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*. (submitted 2016)
- 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 $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology,” *Geostandards and Geoanalytical Research*. (submitted 2016)
- R. Vasques and K. Krycki and R. N. Slaybaugh. “Nonclassical Particle Transport in 1-D Random Periodic Media,” *Nuclear Science and Engineering*. (accepted 2016)
- 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.
- 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.
- 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

- R. Vasques and R.N. Slaybaugh. “Nonclassical SPN in Non-Markov 1-D Stochastic Mixtures.” To be submitted to the International Conference on Mathematics & Computational Methods Applied to Nuclear Science & Engineering, 2017. [invited]
- Kelly L. Rowland, Ryan M. Bergmann, Rachel N. Slaybaugh, Jasmina L. Vujić. “Delta-tracking in the GPU-accelerated WARP Monte Carlo Neutron Transport Code.” To be submitted to the International Conference on Mathematics & Computational Methods Applied to Nuclear Science & Engineering, 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.
- M. Munk, R.N. Slaybaugh, “An Angle-Informed Hybrid Method for CADIS and FW-CADIS.” Proceedings of the PHYSOR 2016 Meeting in Sun Valley, ID, May 2016.
- 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.
- 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. Snuffer, 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. Ila, 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.