

# Elliott D. Biondo, Ph.D.

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Citizenship: USA | Clearance: DOE Q

## Education

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### University of Wisconsin

Ph.D., Nuclear Engineering and Engineering Physics, GPA 3.87

M.S., Nuclear Engineering and Engineering Physics, GPA 3.83

Madison, WI

Aug. 2016

May 2013

### University of Minnesota

B.ChE., Chemical Engineering, GPA 3.49

B.S., Chemistry, GPA 3.49

Minneapolis, MN

May 2011

May 2011

## Experience

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### Oak Ridge National Laboratory

R&D Staff | HPC Methods for Nuclear Applications Group

- Implemented advanced computational geometry features in the Celeritas GPU-based Monte Carlo high-energy physics code, including multi-universe tracking and tree-based acceleration
- Implemented a finite element method for solving the pressure distribution through multi-land  $2\pi$  and segmented squeeze film dampers

Oak Ridge, TN

2022–present

R&D Associate Staff | HPC Methods for Nuclear Applications Group

- Procured funding and implemented mixed CAD/CSG “layered” geometries in the Shift Monte Carlo radiation transport
- Developed and prototyped a novel, rejection-free algorithm for free gas elastic scattering aimed at improved GPU performance
- Assessed the use of singular value decomposition (SVD) for in-memory compression of variance reduction parameters in Shift

2019–2022

Postdoctoral Research Associate | HPC Methods & Applications Team

- Implemented the Windowed Multipole on-the-fly Doppler broadening method on the CPU and GPU in Shift
- Implemented Cartesian mesh surface tallies in Shift
- Assessed the efficacy of a novel fission source convergence technique

2016–2019

### University of Wisconsin

Nuclear Regulatory Commission Grad. Fellow | Comp. Nuc. Eng. Research Group

- Ph.D. dissertation: “Hybrid Monte Carlo/Deterministic Neutron Transport for Shutdown Dose Rate Analysis”
- Methods development, computational implementation, and nuclear systems analysis with a focus on radiation transport, CAD geometry, and neutron activation

Madison, WI

2011–2016

### Oak Ridge National Laboratory

Graduate Student Intern | Radiation Transport Group

- Added CAD geometry support to the ADVANTG Monte Carlo variance reduction parameter generator code

Oak Ridge, TN

Summer 2014

### Polar Semiconductor Inc.

Process Engineering Intern | Manufacturing Group

- Collected/analyzed scanning electron microscope data to improve QA processes for silicon wafer production

Bloomington, MN

Summer 2010

**University of Minnesota***Undergraduate Research Assistant II | Dept. of Chemistry***Minneapolis, MN***2009–2010*

- Synthesized and characterized novel heterocyclic organic compounds with potential tuberculostatic activity

**Naval Surface Warfare Center, Carderock Division***Battery Research Intern | Power & Protective Systems Branch***Bethesda, MD***Summer 2005 & 2006*

- Conducted safety and performance tests of Li-ion batteries for unmanned underwater vehicle applications

**Skills**

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- Extensive experience developing scientific applications on a collaborative team
- Expert in C/C++ with CUDA and MPI, Python (including NumPy, Matplotlib), and MATLAB
- Graduate-level coursework in mathematics, including linear algebra, differential equations, complex analysis, and numerical methods

**Funded grants**

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**ORNL Laboratory Directed Research & Development Seed Proposal***Principal Investigator*

“Layered Geometry for Flexible Monte Carlo Radiation Transport”

**\$190K***2021-2023***Awards**

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**Best Paper and Presentation**, Mathematics and Computation Division, ANS Annual Meeting*Jun. 2024*

A. Bachmann, S. Johnson, S. Hart, E. Biondo, T. Evans

“Investigation of Doppler broadening methods within the Shift Monte Carlo radiation transport code”

**Finalist, Early Career Competition**, Oak Ridge National Laboratory*Dec. 2023*

“Accelerated Monte Carlo Radiation Transport for Fusion Reactor Applications”

**Finalist, Gordon Bell Prize**, Association for Computing Machinery*Nov. 2023*

E. Merzari, S. Hamilton, T. Evans, P. Romano, P. Fischer, M. Min, S. Kerkemeier, Y. H. Lan, J. Fang, M. Phillips, T. Rathnayake, E. Biondo, K. Royston, N. Chalmers, T. Warburton

“Exascale Multiphysics Nuclear Reactor Simulations for Advanced Designs”

**Graduate Fellowship**, Nuclear Regulatory Commission*2013–2016*

Full tuition and \$26,000/year stipend

**Best of RPSD 2014**, American Nuclear Society Annual Meeting*Jun. 2015*

E. Biondo, A. Davis, A. Scopatz, P. Wilson

“Rigorous Two-Step Activation for Fusion Systems with PyNE”

Special session at the ANS Annual 2015 meeting for top presenters at ANS RPSD 2014 meeting

**Student Paper Award**, American Nuclear Society Winter Meeting*Nov. 2013*

E. Biondo, E. Relson, A. Davis, P. Wilson

“Implementation, Benchmarking, and Application of R2S-ACT: an Open-Source, Mesh-Based, Rigorous 2-Step Activation Workflow”

\$100 award

**Chancellor’s Opportunity Award**, University of Wisconsin*Aug. 2011*

\$5,000 award for new graduate students

**National Gold Scholarship**, University of Minnesota*2007–2011*

In-state tuition for out-of-state residents

## Refereed journal articles

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1. T. Evans, K. Royston, S. Hamilton, G. Davidson, **E. Biondo**, S. Johnson, "Automated Hybrid Variance Reduction on Advanced Architectures in the Shift Monte Carlo Code," *Nuclear Science and Engineering*, submitted May, 2024.
2. **E. Biondo**, T. Evans, S. Johnson, S. Hamilton, "Comparison of Nested Geometry Treatments within GPU-Based Monte Carlo Neutron Transport Simulations of Fission Reactors," *International Journal of High Performance Computing Applications*, submitted March, 2024.
3. **E. Biondo**, G. Davidson, T. Evans, S. Hamilton, S. Johnson, T. Pandya, K. Royston, J. Salcedo-Pérez, "Status of GPU Capabilities within the Shift Monte Carlo Radiation Transport Code," *European Physical Journal N: Nuclear Sciences & Technologies*, submitted February, 2024. Presented at *SNA + MC 2024: Joint International Conference on Supercomputing in Nuclear Applications + Monte Carlo*, Paris, France, 2024.
4. J. W. Bae, B. Kos, **E. Biondo**, "Shutdown Dose Rate Analysis with the Shift Monte Carlo Radiation Transport Code and Modular Verification Workflow," *Fusion Engineering and Design*, Vol. 194, 2023.
5. **E. Biondo**, G. Davidson, B. Ade, "Layered CAD/CSG Geometries for Spatially Complex Radiation Transport Scenarios," *Annals of Nuclear Energy*, Vol. 181, 2023.
6. S. Hamilton, T. Evans, K. Royston, **E. Biondo**, "Domain decomposition in the GPU-accelerated Shift Monte Carlo code," *Annals of Nuclear Energy*, Vol. 166, 2022.
7. **E. Biondo**, T. Evans, G. Davidson, S. Hamilton, "Singular Value Decomposition of Adjoint Flux Distributions for Monte Carlo Variance Reduction," *Annals of Nuclear Energy*, Vol. 141, 2020.
8. **E. Biondo**, G. Davidson, T. Pandya, S. Hamilton, T. Evans, "Deterministically Estimated Fission Source Distributions for Monte Carlo  $k$ -Eigenvalue Problems," *Annals of Nuclear Energy*, Vol. 119, 2018.
9. **E. Biondo**, P. Wilson, "Transmutation Approximations for the Application of Hybrid Monte Carlo/Deterministic Neutron Transport to Shutdown Dose Rate Analysis," *Nuclear Science and Engineering*, Vol. 187, Issue 1, 2017.
10. **E. Biondo**, A. Davis, P. Wilson, "Shutdown Dose Rate Analysis with CAD Geometry, Cartesian/Tetrahedral Mesh, and Advanced Variance Reduction," *Fusion Engineering and Design*, Vol. 106, 2016.

## Refereed conference proceedings

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1. S. Johnson, J. Esseiva, **E. Biondo**, P. Canal, M. Demarteau, T. Evans, S. Y. Jun, G. Lima, A. Lund, P. Romano, and S. Tognini, "Celeritas: accelerating Geant4 with GPUs," *CHEP 2023: 26th International Conference on Computing in High Energy & Nuclear Physics*, Norfolk, VA, 2024.
2. E. Merzari, S. Hamilton, T. Evans, P. Romano, P. Fischer, M. Min, S. Kerkemeier, Y. H. Lan, J. Fang, M. Phillips, T. Rathnayake, **E. Biondo**, K. Royston, N. Chalmers, T. Warburton, "Exascale Multiphysics Nuclear Reactor Simulations for Advanced Designs," *SC 2023: International Conference for High Performance Computing, Networking, Storage, and Analysis*, Denver, CO, 2023.
3. **E. Biondo**, G. Davidson, B. Ade, "Layered CAD/CSG Geometry for Neutronics Modeling of Advanced Reactors," *PHYSOR 2022: International Conference on Physics of Reactors*, Pittsburgh, PA, 2022.
4. B. Ade, **E. Biondo**, D. Schappel, E. Fountain, B. Betzler, G. Davidson, "Preliminary Assessment of as-Built Design Characteristics for the Transformational Challenge Reactor," *PHYSOR 2022: International Conference on Physics of Reactors*, Pittsburgh, PA, 2022.
5. **E. Biondo**, V. Sobes, A. Holcomb, S. Hamilton, T. Evans, "Algorithm for Free Gas Elastic Scattering without Rejection Sampling," *M&C 2021: International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering*, Raleigh, NC, 2021.

6. B. Ade, G. Davidson, K. Bekar, **E. Biundo**, "Integration of Shift Monte Carlo Framework into SCALE for Criticality Safety, Depletion, and Few-Group Cross Section Generation," *PHYSOR 2018: Reactor Physics paving the way towards more efficient systems*, Cancún, Mexico, 2018.
7. **E. Biundo**, P. Wilson, "Application of the Multi-Step CADIS Method to Fusion Energy Systems Analysis," *M&C 2017: International Conference on Mathematics & Computational Methods Applied to Nuclear Science and Engineering*, Jeju, South Korea, 2017.
8. **E. Biundo**, A. Ibrahim, S. Mosher, R. Grove, "Accelerating Fusion Reactor Neutronics Modeling by Automatic Coupling of Hybrid Monte Carlo/Deterministic Transport on CAD Geometry," *M&C + SNA + MC 2015: Joint International Conference on Mathematics and Computation, Supercomputing in Nuclear Applications, and the Monte Carlo Method*, Nashville, TN, 2015.
9. E. Relson, P. Wilson, **E. Biundo**, "Improved Mesh Based Photon Sampling Techniques for Neutron Activation Analysis," *M&C 2013: International Conference of Mathematics and Computational Methods Applied to Nuclear Science and Engineering*, Sun Valley, ID, 2013.

### Contributed conference proceedings

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1. A. Bachmann, S. Johnson, S. Hart, **E. Biundo**, T. Evans, "Investigation of Doppler broadening methods within the Shift Monte Carlo radiation transport code," *ANS Annual Conference*, Las Vegas, NV, 2024.
2. **E. Biundo**, A. Davis, A. Scopatz, P. Wilson, "Rigorous Two-Step Activation for Fusion Systems with PyNE," *ANS Annual Meeting*, "Best of RPSD 2014" session, San Antonio, TX, 2015.
3. **E. Biundo**, A. Davis, A. Scopatz, P. Wilson, "Rigorous Two-Step Activation for Fusion Systems with PyNE," *Topical Meeting of the ANS Radiation Protection and Shielding Division (RPSD 2014)*, Knoxville, TN, 2014.
4. **E. Biundo**, A. Scopatz, M. Gidden, R. Slaybaugh, C. Bates, P. Wilson, "Quality Assurance within the PyNE Open Source Toolkit," *ANS Winter Meeting*, Anaheim, CA, 2014.
5. C. Bates, **E. Biundo**, K. Huff, K. Kiesling, A. Scopatz, "PyNE Progress Report," *ANS Winter Meeting*, Anaheim, CA, 2014.
6. **E. Biundo**, E. Relson, A. Davis, P. Wilson, "Implementation, Benchmarking, and Application of R2S-ACT: an Open-Source, Mesh-Based, Rigorous 2-Step Activation Workflow," *ANS Winter Meeting*, Washington, DC, 2013.
7. A. Scopatz, **E. Biundo**, C. Brachem, J. Xia, P. Wilson, "PyNE Progress Report," *ANS Winter Meeting*, Washington, DC, 2013.

### Presentations not accompanied by conference proceedings

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1. **E. Biundo**, S. Johnson, et al., "GPU-Based Monte Carlo Particle Transport Simulations for Nuclear Energy and High-Energy Physics Applications," *On the trail to Exascale and Scalable AI workshop*, Liverpool, United Kingdom, 2024.
2. **E. Biundo**, G. Davidson, T. Evans, S. Hamilton, S. Johnson, T. Pandya, K. Royston, José Salcedo-Peréz, "Advanced Computing Architectures for Production Nuclear Applications," Panelist presentation as part of the "Current Issues in Computational Methods—Roundtable" session, *American Nuclear Society Winter Meeting*, Washington, DC, 2019.
3. **E. Biundo**, "DAGMC Tools for Nuclear Engineering Analysis," *DAGMC Collaboration Meeting*, Institute of Plasma Physics Chinese Academy of Sciences (ASIPP), Hefei, China, 2016.

## Technical reports

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1. G. Davidson, K. Royston, S. Gorti, G. Alvarez, A. Bengston, **E. Biondo**, L. Bullerwell, J. Hays, M. Kasprzyk, P. Mutia, K. O'Connor, S. Simunovic, A. Snyder, C. Weber, R. Wilson, "ASINA Integrated Modeling FY24 End-of-Year Report," Sponsor Report ORNL/SPR-2024/3542, Oak Ridge National Laboratory, 2024.
2. **E. Biondo**, T. Evans, S. Hamilton, P. Romano, A. Siegel, J. Tramm, "CONNECT Neutronics Initial Report," Sponsor Report ORNL/SPR-2024/3660, Oak Ridge National Laboratory, 2024.
3. G. Davidson, K. Royston, G. Alvarez, **E. Biondo**, L. Bullerwell, S. Gorti, M. Kasprzyk, P. Mutia, K. O'Connor, S. Simunovic, C. Weber, R. Wilson, M. Wise, "ASINA Integrated Modeling FY24 Midyear Report," Sponsor Report ORNL/SPR-2024/3353, Oak Ridge National Laboratory, Oak Ridge, TN 2024.
4. A. Bachmann, S. Johnson, **E. Biondo**, S. Hart, T. Evans, "Comparison of Temperature-Dependent Cross Section Treatments Within the Shift Monte Carlo Radiation Transport Code," Technical Report ORNL/TM-2024/3273, Oak Ridge National Laboratory, Oak Ridge, TN, 2024.
5. S. Johnson, **E. Biondo**, J. Esseiva, S. Y. Jun, G. Lima, A. Lund, B. Morgan, S. Tognini, P. Canal, M. Demarteau, T. Evans, P. Romano, "Celeritas R&D Report: Accelerating Geant4," Technical Report ORNL/TM-2023/3022, Oak Ridge National Laboratory, Oak Ridge, TN, 2024.
6. **E. Biondo**, "Implementation of the Windowed Multipole Method in Shift," Technical Report ORNL/TM-2021/2056, Oak Ridge National Laboratory, Oak Ridge, TN, 2021.
7. D. Peplow, G. Davidson, C. Celik, **E. Biondo**, A. Hackett, W. Ray, D. Archer, J. Ghawaly, A. Nicholson, M. Willis, B. Quiter, M. Bandstra, R. Meyer, C. Chow, I. Stewart, J. Johnson, "Monte Carlo Simulation of Background and Source Measurements with CSG and CAD Geometries," Technical Report ORNL/TM-2021/2078, Oak Ridge National Laboratory, Oak Ridge, TN, 2021.
8. D. Archer, M. Bandstra, **E. Biondo**, C. Celik, G. Davidson, J. Ghawaly, A. Hackett, J. Johnson, A. Nicholson, D. Peplow, B. Quiter, W. Ray, M. Salathe, M. Swinney, M. Willis, "Modeling Urban Scenarios & Experiments (MUSE) Final Report," Technical Report ORNL/TM-2021/1888, Oak Ridge National Laboratory, Oak Ridge, TN, 2021.
9. S. Johnson, T. Evans, G. Davidson, S. Hamilton, T. Pandya, K. Royston, **E. Biondo**, "Omnibus User Manual," Technical Report ORNL/TM-2018/1073, Oak Ridge National Laboratory, Oak Ridge, TN, 2020.
10. G. Davidson, S. Bhatt, M. Swinney, **E. Biondo**, J. Salcedo Perez, K. Banerjee, A. Perry, E. Asano, E. Gonzalez, B. Kiedrowski, "Initial Coupled Simulations of a Critical Dual-Purpose Canister in a Saturated Repository," Technical Report ORNL/SPR-2020/1723, Oak Ridge National Laboratory, Oak Ridge, TN, 2020.
11. **E. Biondo**, G. Davidson, T. Evans, "Monte Carlo Fission Source Convergence Acceleration with Deterministically Estimated Fission Source Distributions," Technical Report ORNL/SR-2017/101, Oak Ridge National Laboratory, Oak Ridge, TN, 2017.
12. B. Ade, K. Bekar, G. Davidson, **E. Biondo**, "Integration of the Shift Monte Carlo Framework into SCALE/TRITON and Addition of Few-Group Cross Section Tallies to Shift," Technical Report ORNL/SPR-2017/523, Oak Ridge National Laboratory, Oak Ridge, TN, 2017.
13. A. Davis, M. Sawan, P. Wilson, **E. Biondo**, A. Ibrahim, P. Shriwise, E. Marriott, "Report on the ITER CLITE Shutdown Dose Rate Calculations," Technical Report, US ITER, Oak Ridge, TN, 2016.
14. **E. Biondo**, "Hybrid Monte Carlo Variance Reduction with CAD Geometry for Fusion Energy Systems," Technical Report RNSD-TN-14-002, Oak Ridge National Laboratory, Oak Ridge, TN, 2014.
15. **E. Biondo**, "Multiplier and Driver Mesh-Based Rigorous 2-Step Activation Analysis," Technical Report, Shine Medical Technologies, Monona, WI, 2013.
16. **E. Biondo**, W. Noland, "Steps Toward the Synthesis of Diels-Alder Adducts of Vinylidene Bis-Heterocycles with Potential Biological Activity," Technical Report, University of Minnesota Department of Chemistry, Minneapolis, MN, 2009.

17. **E. Biondo**, J. Banner, "The Effects of Overcharge on the Performance and Safety of Lithium Ion Pouch Batteries," Technical Report, Naval Surface Warfare Center, Carderock Division, Bethesda, MD, 2006.
18. **E. Biondo**, J. Banner, D. Fuentevilla, "Environmental Performance Testing of Mark 141 Batteries," Technical Report, Naval Surface Warfare Center, Carderock Division, Bethesda, MD, 2005.

## Teaching and mentorship experience

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<b>Mentor</b> , Appalachian STEM Academy Two-week summer program guiding 5 high school students through a nuclear engineering project. Oak Ridge, TN	Jul. 2024
<b>Mentor</b> , Appalachian STEM Academy Two-week summer program guiding 4 high school students through a nuclear engineering project. Oak Ridge, TN	Jul. 2023
<b>Presenter</b> , Exnihilo Workshop Four-hour workshop demonstrating the rad. trans. capabilities in the Exnihilo software suite <i>RPSD 2018: 20th Topical Meeting of the Radiation Protection &amp; Shielding Division of ANS</i> Santa Fe, NM	Sept. 2018
<b>Presenter</b> , Python for Nuclear Engineering (PyNE) Tutorial Session Four-hour workshop demonstrating the capabilities of the PyNE package <i>American Nuclear Society Student Conference</i> Madison, WI	Mar. 2016
<b>Presenter</b> , Python for Nuclear Engineering (PyNE) Tutorial Session Four-hour workshop demonstrating the capabilities of the PyNE package <i>M&amp;C 2015: International Conference of Mathematics and Computational Methods Applied to Nuclear Science and Engineering</i> Nashville, TN	Apr. 2015
<b>Presenter</b> , Python for Nuclear Engineering (PyNE) tutorial session Four-hour workshop demonstrating the capabilities of the PyNE package <i>RPSD 2014: 18th Topical Meeting of the Radiation Protection &amp; Shielding Division of ANS</i> Knoxville, TN	Sept. 2014

## Other professional experience

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<b>Session Chair</b> , G-7: Monte Carlo codes: current status and future trends <i>SNA + MC 2024: Joint International Conference on Supercomputing in Nuclear Applications + Monte Carlo</i> Paris, France	Oct. 2024
<b>Reviewer</b> , Technical Program Extended Committee <i>M&amp;C 2023: International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering</i> Niagara Falls, Canada	Aug. 2023

## Foreign Languages

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<b>Swahili</b> <i>ACTFL Oral Proficiency Interview (OPI)</i> Score: Advanced Low (4 <sup>th</sup> highest score out of 10)	Feb. 2022
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