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In R⁶

Sep 2025

CURRENT POSITION

	Eugene P. Wigner Distinguished Staff Fellow, Nuclear Energy and Fuel20Cycle Division, Oak Ridge National Laboratory (ORNL)20	022 – present
EDUC	ATION	
Ph. D.	Nuclear Engineering , Purdue University, West Lafayette Dissertation: A Novel Muon Spectrometer Using Multi-Layer Pressurized Gas Cherenkov Radiators for Muon Tomography Advisor: Prof. Stylianos Chatzidakis	2017-2022
M.S.	Nuclear Engineering, University of California, Berkeley Thesis: Offshore Co-generation of Electricity and Desalinated Water: Floating Fluoride-Salt-Cooled High-Temperature Reactors (FHR) Advisor: Prof. Per Peterson	2015-2017
B.S.	Nuclear and Quantum Engineering, Korea Advanced Institute of Science and Technology (KAIST), Republic of Korea Thesis: Optimization of Signal to Noise Ratio by Analyzing Gamma Spectrum from PIN diode Advisor: Prof. Mansung Yim	2013-2015
RESEA	ARCH PROJECTS	
	 A Momentum Integrated Muon Scattering Tomography (MMST) For Spent Nuclear Fuel Cask Imaging Role: Principal Investigator (PI) Project: ORNL's Laboratory Director Research Development (LDRD) Fellowship Sponsor: U.S. Department of Energy (DOE), Contract Number DE-AC05- 000R22725 (Project ID: 11321) Funding Amount: \$820,400 	Jan 2023 – Dec 2025
	Cosmic Radiation Noise Cancellation Algorithm Development in Radiation	Oct 2023 –

Portal Monitors (RPMs)

- Role: PI

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- Sponsor: U.S. DOE, Contract Number DE-AC05-00OR22725 (Project ID: 11397)
- Funding Amount: \$485,000

 High-Energy Radiation Effects on Superconducting Qubits Role: PI Project: ORNL's LDRD SEED Sponsor: U.S DOE and ORNL Funding Amount: \$240,000 	Apr 2025 – Mar 2026
 Cosmic Ray Muon Detection at The Underground Research Laboratory Role: Contributor Sponsor: DOE's Office of Nuclear Energy – Spent Fuel and Waste Disposition (DOE NE-81) 	Oct 2020 – Sep 2025
 Develop And Establish Experimental Capabilities of Flow Diagnostics Featuring Ultrasound Imaging Technology Role: Contributor Project: ORNL's LDRD SEED Sponsor: U.S DOE and ORNL Funding Amount: \$232,300 	Oct 2024 – Sep 2026
COMPLETED R&D PROJECTS	

 Vacuum Drying Experiment Design for Simulated Damaged Fuels Role: Contributor Sponsor: DOE's Office of Nuclear Energy – Spent Fuel and Waste Disposition (DOE NE-81) 	
 Momentum Integrated POCA Algorithm For Muon Scattering Tomography Outcomes: Successfully developed a MMST imaging algorithm, significantly enhancing muon scattering tomography imaging resolution. This innovation strengthens the capabilities for precise monitoring of SNF canisters and nuclear security applications. 	Aug 2021 – May 2022
 Effective Solid Angle Model for Cosmic Ray Muons Flux Estimation Outcomes: Developed an enhanced cosmic muon flux estimation model that integrates detector configurations with a cosine-squared mathematical framework. This advancement provides greater accuracy in flux predictions, optimizing detector performance for various applications. 	Aug 2020 – May 2022
Investigation of Thermohydraulic Limits of PUR-1 Reactor Using CFD: LEU Plate-Fueled, Pool Type, and Cooled by Natural Circulation	May 2019 – Aug 2020

- Outcome: Successfully determined the maximum operating power of the PUR-1 reactor under its current coolant environment (natural circulation) without inducing coolant boiling. Additionally, enhanced the reactor's cooling capacities, ensuring improved operational safety and efficiency.

CFD Analysis of Thermohydraulic Performances Within Spent	Nuclear	Aug 2017 –
Fuel (SNF) Dry Casks With Additives		Aug 2020

- Outcome: Developed a homogeneous additive model to simulate the thermohydraulic behavior of millions of small spherical metallic additives within SNF dry casks efficiently. This model enables improved analysis and optimization of heat dissipation and safety in SNF storage systems.

TEACHING EXPERIENCE

Teaching Assistant, School of Nuclear Engineering, Purdue University, West	2018 - 2020
 Nuclear Engineering Radiation Experiment I (NUCL 205) Delivered fundamental knowledge on nuclear radiation measurement and detection to over 40 sophomores in nuclear engineering, physics, and health physics. Focused on core concepts and practical applications to build a strong foundation for further studies in radiation science. 	Spring 2019 Spring 2020
Nuclear Engineering Radiation Experiment II (NUCL 305)	Fall 2019
 Taught advanced principles and practical techniques of nuclear radiation measurement and detection to over 30 senior nuclear engineering students. 	Spring 2020
- Emphasized laboratory-based learning and real-world applications to prepare students for professional roles in the nuclear industry.	
Advanced Nuclear Engineering Radiation Experiment (NUCL 504: Graduate level)	Spring 2018
- Offered advanced instruction on nuclear radiation measurement for graduate students through hands-on demonstrations utilizing the PUR-1 reactor, subcritical pile, and neutron detectors.	
- Designed experiential learning opportunities to bridge theoretical knowledge with experimental practices in nuclear engineering.	
MENTORSHIP EXPERIENCE	
Ph. D. Thesis Committee Member of:Luyu Bo, Department of Mechanical Engineering, Virginia Tech	2024 – present

- Reshma Ughade, School of Nuclear Engineering, Purdue University 2023 – present

Mentorship (DOE's SULI and GRO internship programs)

- Matthew Romano, Physics, Florida Institute of Technolo	bgy, FL Summer 2025
 Julia Niedermeier, Physics, Technical University of Mur Aaron Sucov, Nuclear Engineering, Rensselaer Polytech 	nic Institute,
 Ethan Wever, Nuclear Engineering, University of Tennes Collin Webb, Nuclear Engineering, University of Tennes Reshma Ughade, Nuclear Engineering, Purdue Universit 	ssee, Knoxville Summer 2024 ssee, Knoxville y
LEADERSHIP	
 Guest Editor-in-Chief of Journal of Applied Physics Special issue on Muography: Discoveries, Innovations, and Guest editors, Konstantin Borozdin (Decision Sciences), A (University of New Mexico), Haruo Miyadera (Toshiba E & Solutions Corporation), Christopher Morris (LANL), M (BGZ), and Hiroyuki Tanaka (University of Tokyo). 	2024 – 2025 nd Applications Adam Hecht Energy Systems Iaik Stuke
 Executive Committee Member American Nuclear Society (ANS) professional division – Waste Management Division (FCWMD) 	Expected 2025 Fuel Cycle and
 Session Organizer Technical session: UNF/SNF Monitoring, Storage and Transportation Advances INMM Student Conference 	2024 ANS Annual Conference 2019 INMM conference
Session Chair	
- Technical Session: Innovations for FCWMD Applications	2024 ANS Annual Conference
- Technical Session: Spent Fuel Transportation Needs and Alternative Fuel Options	2023 ANS Winter Meeting
- Technical Session: Radiation Detection and Imaging III	2023 ANS Student Conference
- Technical Session: Advanced Monitoring and Characterization I	2022 ANS Winter Meeting
Invited Presentations	
- Invited seminar at GEN IV International Forum	July 2022
- Invited talk at Hanbat University, South Korea	June 2022
- wigner Disunguisned Staff Fellow Technical Seminar - Technical Seminar at Canadian Nuclear Laboratory	May 2022 Jan 2022
- Invited talk at US-Korea Conference	Jan 2022
- Invited presentation at WMS Management Symposium	March 2020

COMMUNITY INVOLVEMENT	
 Invited Technical Talk for Hapeville Charter School Students Providing shared experiences and opportunities for underrepresented students aspiring to pursue careers in STEM fields. 	March 2024
 Invited Technical Reviewer for U.S. DOE-NE and DOE-SC Review proposals for the Nuclear Engineering University Program (NEUP) and Small Business Innovation Research (SBIR) initiatives. 	2024 – present
 Reviewer for Peer-Reviewed Journals Scientific Reports (Nature), Journal of Radiation Research and Applied Science (Elsevier), Journal of Atmospheric and Solar-Terrestrial Physics (Elsevier), Nuclear Science and Engineering (ANS), Nuclear Engineering and Technology (ScienceDirect), Advances (AIP), and Energies (MDPI). 	2020 – present
 Conference Proceedings ANS Annual, Winter, and Student Conferences 	2022 - present
MEMBERSHIPS IN PROFESSIONAL SOCIETIES	
 American Nuclear Society (ANS) Institute of Nuclear Materials Management (INMM) American Society of Mechanical Engineering (ASME) Institute of Electrical and Electronics Engineers (IEEE) Korean-American Scientists and Engineers Association (KSEA) 	
FELLOWSHIP AND SCHOLARSHIPS	
1. Eugene P. Wigner Distinguished Staff Fellowship Organization: Oak Ridge National Laboratory Award for: Recognition for outstanding contributions to cosmic ray muon	Oct 2022
 American Nuclear Society (ANS) Graduate Scholarship Organization: American Nuclear Society Award for: Recognition for contributions to waste management 	Aug 2022
 3. Korean American Science and Engineering Association (KSEA) Scholarship Organization: Korean American Science and Engineering Association Award for: Outstanding graduate students who excel in academics and have demonstrated a potential to become future leaders of the society. 	Apr 2021
 4. Purdue Outstanding Graduate Scholarship Organization: Purdue University 	Mar 2021

Award for: Recognition by the College of Engineering, Purdue University for outstanding

5.	American Nuclear Society (ANS) Outstanding Graduate Scholarship	Aug 2020
	Organization: American Nuclear Society	
	Award for: Recognition for contributions to waste management	
6.	Roy G. Post Foundation Scholarship	Mar 2020

6. Roy G. Post Foundation Scholarship Ma Organization: Roy G. Post Foundation Award for: Recognition for outstanding contributions to waste management

AWARDS AND HONORS

1.	Featured in the ANS Nuclear News inaugural '40 Under 40 list'	Dec 2024
2.	Grant Award from Group of Instrumentation and Measurement Science	Sep 2022
	(GIMS) in American Physical Society (APS)	
3.	American Nuclear Society Alpha Nu Sigma (AN Σ) honor society lifetime	Mar 2022
	member	
4.	Braslau Family Grant, American Physics Society, APS March meeting	Mar 2022
5.	Best Presentation Award, US-Korea Conference on Science and	Dec 2021
	Technology	
6.	Winner of "Pitch your PhD" competition in the 2021 ANS Winter meeting	Dec 2021
7.	Best Paper Award, 28th International Conference on Nuclear Engineering	Sep 2021
	(Sept 2021)	
8.	Purdue University College of Engineering Magoon Excellence in Teaching	Mar 2021
	Award	

9. Army Commendation Medal (ARCOM) awarded by U.S Army

10. Army Achievement Medals (AAM) awarded by U.S Army

PUBLICATIONS

Peer-reviewed Journal Articles

- J. Bae, A. Enders, C. Massey, J. Livesay, and C. Blessinger, "Radiation Portal Monitor Data File Format for Comprehensive Background Radiation Monitoring" *Nuclear Instruments and Methods in Physics Research*, A (2025) DOI: doi.org/10.1016/j.nima.2025.170516
- J. Bae, R. Montgomery, and S. Chatzidakis, "Image Reconstruction Algorithm for Momentum Dependent Muon Scattering Tomography" *Nuclear Engineering and Technology*, 56(5) (2024)
 DOI: doi.org/10.1016/j.net.2023.12.009
- [3] J. Bae, R. Montgomery, and S. Chatzidakis, "Enhanced Material Identification via Momentum Integrated Muon Scattering Tomography", *Nuclear Science and Technology Open Research*, 2(42) (2024) DOI: doi.org/10.12688/nuclscitechnolopenres.17545.1

- [4] J. Bae, R. Montgomery, and S. Chatzidakis, "Momentum informed muon scattering tomography for monitoring spent nuclear fuels in dry storage cask," *Nature Scientific Reports*, 14(1), 6717 (2024) DOI: doi: org/10.1028/a41508.024.57105.x
 - DOI: doi.org/10.1038/s41598-024-57105-y
- [5] J. Bae, R. Montgomery, and S. Chatzidakis, "Nuclear Material Accountancy Using Momentum-Informed Muon Scattering Tomography", Annals of Nuclear Energy, 197 (2024)

DOI: doi.org/10.1016/j.anucene.2023.110240

- [6] R. Ughade, J. Bae, and S. Chatzidakis, "Performance Evaluation of Cosmic Ray Muon Trajectory Estimation Algorithms", *AIP Advances*, 13 (2023) DOI: doi.org/10.1063/5.0174796
- J. Bae and S. Chatzidakis, "Development of Compact Muon Spectrometer Using Multi-Layer Gas Cherenkov Radiators" *Results in Physics*, 39 105771 (2022). DOI: doi.org/10.1016/j.rinp.2022.105771
- [8] [Dissertation] J. Bae, "A Novel Muon Spectrometer Using Multi-Layer Pressurized Gas Cherenkov Radiators for Muon Tomography", *Purdue University*. (2022). DOI: doi.org/10.25394/PGS.19686633.v1
- [9] J. Bae and R. Bean, "Investigation of Thermohydraulic Limits on Maximum Reactor Power in LEU Plate-Fueled, Pool-Type Research Reactor", *Nuclear Science and Engineering*, 196 (2022).

DOI: doi.org/10.1080/00295639.2022.2055700

[10] [Invited Article] J. Bae and S. Chatzidakis, "Momentum-Dependent Cosmic Ray Muon Computed Tomography Using a Fieldable Muon Spectrometer", *Energies*, 15(7), 2666 (2022).

DOI: doi.org/10.3390/en15072666

- [11] J. Bae and S. Chatzidakis, "A Fieldable Muon Spectrometer for Nuclear Security Applications", *Nature Scientific Reports*, 12, 2559 (2022). DOI: doi.org/10.1038/s41598-022-06510-2
- [12] J. Bae and S. Chatzidakis, "A New Semi-Empirical Model for Cosmic Ray Muon Flux Estimation", *Progress of Theoretical and Experimental Physics*, 2022(4) (2022). DOI: doi.org/10.1093/ptep/ptac016
- S. Chatzidakis and J. Bae, "Advances in Cosmic Ray Muon Computed Tomography and Fieldable Spectroscopy" *HNPS Advances in Nuclear Physics*, 28 pp. 184-190 (2022). DOI: doi.org/10.12681/hnps.3584
- [14] J. Bae, R. Bean and R. Abboud, "CFD Analysis of a Dry Storage Cask with Advanced Spent Nuclear Fuel Cask Additives", *Annals of Nuclear Energy*, 145 (2020) DOI: doi.org/10.1016/j.anucene.2020.107610

Book Chapter

 J. Bae, R. Ughade, S. Chatzidakis, (2024) "Gamma Ray and Cosmic Ray Muon Modalities for Cargo Inspection,", In: Emerging Radiation Detection, Springer. DOI: doi.org/10.1007/978-3-031-63897-8_12

Technical Reports and Memos

- [1] S. Tognini, J. Bae, "URL Muon Detector Project: Computational Framework Status Report," ORNL/SPR-2024/3435 (2024)
- J. Bae, and R. Montgomery, "GEANT4 Simulation and MATLAB Data Processing and Imaging Packages for Momentum-Dependent Muon Scattering Tomography", ORNL/TM-2023/3181 (2023)
- [3] J. Bae, and P. Cantonwine, "A Vacuum Drying Study of Simulated Failed Nuclear Fuel (FY23)", ORNL/SPR-2023/3081 (2023)
- [4] S. Tognini, J. Bae, H. Gadey, and K Deisenroth, "URL Muon Detector Project Simulation Status Report", ORNL/SPR-2023/2987 (2023)
- [5] J. Meszaros, S. Tognini, R. Montgomery, R. Howard, H. Gadey, J. Bae, and S. Chatzidakis, "Underground Research Laboratory Muon Detector Project Progress Report", M4SF 21OR010310051 (2021)

Conference Proceedings and Oral/Poster Presentations

- [1] J. Niedermeier, J. Bae, M. Stuke "Threshold Analysis of Modelling and Measurement Accuracies in Muon Scattering Tomography," Transactions of American Nuclear Society (2025).
- [2] J. Bae, A. Enders, C. Massey, J. Livesay, C. Blessinger, "A Comprehensive Data File Format for Radiation Portal Monitors," Transactions of American Nuclear Society 131, 852-855 (2024).

DOI: doi.org/10.13182/T131-45823

- [3] R. Ughade, J. Bae, S. Chatzidakis, "3D Analysis for Generalized Muon Trajectory Estimation Algorithm," Transactions of American Nuclear Society 131, 856-859 (2024).
- [4] E. Wever, C. Webb, J. Bae, R. Bean, S. Tognini, P. Cantonwine, A. Enders, "Metal Latticed Collimators for Radiation Portal Monitors," Transactions of American Nuclear Society 131, 848-851 (2024).
- [5] J. Bae, R. Bean, K. Mondal, S. Tognini, A. Enders, R. Montgomery, "Radiation Source Localization Algorithm in the Pedestrian Radiation Portal Monitor", Transactions of American Nuclear Society 130, 874-877 (2024).
- [6] S. Tognini, J. Bae, R. Bean, K. A. Enders, Mondal, R. Montgomery, "Simulation Framework for Cosmic Ray Muon Impact on Radiation Portal Monitor", Transactions of American Nuclear Society 130, 878-881 (2024).
- [7] J. Bae, R. Montgomery, S. Chatzidakis, "Nuclear Material Accountancy Using Momentum Integrated Muon Scattering Tomography", ANS Winter Meeting, Nov 12-15, 2023, Washington, DC.
- [8] R. Ughade, J. Bae, S. Chatzidakis, "Assessment of Performance for Algorithms Estimating Cosmic Ray Muon Trajectories", Transactions of American Nuclear Society 129, 369-372 (2023).
- [9] J. Bae, R. Montgomery, P, Shikhaliev, R. Bean, "Momentum-Informed Muon Scattering Tomography for Spent Nuclear Fuel Storage Monitoring", LDRD Poster Fair, Sep 27, 2023, ORNL.
- [10] J. Bae, R. Montgomery, S. Chatzidakis, "A New Momentum-Integrated Muon Tomography Imaging Algorithm", Transactions of American Nuclear Society 128, 122-125 (2023).

- [11] J. Bae and S. Chatzidakis, "Monitoring Spent Nuclear Fuel in a Dry Cask Using Momentum Integrated Muon Scattering Tomography," Transactions of American Nuclear Society 127, 828-832 (2022).
- [12] H. Gadey, R. Howard, S. Tognini, J. Meszaros, R. Montgomery, S. Chatzidakis, J. Bae, R. Clark, "Using Cosmic Ray Muons to Assess Geological Characteristics in the Subsurface" Transactions of American Nuclear Society 127, 802-806 (2022).
- [13] [INVITED] J. Bae, "A High-Resolution Muon Spectrometer Using Multi-Layer Gas Cherenkov Radiators", GEN IV International Forum, July 27, 2022, online.
- [14] J. Bae and S. Chatzidakis, "Muon Spectrometer-Tomography System for Monitoring Spent Nuclear Fuel Casks", Proceedings of Institute of Nuclear Materials Management (INMM) (2022).
- [15] J. Bae and S. Chatzidakis, "Non-Linear Cherenkov Muon Spectrometer Using Multi-Layer Pressurized C₃F₈ Gas Radiators", ANS Annual Meeting, Transactions of American Nuclear Society 126, 818-821 (2022).
- [16] Z. Dahm, A. Anwar, S. Chatzidakis, and J. Bae, "Next Generation Nuclear Engineering Education and Training Using Virtual Labs", Transactions of American Nuclear Society 126, 45-48 (2022).
- [17] A. Anwar, J. Bae, and S. Chatzidakis, "Modeling Helium-3 Neutron Detectors for Virtual Labs in Nuclear Engineering", ANS Student Conference (2022).
- [18] J. Bae and S. Chatzidakis, "A High-Resolution Muon Spectrometer Using Multi-Layer Gas Cherenkov Radiators", American Physical Society (APS) March Meeting, Mar 14-18, 2022, Chicago, IL.
- [19] J. Bae and S. Chatzidakis, "Applied Gas Cherenkov Radiators to Measure Cosmic Ray Muon Momentum", Proceedings of UKC (2021)
- [20] A. Anwar, Z. Dahm, J. Bae, M. Sharpe, G. Takahashi, and S. Chatzidakis, "Developing high fidelity, real-time nuclear-based Virtual Laboratories using physics-based modeling and authentic 3D machine interfaces", NESTet conference 2021 (virtual).
- [21] J. Bae and S. Chatzidakis, "Fieldable Muon Momentum Measurement using Coupled Pressurized Gaseous Cherenkov Detectors", Trans. Am. Nuc. Soc. 125, 400-403 (2021).
- [22] J. Bae and S. Chatzidakis, "A Cosmic Ray Muon Spectrometer Using Pressurized Gaseous Cherenkov Radiators", IEEE NSS-MIC Conf. Records (2021).
- [23] J. Bae and S. Chatzidakis, "The Effect of Cosmic Ray Muon Momentum Measurement for Monitoring Shielded Special Nuclear Materials", proceedings of INMM, (2021).
- [24] J. Bae and S. Chatzidakis, R. Bean, "Effective Solid Angle Model and Monte Carlo Method: Improved Estimations to Measure Cosmic Muon Intensity at Sea Level in All Zenith Angles", ICONE28 proceedings, 4 (2021).
- [25] [INVITED] J. Bae, R. Bean, and R. Abboud, "A Critical and CFD Analysis of a Dry Storage Cask with Advanced Spent Nuclear Fuel Cask Additives", Waste Management Symposium (WMS), Phoenix, AZ, (2020).
- [26] **J. Bae** and R. Bean, "Analytical Methods in Safeguards for Nuclear Nonproliferation and Complete, Verifiable, Irreversible Denuclearization (CVID) of North Korea", INMM proceedings (2019).
- [27] J. Bae, R. Bean, and R. Abboud, "A Criticality Analysis of a Dry Storage Cask with Advanced Nuclear Fuel Cask Additive", Trans. Am. Nuc. Soc. 118, 147-150 (2018).