Matthew Durbin, Ph.D. Candidate

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Education

2017 – 2022 **Ph.D. Nuclear Engineering, The Pennsylvania State University**.
Ken and Mary Alice Lindquist Department of Nuclear Engineering
Advisor: Professor Azaree Lintereur
Fellow: Nuclear Regulatory Commission Graduate Fellowship Program (2019-· · ·)

2013 – 2017 **B.S. Physics, The University of Texas at Austin**.
Department of Physics
Track: Radiation Physics

Work Experience

2017 – · · · · **Graduate Research Assistant, The Pennsylvania State University**
Ken and Mary Alice Lindquist Department of Nuclear Engineering

Spring 2019 **Graduate Teaching Assistant, The Pennsylvania State University**
Ken and Mary Alice Lindquist Department of Nuclear Engineering
Radiation Detection and Measurements Laboratory Course

Summer 2017 **Teaching Assistant, The University of Texas at Austin**
Walker Department of Mechanical Engineering
Health Physics Laboratory Course

Summer 2016 **Medical Physics Intern, The University of Texas Medical Branch**
Department of Radiation Oncology, Physics Division

2015 – 2017 **Undergraduate Research Assistant, The University of Texas at Austin**
Nuclear Engineering Teaching Laboratory

2014 – 2015 **Substitute Teacher, Austin Independent School District, Austin, Texas**
Secondary level STEM classes

Research

Ken and Mary Alice Lindquist Department of Nuclear Engineering

2018 – · · · · **Gamma-Ray Source Localization** - *Thesis Topic*
PI: Prof. Azaree Lintereur
○ Designed NaI based directional detection system of 4 and 8 detectors
○ Adapted off-the-shelf power supply for preamp/voltage divider
○ Implemented and optimized various machine learning algorithms to predict source location
○ Acquired large simulated and experimentally obtained datasets of system response to various source locations

Research (continued)

2019 – · · · ·

Pulse Shape Discrimination of Gamma Rays and Neutrons
PIs: Profs. Marek Flaska & Azaree Lintereur
○ Developed python code to process and clean raw waveforms sets from a variety of photosensor-organic scintillator combinations
○ Developed and optimized a novel machine learning regression based approach that gives a "modified" pulse shape parameter based on extracted waveform features, leading to better particle separation

2019 – · · · ·

Detection of Missing Radioactive materials
PI: Prof. Azaree Lintereur
○ Designed multiple simulated models of simple spent fuel assemblies of various rod number, pitch, and relative gamma ray emissions between rods
○ Acquired simulated datasets of gamma ray detector responses for various diversion scenarios
○ Trained multiple machine learning models to detect diversion and pinpoint array positions from which rods or sources are missing
○ Tested models on a simple experimentally acquired dataset with 99% accuracy

2017 – 2018

Radiation Damage in Gallium-Nitride (GaN)
PI: Prof. Azaree Lintereur
○ Simulated gamma ray interactions from various sources in GaN samples
○ Correlated interactions to atom displacements and device damage
○ Prepped samples and assisted in irradiations at the Pacific Northwest National Laboratory High Exposure Facility

Nuclear Engineering Teaching Laboratory

2015 – 2017

Gamma-Gamma Coincidence Detection
PI: Prof. Sheldon Landsberger
○ Performed experiments to determine the optimal coincidence timing window of LaBr3 and HPGe coincidence systems
○ Assisted in experiments characterising signal-to-noise performance of the two systems as a function of count-rate

2017

Rotational Neutron Localization
PI: Prof. Sheldon Landsberger
○ Characterized a B-10 based neutron detector
○ Quantified angular response of the detector to a neutron source with various shielding

Honors and Awards

Fellowships and Scholarships

2019 – · · · ·

Graduate Fellow *Nuclear Regulatory Commission Graduate Fellowship Program*

2015 – 2017

Scholarship *Nuclear Regulatory Commission Undergraduate Scholarship*

Awards

2020

J. D. Williams Student Paper Award *Best Student Poster*
Optimization of a K-Nearest Neighbors Regression Algorithm for Improved Pulse Shape Discrimination of Gamma Rays and Neutrons in Organic Scintillators

Honors and Awards (continued)

2019 **J. D. Williams Student Paper Award** *Division Finalist: Nuclear Security and Physical Protection*
Development of Machine Learning Algorithms for Directional Gamma Ray Detector

2019 **J. D. Williams Student Paper Award** *Education & Training Student Research Initiative Winner*
Future Technical and Policy Challenges in Nuclear Security and Physical Protection

Grants

2020 **IEEE NSS-MIC Trainee Grant**

2019 **Valentin T. Jordanov Radiation Instrumentation Travel Grant**

2019 **IEEE NSS-MIC Trainee Grant**

2019 **PSU Global Programs Graduate Student Travel Grant** (Two time recipient)

Honor Societies

2018 – · · · · **Alpha Nu Sigma** *Nuclear Engineering Honor Society*

2016 – · · · · **Sigma Pi Sigma** *Physics Honor Society*

Service and Involvement

Leadership Positions

2019 – · · · · **President** *Penn State Student Chapter - Institute of Nuclear Materials Management*

2017 – 2019 **Treasurer** *Penn State Student Chapter - Institute of Nuclear Materials Management*

2018 – 2019 **Secretary** *Penn State Student Chapter - Alpha Nu Sigma*

2015 – 2016 **Outreach Chair** *University of Texas Student Chapter - Society of Physics Students*

Conference Session Chair

2020 **Institute of Nuclear Materials Management Annual Meeting** Virtual
Detection - Nuclear Protection and Physical Security

2019 **IEEE Nuclear Science Symposium** Manchester, UK
Neutron Detectors and Gamma Imaging II

2019 **International Conference on the Applications of Nuclear Techniques** Crete, Greece
Poster Session

Memberships

2017 – · · · · **Institute of Nuclear Materials Management**

2019 – · · · · **IEEE Nuclear & Plasma Sciences Society**

2017 – 2019 **American Nuclear Society**

Service and Involvement (continued)

Miscellaneous

2018 – · · · ·
Ken and Mary Alice Lindquist Department of Nuclear Engineering
○ Attended and provided feedback for many faculty candidate seminars, including the recent department head search
○ Met with department head and student leadership to discuss various student affairs within the department, including providing input on the new "Nuclear Innovation Commons" space
○ Interfaced with the Penn State Nuclear Engineering Society (Alumni) to discuss student affairs and collaboration

2017
Texas Nuclear Engineering Student Delegation
○ Met with state level congress persons and their staff to promote nuclear energy and STEM education

2015 – · · · ·
Outreach
○ Guided students, Boy Scouts, and community members through tours, activities, and demonstrations for various outreach events at Penn State's Breazeale Reactor facility
○ Organized nuclear science and engineering demonstrations for Penn State's annual "Haunted U" outreach science event (2 years)
○ Guided students and community members through activities and demonstrations for various outreach events though the Nuclear Engineering program and Physics Department at the University of Texas

Skills

Coding — Python (NumPy, pandas, SciPy, matplotlib, SQLite, scikit-learn, TensorFlow), SQL, Matlab, MS Excel, LaTeX, MCNP (PTRAC, VisEd), Arduino

Technical — Gamma ray spectroscopy, data acquisition/analysis/visualization, machine learning, typesetting, teaching

Publications, Presentations, Proceedings

– Journal – Proceedings – Summary – Podium Presentation – Poster – Paper Award

R. Sheatsley, **M. Durbin**, A. Lintereur, P. McDaniel. *Improving Radioactive Material Localization by Leveraging Cyber-Security Model Optimizations*, IEEE Sensors, 2021. - *Accepted - Under Revisions*

M. Durbin, M. Wonders, M. Flaska, A. Lintereur. *K-Nearest Neighbors Regression for the Discrimination of Gamma Rays and Neutrons in Organic Scintillators*, Nucl. Inst. Meth. A., 987, 2021.

M. Durbin, C. Balbier, A. Lintereur. *Development of a Fully Connected Residual Neural Network for Directional Gamma Ray Detection*, Int. J. Mod. Phys: Conf. Ser. 50, 2020 - (Presented at the Int. Conf. App. Nucl. Tech., Creete, Greece, 2019)

M. Durbin, A. Lintereur. *Machine Learning Approaches to Determine Missing Material from Nuclear Fuel Assemblies*, Inst. of Nucl. Mat. Mang. Annual Meeting, Virtual, 2020.

M. Durbin, M. Wonders, M. Flaska, A. Lintereur. *Optimization of a K-Nearest Neighbors Regression Algorithm for Improved Pulse Shape Discrimination of Gamma Rays and Neutrons in Organic Scintillators*, Inst. of Nucl. Mat. Mang. Annual Meeting, Virtual, 2020.

M. Durbin, A. Lintereur. *Implementation of Machine Learning Algorithms for Detecting Missing Radioactive Material*, J. Radioanal Nucl. Chem., 324, 2020.

M. Durbin, M. Wonders, M. Flaska, A. Lintereur. *Application of a Novel Machine Learning Approach to SiPM-Based Neutron/Gamma Detection and Discrimination*, IEEE Nuclear Science Symposium, Manchester, UK, 2019.

M. Durbin, A. Lintereur. *Machine Learning Applications for the Detection of Missing Radioactive Sources*, IEEE Nuclear Science Symposium, Manchester, UK, 2019.

P-C. Simon, P. Bouhaddane, **M. Durbin**, *et. al. Who's Who? Energy Sources*, Research to Action: The Science of (Project) Drawdown, University Park, Pennsylvania, USA, 2019

M. Wonders, P-C. Simon, **M. Durbin**, *et. al. The Future of Nuclear Energy: Small Modular Reactors and Generation IV, A New Hope*, Research to Action: The Science of (Project) Drawdown, University Park, Pennsylvania, USA, 2019

M. Wonders, **M. Durbin**, *et. al. Nuclear Security & Physical Protection Challenges from 2020-2040: Security in the Virtual Realm*, Inst. of Nucl. Mat. Mang. Annual Meeting, Palm Desert, California, USA, 2019.

M. Durbin, *et. al. Development of Machine Learning Algorithms for Directional Gamma Ray Detection*, Inst. of Nucl. Mat. Mang. Annual Meeting, Palm Desert, California, USA, 2019.

M. Durbin, *et. al. Machine Learning Applications in Directional Gamma Ray Detection*, PSU Inst. Comp. Data Sci. Symp., University Park, Pennsylvania, USA, 2019

M. Durbin, *et. al. Comparative Gamma-Gamma Coincidence Perfomrance of LaBr3 and HPGe Detectors in High Count-Rate Scenarios*, American Nuclear Society Student Conference, Gainesville, Florida, USA, 2018

A. Drescher, M. Yoho, S. Landsberger, **M. Durbin**, *et. al. Gamma-gamma Coincidence Performance of LaBr3:Ce Scintillation Detectors vs HPGe Detectors in High Count-Rate Scenarios*, App. Rad. and Isot. 112, 2017.