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
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 our 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 displacements and dammage
○ 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

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

Honors and Awards (continued)

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

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**

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
○ Regularly in contact 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

Service and Involvement (continued)

2015 – · · · · **Outreach**

- Tour, activity, and demonstration guide for various community open house, high school, and Boy Scout 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)
- Activity and demonstration guide for various community open house and high school events though the Nuclear Engineering program and Physics Department at the University of Texas

Skills

General Coding	Python (NumPy, pandas, SciPy, matplotlib, SQLite, scikit-learn, TensorFlow), SQL, Matlab, MS Excel, LaTeX, Arduino
Radiation Transport	MCNP (PTRAC, VisEd)
Misc.	Gamma ray spectroscopy, data acquisition/analysis/visualization, machine learning, typesetting, teaching

Publications, Presentations, Proceedings

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

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

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.