

# 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)

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- 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 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 LaBr<sub>3</sub> 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

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### 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 through 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, L <sup>A</sup> T <sub>E</sub> X, 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., Crete, 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 Performance of LaBr<sub>3</sub> 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 LaBr<sub>3</sub>:Ce Scintillation Detectors vs HPGe Detectors in High Count-Rate Scenarios*, App. Rad. and Isot. 112, 2017.