

# Kenneth J. Dayman

## Curriculum Vitae

### Contact

Nuclear Security Modeling Group  
Reactor and Nuclear Systems Division  
Oak Ridge National Laboratory  
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### Education

*Ph.D., Mechanical Engineering, Nuclear Engineering*, August 2015  
University of Texas at Austin  
Austin, TX

Dissertation: *Determination of Independent and Cumulative Fission Product Yields with Gamma Spectrometry*  
Adviser: Prof. Steven Biegalski

*M.S.E., Mechanical Engineering, Nuclear Engineering*, May 2012  
University of Texas at Austin  
Austin, TX

Thesis: *Multivariate Analysis Applied to the Characterization of Spent Nuclear Fuel*  
Adviser: Prof. Sheldon Landsberger

*B.S., Mathematics*, May 2010  
University of Texas at Austin  
Austin, TX

### Research Experience

9/2011 - 2015

**University of Texas at Austin**  
*Nuclear Forensics Graduate Fellow*

- Developed Matlab tools for semi-automated analysis of complex fission product gamma spectra using optimization and decay-chain modeling
- Irradiated  $U_3O_8$  to produce fission products, collected gamma spectra, and determined empirical activity time series
- Developed a flexible numerical predictive model for the buildup and decay of fission products including neutron reaction coupling terms
- Determined independent and cumulative fission product yields using Bayesian inference and convex optimization
- Quantified uncertainties using a Monte Carlo procedure to estimate the posterior distributions for yields

8/2010 - 9/2011

**University of Texas at Austin**  
*Graduate Research Assistant*

- Researched applications of multivariate classifier and regression models for nuclear nonproliferation and forensics applications
- Developed classification algorithms to determine spent nuclear fuel reactor of origin using nuclide activities

- Developed and tested model-specific regression algorithms to predict burnup of PWR and BWR fuels

Summer 2010, 2011 **Pacific Northwest National Laboratory**

*National Security Intern*

- Completed intensive introductory course on nuclear nonproliferation & and safeguards
- Worked with radiochemistry team developing technology for near-real time process monitoring using nondestructive measurements and multivariate data analysis
- Work has been presented at the American Nuclear Society annual conferences and has been published in *Nuclear Instruments and Methods A*
- Developed into Master's thesis
- Supervised by Christopher Orton

1/2009 - 5/2010

**University of Texas at Austin**

*Undergraduate Research Assistant*

- Conducted research projects focusing on gamma spectroscopy, Compton suppression, and neutron activation analysis
- Studied the neutron flux variation in the UT TRIGA reactor and effects of sample self-shielding
- Results presented at the American Nuclear Society annual conference and published in the *Journal of Radioanalytical and Nuclear Chemistry*
- Supervised by Sheldon Landsberger

#### **Graduate Class Projects**

- **A Thermodynamic Analysis of the Temporal Cycling of the Oklo Reactors**  
A scoping study coupling *thermodynamic and neutronic analyses* was performed in order to study the feasibility of thermodynamically-driven evaporation and condensation of water driving cyclic operation of the natural reactors in Oklo, Gabon.
- **MCNPX Digital Workshop**  
Collaborated with seven students to develop an example-driven instructional course in radiation transport using MCNPX. The students *prepared and delivered lectures* and wrote a text for the course. Supervised by Erich Schneider.
- **Changeover to Traveling Wave Reactors: A Comparative Study of Future Nuclear Fuel Cycle Options**  
Collaborated with four students to model a changeover from the current US once-through LWR nuclear fuel cycle to a fuel cycle based on traveling wave reactors. The analysis included *material balances* for different realizations of fuel cycles using traveling wave reactors, as well as the *economic, safety, and nonproliferation impacts* of each option. The project was chosen as the best in the class by the professor, Erich Schneider, and the results were presented at the 2012 annual meeting of the American Nuclear Society.
- **Graph Cuts with k-Discovery: A Hierarchical Approach**  
Developed a hierarchical clustering algorithm based on a *spectral clustering* understanding of graph cuts. The results were submitted to the *International Conference on Machine Learning*.

- **Prospects for the Future Conversion of FRM-II to Low Enriched Uranium**

Worked on a team of graduate policy and nuclear engineering students to *study the current status and outlook* of global phase-out of non-weapons-use HEU. *Conducted interviews with domestic and international experts*, including international travel to Germany, to study the status of conversion of the FRM-II reactor from HEU to LEU fuel. The results were published as a book, *Nuclear Terrorism and Global Security: The challenge of phasing out highly enriched uranium*, in the Rutledge Series on Global Security Studies.

**External Reviewer**

- *Environmental Radioactivity*
- *Journal of Radioanalytical and Nuclear Chemistry*

**Teaching Experience**

Fall 2012

**University of Texas**

*Guest Lecturer*

- Gave lectures in a graduate-level reactor theory course
- Discussed analytic and numerical solutions to neutron diffusion problems and criticality-search problems

Summer 2010-2012

**University of Texas**

*Laboratory Teaching Assistant*

- Taught laboratory sections of a nuclear instrumentation course
- Gave lectures on Geiger counters, gamma spectroscopy, Compton suppression, and neutron activation analysis

**Honors**

April 2015

*ANS Isotopes & Radiation Division Research Development & Travel Award*

June 2013

*Innovations in Fuel Cycle Research*

Second Place in Open Competition: Materials Protection, Control, and Accountancy

Nov. 2011

*UT Office of Graduate Studies Professional Development Award*

2011–present

*DoD/DHS Nuclear Forensics Graduate Fellowship*

Awarded in 2011

2010

*Meyer Endowed Scholarship in Engineering*

Awarded in 2010

**Research Interests**

Bayesian statistics; inverse problem theory; numerical optimization applied to inverse problems and experimental design; data mining and machine learning for the analysis of large/complex datasets and extraction of obscured variables; modeling of radionuclides through time; analysis of uncertainty in complex data analysis scenarios; metrology; neutron activation analysis; gamma spectroscopy; coincidence and anti-coincidence spectroscopy; development of methods for rapid analysis of post-detonation fallout debris; nondestructive analysis as a rapid alternative to destructive analysis applications; measurement and evaluation of nuclear data such as half-lives, branching ratios, cross sections, gamma intensities, and fission yields.

## Technical Skills

### Experimental Abilities

Gamma spectroscopy, Compton suppression, gamma-gamma coincidence spectroscopy, neutron activation analysis, neutron beam activation, digital data collection and processing

### Computation

Matlab, Origen-ARP/S, Origen2.2, MCNPX, L<sup>A</sup>T<sub>E</sub>X, Python, NJOY99, Mathematica, Windows and Macintosh operating systems, document, spreadsheet, and presentation preparation software

## Professional Service

- 2011–2014            President  
American Nuclear Society UT Student Chapter
- Coordinated outreach activities
  - Developed new outreach and educational outlets
  - Responsible for annual status reports
- 2011                Laboratory Teaching Assistant  
University of Texas & Huston Tillotson University
- Assembled Geiger-Mueller counting systems at HTU
  - Trained faculty in using new instrumentation for instructing a course on radiation safety and instrumentation
- 2010                Treasurer  
American Nuclear Society UT Student Chapter
- Maintained budget
  - Aided in outreach and social events

## Memberships

- 2009–present      Student Member, American Nuclear Society
- 2010–2015        Member, American Nuclear Society UT Student Chapter

## Publications

### Refereed Journal Articles

1. **K. Dayman**, S. Biegalski, D. Haas, A. Prinke, and S. Stave. Evaluation of Independent and Cumulative Fission Product Yields with Gamma Spectrometry. *J Radioanal Nucl Ch*, 2015.
2. **K. Dayman** and S. Biegalski. Automatic Identification and Quantification of Radionuclides in Gamma Spectra using Numerical Optimization. *J Radioanal Nucl Ch*, 2015.
3. R. I. Palomares, **K. Dayman**, S. Landsberger, S. Biegalski, C. Z. Soderquist, A. J. Casella, M. C. Brady Raap, and J. M. Schwantes. Measuring the Noble Metal and Iodine Composition of Extracted Noble Metal Phase from Spent Nuclear Fuel Using Instrumental Neutron Activation Analysis. *Appl Radiat Isotopes*, 98:66–70, 2015.
4. **K. Dayman**, S. Biegalski, and D. Haas. Measurement of Short-Lived Fission Product Yields with Gamma Spectrometry. *J Radioanal Nucl Ch*, DOI 10.1007/s10967-015-3993-9, 2015.
5. **K. Dayman**, J. B. Coble, C. R. Orton, and J. M. Schwantes. Characterization of Used Nuclear Fuel with Multivariate Analysis for Process Monitoring. *Nucl Instr and Meth, A* 735:624–632, 2013.

6. **K. Dayman** and S. Biegalski. Feasibility of Fuel Cycle Characterization using Multiple Nuclide Signatures. *J Radioanal Nucl Ch*, 296:195–201, 2013.
7. S. Landsberger and **K. Dayman**. Monitoring of Neutron Flux Changes in Short-Lived Neutron Activation Analysis. *J Radioanal Nucl Ch*, 296:329–332, 2013.
8. S. Landsberger, G. George, R. Lara, D. Tamalis, J. Louis-Jean, and **K. Dayman**. Analysis of Naturally Occurring Radioactive Material Using Neutron Activation Analysis and Passive Compton Suppression Gamma-Ray Spectrometry. *Nukleonika*, 57(4):461–465, 2012.

#### Book Chapters

1. **K. Dayman**. *Nuclear Terrorism and Global Security: The Challenge of Phasing Out Highly Enriched Uranium*, chapter Germany: The FRM-II Reactor, pages 121–135. Routledge Series on Global Security Studies. Routledge, April 2013.

#### Technical Reports

1. J. B. Coble, C. R. Orton, D. V. Jordan, J. M. Schwantes, S. E. Bender, **K. Dayman**, K. Unlu, and S. Landsberger. The Multi-Isotope Process (MIP) Monitor Project: FY12 Progress and Accomplishments. Technical Report PNNL-21819, Pacific Northwest National Laboratory, Richland, Washington 99352, September 2012.
2. C. R. Orton, C. G. Fraga, J. W. Hayes, J. M. Schwantes, S. E. Bender, K. Unlu, **K. Dayman**, S. S. Schreiber, and S. Landsberger. The Multi-Isotope Process Monitor Project: FY11 Progress and Accomplishments. Technical Report PNNL-20707, Pacific Northwest National Laboratory, Richland, Washington 99352, August 2011.

#### Conference Presentations

1. **K. Dayman**, S. Biegalski, and D. Haas. Determination of Short-Lived Fission Product Yields with Gamma Spectrometry. Presented at the 8<sup>th</sup> International Conference on Isotopes, August 2014.
2. **K. Dayman**, T. Tipping, and S. Biegalski. A Field Survey Laboratory for a Course in Nuclear Instrumentation. In *Transactions of the American Nuclear Society*, volume 109, pages 243–244, Washington, D.C., November 2013 (*refereed proceedings*).
3. **K. Dayman**. Measurement of Short-Lived Fission Product Yields. Presented at the NNFEDP Academic-National Laboratory Collaboration Meeting, July 2013.
4. S. Landsberger, S. G. Landsberger, G. Graham, G. Kuzmin, D. Millsap, **K. Dayman**, C. Lu, D. Tamalis, J. Louis-Jean, G. Dort, and T. Dudley. Naturally Occurring Radioactive Material (NORM) Wastes from Oil Exploration. Presented at the 7<sup>th</sup> Symposium of Naturally Occurring Radioactive Material, April 2013.
5. **K. Dayman**, C. Orton, J. Coble, and J. Schwantes. Characterization of Spent Nuclear Fuel using Multivariate Analysis. In *Transactions of the American Nuclear Society*, volume 107, pages 354–356, San Diego, CA, Nov. 2012 (*refereed proceedings*).
6. J. Graham, **K. Dayman**, U. Phathanapirom, B. Epping, and K. McConnell. A Comparative Study of CANDLE Reactor Based U.S. Nuclear Fuel Cycles. In *Transactions of the American Nuclear Society*, volume 106, pages 224–225, Chicago, IL, June 2012 (*refereed proceedings*).
7. **K. Dayman** and S. Landsberger. Characterization of Spent Nuclear Fuel using Multivariate Signatures. Presented at the American Nuclear Society Student Conference, April 2012.
8. **K. Dayman**, C. Orton, and S. Landsberger. Applications of Statistical Learning Techniques to Gamma Spectra: Process Monitoring and the Characterization of Spent Nuclear Fuel. Presented at the Southwest Regional Meeting of the American Chemistry Society, Nov. 2011.

9. S. Landsberger, **K. Dayman**, C. Orton, and J. Schwantes. Automated Measurement of Burnup Credit Using PLS. In *Transactions of the American Nuclear Society*, volume 104, pages 217–218, Hollywood, FL, July 2011 (*refereed proceedings*).
10. **K. Dayman**. Multivariate Analysis Applied to the Characterization of Spent Nuclear Fuel. Presented at the NNFEDP Academic-National Laboratory Collaboration Meeting, July 2012.
11. **K. Dayman**, S. Landsberger, and C. Orton. Automated Measurement of Burnup Credit Using PLS. Presented at the American Nuclear Society Student Conference, April 2011.
12. C. Orton, C. Fraga, J. Hayes, S. Bender, K. Unlu, **K. Dayman**, S. Landsberger, R. Christensen, and J. Schwantes. The Multi-Isotope Process Monitor: FY 11 Accomplishments. Presented at the FCR&D MPACT Working Group Meeting, 2011.
13. C. Orton, C. Fraga, S. Bender, **K. Dayman**, R. Christensen, and J. Schwantes. The Multi-Isotope Process Monitor: Nondestructive, Near-Real-Time Nuclear Safeguards Monitoring for Processing Plants. Presented at the FCR&D MPACT Working Group Meeting, 2010.
14. S. Landsberger, **K. Dayman**, and V. Patel. A Demonstration of Self-Shielding for the Analysis of Gold with Neutron Activation Analysis. In *Transactions of the American Nuclear Society*, volume 102, pages 201–202, San Diego, CA, June 2010 (*refereed proceedings*).

November 10, 2015