STATE OF OHIO

Executive Department

OFFICE OF THE GOVERNOR

Columbus

I, Mike DeWine, Governor of the State of Ohio, do hereby appoint Lei Raymond Cao, from Upper Arlington, Franklin County, Ohio, as a Member of the Ohio Nuclear Development Authority for a term beginning August 2, 2024 and ending at the close of business August 1, 2029.

IN WITNESS WHEREOF, I have hereunto subscribed my name and caused the Great Seal of the State of Ohio to be affixed, at Columbus, this 2nd day of August in the year of our Lord, Two Thousand and Twenty Four.

Mike DeWine
Governor

Lei Raymond Cao, Ph.D. (U.S. Citizen)
Professor, Nuclear Engineering
Department of Mechanical and Aerospace Engineering
Director, OSU Nuclear Reactor Laboratory
College of Engineering
The Ohio State University
201 W 9th Avenue
Columbus, OH 43210
Office phone: 614-247-8701
Email: cao.152@osu.edu

Education: Ph.D. **Mechanical Engineering (Nuclear and Radiation Engineering Program),** University of Texas at Austin, 2007
Thesis: Development of a High-Resolution Neutron Radiography System and Evaluation Method

MS. **Nuclear Physics**, China Institute of Atomic Energy, 2002
Thesis: Neutron Activation Analysis of Air Particulate Matter and Source Analysis

BS. **Nuclear Physics**, Lanzhou University, 1994

CURRENT AND PREVIOUS ACADEMIC POSITIONS:

Director, OSU Nuclear Reactor Laboratory (OSU-NRL) **2016 - Present**

- Director of laboratory that includes a 500-kW pool-type research reactor, managing staff, operation, regulatory compliance, and budgeting of the OSU-NRL
- Strategic planning for the OSU-NRL as a research center within College of Engineering
- Technical POC of U.S. Nuclear Science User Facilities
- Expanding the utilization of OSU-NRL in research, education & training, and service

Program Chair, Nuclear Engineering (NE) Program **2019 - 2023**

- Strategic planning and day-to-day operation of the NE graduate and undergraduate minor programs
- Outreach, alumni relationship, government relationship, graduate study policy and implementation, course planning, seminar, industrial connections

Full Professor **2018 - Present**
Associate Professor **2015 - 2018**
Assistant Professor **2009 - 2015**
The Ohio State University
Columbus, OH 43210

- Nuclear non-proliferation
- Wide band-gap semiconductor sensors (e.g., SiC, GaN, Ga_2O_3) for nuclear fuel cycle and advanced reactors
- Perovskite X-ray/gamma-ray detector and medical applications
- Sensor and instrumentation for advanced reactor applications
- Nuclear Voltaic Batteries
- Neutron Radiography and Tomography
- Neutron Depth Profiling (NDP) technologies for materials characterization
- Prompt Gamma Neutron Activation Analysis (PGNAA)
- Teach undergraduate and graduate level nuclear engineering courses

Postdoctoral Research Associate **2007 - 2009**
National Institute of Standards and Technology, Center for
Neutron Research, Gaithersburg, Maryland

- Work on neutron prompt gamma activation analysis beam line
- Work on neutron depth profiling facility
- Determine hydrogen concentrations in hydrogen storage materials
- Determine boron concentration distribution in straw-type neutron detectors
- Determine O-18 concentration in metal oxidation
- Determine helium distribution in fusion first-wall
- Develop neutron imaging apparatus
- Calibrate neutron microscopy capability using a neutron lens

Postdoctoral Research Associate **2007 - 2007**
Positron Emission Tomography (PET) Laboratory
Harvard Medical School, Boston, MA

- Micro-PET, 3D imaging reconstruction, and data analysis
- In-vitro animal imaging using F-18, C-11 positron emitters

Graduate Research Associate **2004 - 2007**
Department of Mechanical Engineering University
of Texas at Austin, Austin, TX

- High-resolution neutron imaging and the performance evaluation

Associate Professor **2003 - 2004**
Department of Nuclear Science and Technology
South China University

Visiting Scholar **2002 – 2002**
Nuclear and Radiation Engineering Program
University of Texas at Austin, Austin, TX

Graduate Research Associate **1999 - 2002**
Neutron Activation Analysis Group
China Institute of Atomic Energy

- Neutron activation analysis and source model development for air pollution

Lecturer, Assistant Professor **1994 - 1999**
Department of Nuclear Science and Technology
South China University

INDUSTRY CONSULTING:

Chief Technology Advisor, Awareability Technologies LLC **2017 - present**

HONORS:

- Outstanding Master's Thesis Award, CIAE, 2002
- International Atomic Energy Agency (IAEA) Fellowship, 2002
- German Academic Exchange Service Fellowship, 2003
- Young Investigator Award, U.S. Defense Threat Reduction Agency, 2011
- OSU College of Engineering's Lumley Interdisciplinary Research Award, 2012
- OSU College of Engineering's Lumley Research Award, 2013
- OSU College of Engineering's Lumley Research Award, 2015
- ANS Graduate Student Design Competition Finalist (Advisor), 2015

- Distinguished Faculty Award, Mechanical and Aerospace Engineering, 2022
- Best paper in 2021, IEEE Transactions on Nuclear Science, 2023
- Radiation Science and Technology Award, American Nuclear Society, 2023

FOCUSED RESEARCH:

- WBG Semiconductor Radiation Sensor
- Nuclear Instrumentation
- Radiation Effects and Survivability
- Nuclear Voltaic Battery
- Reactor and In-pile Instrumentation
- Neutron Analytical Techniques (Neutron Depth Profiling, Prompt Gamma Neutron Activation Analysis)
- Neutron Radiography and Tomography

COURSE TAUGHT:

- NE5742: Nuclear Radiation and Their Measurement (graduate level)
- NE4506: Undergraduate Nuclear Engineering Lab (Undergraduate level)
- NE6725: Nuclear Reactor Lab (graduate level)
- NE6708: Reactor Physics (graduate level)
- NE4505: Introduction to Nuclear Science and Engineering (Undergraduate level)
- NE6766: Nuclear Engineering Design (graduate level)
- NE880.08: Advanced Nuclear Instrumentation and Control (graduate level)
- NE6881: Nuclear Engineering Graduate Student seminar
- NE8194: Advanced Topics in Semiconductor Radiation Sensor (graduate level)

MEMBERSHIP:

- American Nuclear Society, 2004 – present
- IEEE Nuclear Science and Plasma Society, senior member, 2009 – present
- The Honor Society of Phi Kappa Phi
- American Association for the Advancement of Science (AAAS), 2014 - present
- SPIE, 2016 – present

EDITORIAL:

Associate Editor, IEEE Transactions on Nuclear Science (2013 – present)

Senior Editor, IEEE Transactions on Nuclear Science (2023 – present)

Editorial Advisory Board, Journal of Nuclear Science and Engineering (2020 – present)

PROFESSIONAL SOCIETY AND MAJOR EXTERNAL COMMITTEES:

Session Chair, NIST, Neutron for The Future, Nuclear Method and Radiochemistry,

Rockville Maryland Oct. 2023

Session Chair, DOE Workshop on Radiographic Imaging and Applications (WORIA),

Neutron Sources, Oak Ridge National Lab Feb. 2023

DOE workshop on Technologies to Reactors: Enabling Accelerated Deployment of Nuclear Energy Systems, July 24-27, 2018

DOE workshop on Fission Battery Initiative: Safeguards and Security of Fission Batteries, April 2nd ,2021

Executive Committee, American Nuclear Society (ANS), Bylaws and Rules

2011-2014

American Nuclear Society, Isotopes and Radiation Division (IRD)
- Executive Committee 2011- present
- Treasurer 2011 - 2014
- Vice Chair/Chair Elect 2014 - 2015
- Chair 2015 - 2016

9th Methods and Applications of Radioanalytical Chemistry Conference
- Assistant Program Chair 2011 - 2013
- Technical Program Committee 2011 - 2013

10th Methods and Applications of Radioanalytical Chemistry Conference
- Assistant Program Chair 2013 - 2015
- Technical Program Committee 2013 - 2015

11th Methods and Applications of Radioanalytical Chemistry Conference
- Assistant Program Chair 2015 - 2018
- Technical Program Committee 2015 - 2018

12th Methods and Applications of Radioanalytical Chemistry Conference
- Assistant Program Chair 2018 - 2022
- Technical Program Committee 2018 - 2022

13th Methods and Applications of Radioanalytical Chemistry Conference
- Assistant Program Chair 2022 - 2025
- Technical Program Committee 2022 - 2025

8th International Conference & Expo on Isotopes
- Technical Program Committee 2012 – 2014

9th International Conference & Expo on Isotopes
- Technical Program Committee 2014 – 2018

10th International Conference & Expo on Isotopes
- Technical Program Committee 2018 – 2020

COORDINATOR:

National Nuclear Forensics Expertise Development Program Nuclear Forensics Graduate Fellowship Program (NFP) 2013 - present

JOURNAL PUBLICATIONS:

From Google Scholar	
Sum of the Times Cited:	10299
h-index:	26
i10-index:	64

1. Panaccione, Wyatt, Zhifang Shi, Praneeth Kandlakunta, Taylor Nichols, Susan White, Jinsong Huang, and Lei R. Cao. "Testing of an organic metal halide perovskite for fast neutron detection." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 1064 (2024): 169340.

2. Van Zile, Matthew, Kevin Herminghuysen, Andrew Kauffman, Susan White, Praneeth Kandlakunta, Shelly Li, Michael Simpson, and Lei R. Cao. "Gamma-ray spectra of post-irradiated uranium salt for total mass accounting with sodium-22 tracer." ***Progress in Nuclear Energy*** 168 (2024): 104992.

3. Kandlakunta, Praneeth, Matthew Van Zile, Susan White, and Lei Raymond Cao. "Response of silicon solar cells to neutrons in post-detonation monitoring." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** (2024): 169217.

4. Pakari, Oskari V., Andrew Lucas, Flynn B. Darby, Vincent P. Lamirand, Tessa Maurer, Matthew G. Bisbee, Lei R. Cao, Andreas Pautz, and Sara A. Pozzi. "Gamma-ray Spectroscopy in Low-Power Nuclear Research Reactors." ***Journal of Nuclear Engineering*** 5, no. 1 (2024): 26-43.

5. Bisbee, Matthew, Ibrahim Oksuz, Nerine Quinnan Hetrick, and Andrew Townsend Cherepy. "Improved image stitching method for neutron imaging of large object with small beam size." ***In Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XXV,*** vol. 12696, pp. 1269607-1. 2023.

6. David, Matthew Bisbee, Andrew Maier, Praneeth Kandlakunta, Christopher J. Brooks, R. Gregory Downing, and Lei R. Cao. "A demonstration study of lithium-ion battery by neutron depth profiling with a low flux neutron source." ***In Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XXV,*** vol. 12696, pp. 116-129. SPIE, 2023.Wood,

7. Smidts, Carol, Gustavo Reyes, Cassiano Endres de Oliveira, and Lei Raymond Cao. "The research challenges in security and safeguards for nuclear fission batteries." ***Progress in Nuclear Energy*** 159 (2023): 104627.

8. Tsai, Hsinhan, Lei Pan, Xinxin Li, Jinkyoung Yoo, Sergei Tretiak, Xuedan Ma, Lei R. Cao, and Wanyi Nie. "Quantum Efficiency Gain in 2D Perovskite Photo and X-Ray Detectors." ***Advanced Optical Materials*** (2023): 2300847. **https://doi.org/10.1002/adom.202300847**

9. Davis, Heath, Cordell Delzer, Xianfei Wen, Lei R. Cao, Jason Hayward, and Eric Lukosi. "Systematic evaluation of fast neutron sensing with Cesium Hafnium Chloride." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 1052 (2023): 168247.

10. Hoffman, M.K., Spitz, H.B., Bissmeyer, P.H. Hlinka V., Cao, Lei R. Molecular plating of Am-241 on a Schottky metal contact. ***J Radioanal Nucl Chem*** (2022). https://doi.org/10.1007/s10967-022-08504-w

11. Bisbee, M. G., I. Oksuz, M. P. VanZile, N. J. Cherepy, and L. R. Cao. "An automated fast neutron computed tomography instrument with on-line focusing for non-destructive evaluation." ***Review of Scientific Instruments*** 93, no. 11 (2022): 113702.

12. Kandlakunta, Praneeth, Matthew Van Zile, and Lei Raymond Cao. "Silicon Solar Cells for Post-Detonation Monitoring and Gamma-Radiation Effects." ***Nuclear Science and Engineering*** 196, no. 11 (2022): 1383-1396.

13. Oksuz, M. Bisbee, J. Hall, Nerine Cherepy, Lei R. Cao, "Quantifying spatial resolution in a fast neutron radiography system", ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** (2022), doi: https://doi.org/10.1016/j.nima.2022.166331

14. Oksuz, Ibrahim, Matt Bisbee, Nerine Cherepy, Joe Tringe, Andrew Townsend, James Hall, and Lei Cao. "Comparison of thermal and fast neutron computed tomography of complex objects by additive manufacturing and electrical discharge machining." In ***Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XXIV***, vol. 12241, pp. 98-107. SPIE, 2022. http://dx.doi.org/10.1117/12.2635773

15. Bisbee, M. G., A. J. Hardy, I. Oksuz, L. R. Cao, N. J. Cherepy, D. J. Schneberk, K. M. Champley et al. "Experimental x-ray and fast neutron CT comparative analysis." In ***Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XXIV***, vol. 12241, pp. 108-116. SPIE, 2022. http://dx.doi.org/10.1117/12.2635503

16. Giglio, Daryl, Sha Xue, Katie Hoffman, Praneeth Kandlakunta, Henry Spitz, Vasil Hlinka, and Lei R. Cao. "Longevity evaluation of SiC based alpha voltaic batteries with surface alpha sources." In ***Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XXIV***, vol. 12241, pp. 138-155. SPIE, 2022. http://dx.doi.org/10.1117/12.2635657

17. Cao, G., Larson, N., Storms, B. Cao, L. R. Gamma-ray spectra analyses of molten salts in spent nuclear fuels pyroprocessing facilities for mass measurement. ***J Radioanal Nucl Chem*** (2022). https://doi.org/10.1007/s10967-022-08339-5

18. Dai, Xuezeng, Chengbin Fei, Praneeth Kandlakunta, Liang Zhao, Zhenyi Ni, Lei R. Cao, and Jinsong Huang. "Origin of the X-Ray-Induced Damage in Perovskite Solar Cells." ***IEEE Transactions on Nuclear Science*** 69, no. 8 (2022): 1850-1856.

19. Tan, Ryan, Bogdan Dryzhakov, Kate Higgins, Jessica Charest, Zachary Dancoes, Praneeth Kandlakunta, Lei R. Cao, Mahshid Ahmadi, Bin Hu, and Eric Lukosi. "Lithium Chloride-Substituted Methylammonium Lead Tribromide Perovskites for Dual γ/Neutron Sensing." ***ACS Applied Materials & Interfaces*** 14, no. 30 (2022): 34571-34582.

20. Tsai, Hsinhan, Shreetu Shrestha, Lei Pan, Hsin-Hsiang Huang, Joseph Strzalka, Darrick Williams, Leeyih Wang, Lei R. Cao, and Wanyi Nie. "Quasi-2D Perovskite Crystalline Layers for Printable Direct Conversion X-Ray Imaging." ***Advanced Materials*** (2022): 2106498.

21. Hsinhan Tsai , Dibyajyoti Ghosh, Wyatt Panaccione, Li-Yun Su, Cheng-Hung Hou, Leeyih Wang, Lei Raymond Cao, Sergei Tretiak, and Wanyi Nie, Addressing the Voltage Induced

Instability Problem of Perovskite Semiconductor Detectors, ***ACS Energy Lett***. 2022, 7, 11, 3871–3879, https://doi.org/10.1021/acsenergylett.2c02054

22. Taylor, Neil R., Mihee Ji, Lei Pan, Praneeth Kandlakunta, Ivan Kravchenko, Pooran Joshi, Tolga Aytug, M. Parans Paranthaman, and Lei R. Cao. "Large area vertical Ga_2O_3 Schottky diodes for X-ray detection." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 1013 (2021): 165664.

23. Taylor, Neil R., Yongchao Yu, Mihee Ji, Pooran Joshi, and Lei R. Cao. "Direct metal contacts printing on 4H-SiC for alpha detectors and inhomogeneous Schottky barriers." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 989 (2021): 164961. IF: 1.265

24. Cao, Lei R., Lei Pan (Student), Praneeth Kandlakunta, and Wanyi Nie. "Perovskite detectors for x-ray imaging and gamma spectroscopy: overview and current state-of-the-art." In ***Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XXIII***, vol. 11838, p. 118380B. International Society for Optics and Photonics, 2021.

25. Gao, Hantian, Shreyas Muralidharan, Md Rezaul Karim, Lei R. Cao, Kevin D. Leedy, Hongping Zhao, Siddharth Rajan, David C. Look, and Leonard J. Brillson. "Depth-resolved cathodoluminescence and surface photovoltage spectroscopies of gallium vacancies in β-Ga2O3 with neutron irradiation and forming gas anneals." ***Journal of Vacuum Science & Technology B, Nanotechnology and Microelectronics: Materials, Processing, Measurement, and Phenomena*** 39, no. 5 (2021): 052205.

26. Oksuz, Ibrahim, Matt Bisbee, Nerine Cherepy, Andrew Townsend, James Hall, Joseph Nicolino, Saphon Hok, and Lei Cao. "Fast neutron computed tomography of multi-material complex objects." ***In Hard X-Ray, Gamma-Ray, and Neutron Detector Physics*** XXIII, vol. 11838, p. 118380L. International Society for Optics and Photonics, 2021.

27. Pan, Lei, Shreetu Shrestha, Neil Taylor, Wanyi Nie, and Lei Cao. "Determination of X-ray detection limit and application in perovskite X-ray detectors." ***Nature Communication***, (2021). 12, no. 1 (2021): 1-9.

28. Lei Pan, Praneeth Kandlakunta, Matt Van Zile, Xuezeng Dai, Jinsong Huang, John McClory, Lei R. Cao, "Acquiring and modeling of Si solar cell transient response to pulsed X-ray." ***IEEE Transactions on Nuclear Science***, (2021): doi: 10.1109/TNS.2021.3067193

29. L Pan, Y Feng, J Huang, L. R Cao, "Comparison of Zr, Bi, Ti, and Ga as metal contacts in inorganic perovskite CsPbBr3 Gamma-ray Detector", ***IEEE Transactions on Nuclear Science***, 2020. DOI: 10.1109/TNS.2020.3018101.

30. Harris, N.C., Yang, H., Ge, J., Zhang, J., Coble, J., Skutnik, S., Taylor, N.R., Jarrell, J., Blue, T.E., Cao, L. and Simpson, M., 2021. University Research to Support the MPACT 2020 Milestone. ***Journal of Nuclear Materials Management***, 49(1), pp.136-151.

31. Gao, Hantian, Shreyas Muralidharan, Md Rezaul Karim, Susan M. White, Lei R. Cao, Kevin Leedy, Hongping Zhao, David C. Look, and Leonard J. Brillson. "Neutron irradiation and forming gas anneal impact on β-Ga2O3 deep level defects." ***Journal of Physics D: Applied Physics*** 53, no. 46 (2020): 465102.

32. Oksuz, Ibrahim, Matthew Van Zile, Matt Bisbee, Andrew Kauffman, Joel Hatch, Praneeth Kandlakunta, Nerine J. Cherepy, and Lei R. Cao. "Characterization of a reactor-based fast neutron beam facility for fast neutron imaging." In ***Hard X-Ray, Gamma-Ray, and Neutron Detector Physics*** XXII, vol. 11494, p. 114940T. International Society for Optics and Photonics, 2020.

33. Cherepy, Nerine J., Zachary Seeley, Saphon Hok, Daniel Schneberk, Philip Kerr, Sean O'Neal, Ibrahim Oksuz et al. "Scintillators and detectors for MeV X-ray and neutron imaging." In ***Hard X-Ray, Gamma-Ray, and Neutron Detector Physics*** XXII, vol. 11494, p. 114940N. International Society for Optics and Photonics, 2020.

34. Taylor, Neil R., Yongchao Yu, Mihee Ji, Tolga Aytug, Shannon Mahurin, Richard Mayes, Sacit Cetiner et al. "Thermal and radiation response of 4H–SiC Schottky diodes with direct-write electrical contacts." ***Applied Physics Letters*** 116, no. 25 (2020): 252108.

35. Ji, Mihee, Neil R. Taylor, Ivan Kravchenko, Pooran Joshi, Tolga Aytug, Lei R. Cao, and M. Parans Paranthaman. "Demonstration of Large-Size Vertical Ga 2 O 3 Schottky Barrier Diodes." ***IEEE Transactions on Power Electronics***, 36, no. 1 (2020): 41-44.

36. Pan, Lei, Yuanxiang Feng, Praneeth Kandlakunta, Jinsong Huang, and Lei R. Cao. "Performance of Perovskite CsPbBr 3 Single Crystal Detector for Gamma-Ray Detection." ***IEEE Transactions on Nuclear Science*** 67, no. 2 (2020): 443-449.
[Top 3 most popular papers in this journal]

37. Y Feng, L Pan, H Wei, Y Liu, Z Ni, J Zhao, PN Rudd, Lei R Cao, Jinsong Huang, "Low defects density $CsPbBr_3$ single crystals grown by an additive assisted method for gamma-ray detection", ***Journal of Materials Chemistry C***, vol 8, 33, (2020): 11360-11368.

38. Kandlakunta, Praneeth, Chuting Tan, Nathan Smith, Sha Xue, Neil Taylor, R. Gregory Downing, Vasil Hlinka, and Lei R. Cao. "Silicon carbide detectors for high flux neutron monitoring at near-core locations." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 953 (2020): 163110.

39. Holmes, Jason, Jesse Brown, Franz A. Koeck, Holly Johnson, Manpuneet K. Benipal, Praneeth Kandlakunta, Anna Zaniewski et al. "Performance of 5-μm PIN diamond diodes as thermal neutron detectors." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 961 *(2020):* 163601.

40. Taylor, Neil R., W. Kuang, M. Saeidijavash, Praneeth Kandlakunta, Y. Zhang, and Lei R. Cao. "Direct printing of metal contacts on 4H-SiC for radiation detection." ***AIP Advances*** 9, no. 9 (2019): 095041.

41. Wang, Jinghui, Padhraic Mulligan, Leonard Brillson, and Lei R. Cao. "Erratum:"Review of using gallium nitride for ionizing radiation detection" ***Applied Physics Reviews*** 6, no. 2 (2019): 029902.

42. Taylor, Neil R., Nora Alnajjar, Joshua Jarrell, Praneeth Kandlakunta, Michael Simpson, Thomas E. Blue, and Lei R. Cao. "Isotopic concentration of uranium from alpha spectrum of electrodeposited source on 4H-SiC detector at 500 °C." ***Journal of Radioanalytical and Nuclear Chemistry*** 320, no. 2 (2019): 441-449.

43. Yang, Shuang, Zeyuan Xu, Sha Xue, Praneeth Kandlakunta, Lei Cao, and Jinsong Huang. "Organohalide Lead Perovskites: More Stable than Glass under Gamma-Ray Radiation." ***Advanced Materials*** 31, no. 4 (2019): 1805547.

44. Xue, Sha, Chuting Tan, Praneeth Kandlakunta, Ibrahim Oksuz, Vasil Hlinka, and Lei R. Cao. "Methods for improving the power conversion efficiency of nuclear-voltaic batteries." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 927 (2019): 133-139.

45. Yang, Shuang, Zeyuan Xu, Sha Xue, Praneeth Kandlakunta, Lei Cao, and Jinsong Huang. "Organohalide Lead Perovskites: More Stable than Glass under Gamma-Ray Radiation." ***Advanced Materials*** (2018): 1805547.

46. Jarrell, Joshua T., Milan Stika, Michael Simpson, Thomas E. Blue, and Lei R. Cao. "4H–SiC alpha spectrometry for nuclear forensics with electrodeposited sources." ***Journal of Radioanalytical and Nuclear Chemistry*** 318, no. 1 (2018): 667-672.

47. Stika, M., S. Padilla, J. Jarrell, T. Blue, L. R. Cao, and M. Simpson. "Thin-Layer Electrodeposition of Uranium Metal from Molten LiCl-KCl." ***Journal of The Electrochemical Society*** 165, no. 3 (2018): D135.

48. Chuirazzi, William C., Ibrahim Oksuz, Praneeth Kandlakunta, Thomas N. Massey, Carl R. Brune, Nerine J. Cherepy, H. Paul Martinez, and Lei Cao. "Evaluation of polyvinyl toluene scintillators for fast neutron imaging." ***Journal of Radioanalytical and Nuclear Chemistry*** 318, no. 1 (2018): 543-551.

49. Hardtmayer, Douglas, Kevin Herminghuysen, Susan White, Andrew Kauffman, Jeff Sanders, Shelly Li, and Lei Cao. "Determination of molten salt mass using ^{22}Na tracer mixed with ^{154}Eu and ^{137}Cs." ***Journal of Radioanalytical and Nuclear Chemistry*** 318, no. 1 (2018): 457-463.

50. Gao, Hantian, Shreyas Muralidharan, Nicholas Pronin, Md Rezaul Karim, Susan M. White, Thaddeus Asel, Geoffrey Foster et al. "Optical signatures of deep level defects in Ga2O3." ***Applied Physics Letters*** 112, no. 24 (2018): 242102.

51. Wang, Lei, Josh Jarrell, Sha Xue, Chuting Tan, Thomas Blue, and Lei R. Cao. "Fast neutron detection at near-core location of a research reactor with a SiC detector." ***Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*** 888 (2018): 126-131.

52. Cao, Lei, Josh Jarrell, Susan White, Kevin Herminghuysen, Andrew Kauffman, Douglas E. Hardtmayer, Jeff Sanders, and Shelly Li. "A radioactive tracer dilution method to determine the mass of molten salt." ***Journal of Radioanalytical and Nuclear Chemistry*** 314, no. 1 (2017): 387-393.

53. Wei, Haotong, Dylan DeSantis, Wei Wei, Yehao Deng, Dengyang Guo, Tom J. Savenije, Lei Cao, and Jinsong Huang. "Dopant compensation in alloyed CH 3 NH 3 PbBr3xCl$_1$-x perovskite single crystals for gamma-ray spectroscopy." ***Nature Materials*** 16, no. 8 (2017): 826.

54. Wei Wei, Yang Zhang, Qiang Xu, Haotong Wei, Yanjun Fang, Qi Wang, Yehao Deng et al. "Monolithic integration of hybrid perovskite single crystals with heterogenous substrate for highly sensitive X-ray imaging." ***Nature Photonics*** 11, no. 5 (2017): 315.

55. Tan, Chuting, Nicholas H. Bashian, Chase W. Hemmelgarn, Wesley J. Thio, Daniel J. Lyons, Yuan F. Zheng, Lei R. Cao, and Anne C. Co. "Ex-situ and in-situ observations of the effects of gamma radiation on lithium-ion battery performance." ***Journal of Power Sources*** 357 (2017): 19-25.

56. Qiang Xu, Haotong Wei, Wei Wei, William Chuirazzi, Dylan DeSantis, Jinsong Huang, Lei Cao, "Detection of charged particles with a methylammonium lead tribromide perovskite single crystal," ***Nuclear Instruments and Methods in Physics Research, Section A***, Volume 848, 11, Pages 106–108, 2017.

57. Qiang Xu, Padhraic Mulligan, Jinghui Wang, William Chuirazzi, Lei Cao, "Bulk GaN alpha-particle detector with large depletion region and improved energy resolution," ***Nuclear Instruments and Methods in Physics Research, Section A***, Volume 849, 21, Pages 11–15, 2017.

58. Stika, M., S. Padilla, J. Jarrell, T. Blue, L. R. Cao, and M. Simpson. "Thin-Layer Electrodeposition of Thorium Metal from Molten LiCl-KCl." ***Journal of The Electrochemical Society*** 164, no. 8 (2017): H5078-H5085.

59. Moore, Eric, Joshua Jarrell, and Lei Cao. "Heteroepitaxial diamond growth on 4H-SiC using microwave plasma chemical vapor deposition." ***Heliyon*** 3, no. 9 (2017): e00404.

60. Stika, Milan, Max Chaiken, Joshua Jarrell, Thomas Blue, Lei Raymond Cao, and Michael Forrest Simpson. "Thin-Layer Electrodeposition of Thorium and Uranium from Molten LiCl-KCl." ***ECS Transactions*** 75, no. 15 (2016): 603-608.

61. Chuting Tan, Daniel J. Lyons, Ke Pan, Kwan Yee Leung, William C. Chuirazzi, Marcello Canova, Anne C. Co, Lei R. Cao, "Radiation effects on the electrode and electrolyte of a lithium-ion battery," ***Journal of Power Sources***. Vol. 318, 242–250. 2016.

62. Josh Jarrell, Milan Stika, Max Chaiken, Michael Simpson, Thomas E. Blue, Lei R. Cao. "Determination of the thickness of an electrodeposited thorium film with SiC alpha detectors," ***Journal of Radioanalytical and Nuclear Chemistry***. Vol. 1, no. 1. pp:1-7. 2016.

63. Danny X. Liu, Lei R. Cao, and Anne C. Co. "Demonstrating the Feasibility of Al as Anode Current Collector in Li-Ion Batteries via In Situ Neutron Depth Profiling," ***Chemistry of Materials***. Vol. 28, no. 2. 556-563. 2016.

64. Haotong Wei, Yanjun Fang, Padhraic Mulligan, William Chuirazzi, Hong-Hua Fang, Congcong Wang, Benjamin R. Ecker, Yongli Gao, Maria Antonietta Loi, Lei Cao, Jinsong Huang, "Sensitive X-ray detectors made of methylammonium lead tribromide perovskite single crystals," ***Nature Photonics***. Vol. 10, 333–339. 2016.

65. Qingfeng Dong, Yanjun Fang, Yuchuan Shao, Pahraic Mulligan, Jie Qiu, Lei Cao, Jinsong Huang, "Electron-hole diffusion lengths >175 μm in solution grown CH3NH3PbI3 single crystals," ***Science***. Vol. 347, no. 6225. 967-970. 2015.

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59. L. Cao, Steven.Biegalski, Sean O'Kelly. "A high-resolution neutron radiography device by using micro-channel plate detector" In: The 8th World Conference on Neutron Radiography. Gaithersburg, United States: Springer. (2008): 305-312.

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PATENTS:

	Pat. Ref. #	Pat. Title	Pat. Inventors	Filing Date	Pat. Type
1	P2023-035-7477	Gas and sample extraction system for high-temperature irradiated samples of molten salt, radiopharmaceutical, tritium gas, and noble gas production	Van Zile, Matthew, Cao, Raymond, Kauffman, Andrew	8/26/2022	Provisional
2	P2023-029-7455	Devices, systems, and methods for tritium gas detection	Cao, Raymond, Co, Anne, Kandlakunta, Praneeth	8/10/2022	Provisional
3	P2022-065-7589	Devices and kits for detection of a target analyte and methods of use thereof	Cao, Raymond, Co, Anne	9/23/2022	Provisional
4	P2022-056-6679	Tritium detection devices and methods of making and use thereof	Cao, Raymond, Kandlakunta, Praneeth	6/24/2022	Provisional
5	P2021-072-7091	Nuclear reactor core with rotating fuel modules and related systems	Smidts, Carol, Aldemir, Tunc, Cao, Raymond,Horack, John, Khafizov, Marat	4/29/2022	PCT
6	P2021-072-6236	Rotating fuel core with fuel strips for small modular reactor	Smidts, Carol, Aldemir, Tunc, Cao,Raymond, Horack, John, Khafizov, Marat	4/29/2021	Provisional
7	P2020-301-7612	Charge or electricity generating devices and methods of making and use thereof	Cao, Raymond, Pan, Lei	10/26/2022	PCT
8	P2020-301-6442	Charge or electricity generating devices and methods of making and use thereof	Cao, Raymond, Pan, Lei	6/9/2021	PCT
9	P2020-301-5792	Beta voltaic battery	Cao, Raymond, Pan, Lei	6/9/2020	Provisional

10	P2017-137-4484	Charge generating devices and methods of making use thereof	Cao, Raymond	6/19/2018	Utility
11	P2017-137-090	Charge generating devices and methods of making use thereof	Cao, Raymond	6/19/2017	Provisional
12	P2011-181-03	Detection Devices and Methods	Cao, Raymond	8/28/2014	Utility
13	P2011-181-02	Detection Devices and Methods	Cao, Raymond	2/28/2013	PCT
14	P2011-181-01	Detection Devices and Methods	Cao, Raymond	2/28/2012	Provisional

GRANTS AND CONTRACTS (2009-2023, in bold fonts are active):

	Total (as PI)
Number of Funded Projects	41 (32)
Funding Level	~$18.5 million (~$13 million)

	Role	Sponsor	Total Amount	PoP	Abbreviated Title
1	**PI**	**Nuclear Regulatory Commission**	**$500,000**	**01/01/2024-12/31/2026**	**Rad-hard FPGA for NPP I&C**
2	**PI**	**Nuclear Regulatory Commission**	**$400,000**	**05/31/2023-05/30/2027**	**Ohio State University Fellowship**
3	**PI**	**DOE/NEUP**	**$400,000**	**10/01/2021-12/31/2023**	**Total Mass Accounting in Advanced Liquid-Fueled Reactors**
4	**PI**	**OSU Presidential Catalyst award**	**$199,000**	**10/01/2021-12/31/2023**	**Self-scintillating Perovskite**
5	**PI (also subarea lead for TA3)**	**Georgia Tech and National Nuclear Security Administration (NNSA)**	**$2,750,000 as PI (total $25 millions led by Georgia Tech)**	**10/01/2019-9/30/2024**	**Consortium for Enabling Technologies and Innovation**
6	**PI**	**Nuclear Regulatory Commission**	**$450,000**	**04/01/2022-3/31/2025**	**Ohio State University Nuclear Engineering Faculty Development Program**

7	**PI**	**DOE/UNLP**	**$161,000**	**01/01/2021 - 12/31/2023**	**DOE UNLP fellowship award (Matt Bisbee)**
8	**PI**	**DOE/UNLP**	**$161,000**	**08/01/2022 - 07/31/2025**	**DOE UNLP fellowship award (Jack Lanza)**
9	**PI**	**State of Ohio**	**$100,000**	**10/1/2023-9/30/2024**	**Tritium gas detector**
10	PI	DOE/NEUP	$400,000	10/01/2020-9/30/2023	Gallium Oxide Schottky Diode Detectors for Measurement of Actinide Concentrations in Molten Salts
11	PI	NSF SBIR PHASE 2 /AwareAbility Technologies LLC	$750,000 ($150,000 subcontractor)	5/01/2019-6/01/2023	Wide bandgap semiconductor betavoltaic powered sensor controller
12	PI	DOD-Defense Threats Reduction Agency	$1,050,000	6/06/2019-1/30/2023	Solar Panel for Prompt Detection of Nuclear Detonations
13	PI	Lawrence Livermore National Lab	$430,000	9/01/2016-09/30/2022	Fast neutron radiography and tomography
14	PI	Idaho National Lab	$110,000	9/1/2021 - 9/30/2023	Electrochemical and aqueous spike-based reprocessing nuclear material accounting
15	PI	NSF SBIR PHASE 1 /AwareAbility Technologies LLC	$225,000 ($36,000 subcontractor)	10/01/2017-11/30/2018	Wide bandgap semiconductor betavoltaic powered sensor controller
16	PI	DOE/NEUP	$719,969	10/01/2015-12/31/2018	Monitoring of actinide concentrations in molten LiCl-KCl
17	PI	DOE SBIR/AwareAbility Technologies LLC	$150,000 ($39,000 subcontractor)	10/01/2018-04/30/2019	Intelligent III-V GaN neutron detector array
18	PI	DOE/NSUF	$322,000	2/12/2019-09/30/2021	In-pile heating experiment in support of in-core/near-core sensor
19	PI	DOD-Defense Threats Reduction Agency	$750,000	12/03/2012-2/28/2018	On the radiation sensitivity and failure mechanism of critical radiation- hardened robotic components
20	PI	ORNL	$100,000	1/27/2016 – 12/31/2018	Near-core irradiation of fission chamber
21	PI	LANL	$80,000	2016-2017	Multi-column equipment testing
22	PI	DOD-Defense Threat Reduction Agency	$615,000	5/10/2014-08/31/2019	High efficiency, low-cost nanocomposite radiation detector

23	PI	Apple Inc	$50,000	7/1/2016-06/30/2017	Neutron for energy storage materials
24	PI	Idaho National Lab	$220,000	5/1/2016-9/30/2018	Molten salt mass determination using a trace method
25	PI	DOE	$230,000	9/01/2016-08/31/2017	A NEUP reactor upgrade request for replacement and enhancement of the control-rod drive system for the Ohio State University Research Reactor
26	PI	DOE	$61,167	3/01/2017- 3/31/2019	Irradiation and evaluation of BN, fiber optics, and Ga2O3
27	PI	Ohio	$290,000	7/01/2017-6/30/2019	Research agreement with Ohio Emergency Management Agency
28	PI	DOE	$243,454	8/01/2014 - 7/31/2015	Equipment for Education, Training, and Research in Advanced Instrumentation and Control at The Ohio State University
29	PI	DOE	$455,629	9/01/2011 – 8/31//2014	A High Temperature-tolerant and Radiation-resistant In-core Neutron Sensor for Advanced Reactors
30	PI	DOE	$180,000	1/01/2012 – 12/31/2013	An Integrated Upgrade of Scientific Equipment for Strengthening the Research and Education in Nuclear Energy at the Ohio State University
31	PI	DOD-Defense Threat Reduction Agency	$200,000	5/01/2011 - 9/30/2013	Gadolinium-GaN for Neutron Detection with Gamma Discrimination
32	PI	Nuclear Regulatory Commission	$450,000	10/01/2010-9/31/2013	Ohio State University Nuclear Engineering Faculty Development Program
33	**Co-PI**	**DOE**	**$990,000 ($75,000)**	**10/01/2021-9/30/2024**	**Gallium Nitride-based 100-Mrad Electronics Technology for Advanced Nuclear Reactor Wireless Communications**

34	**Co-PI**	**DTRA/SBIR Phase II**	**$1,094,004 (OSU share: $361,000)**	**09/08/2022 – 09/07/2024**	**Phase II: In-field analysis of trace U and Pu**
35	**Co-PI**	**DARPA**	**$150,000**	**9/1/2023-5/30/2023**	**Fast X-ray tube**
36	Co-PI	DOE	$275,361	01/01/2011-12/31/2011	Ohio State's DOE NEUP General Scientific Infrastructure Support
37	Co-PI	DOE-University of Michigan-Sub	$173,677	10/01/2011-09/30/2016	In-situ Neutron Depth Profiling of Lithium Ion Battery Materials for Improved Electrochemical Performance and Aging Models
38	Co-PI	DOE	$517,692	10/01/2014-09/30/2017	Advanced instrumentation for transient reactor testing
39	Co-PI	DOE-University of Michigan-Sub	$1,340,000	10/01/2011-09/30/2016	U.S.-China Clean Energy Research Center-Clean Vehicles (CERC-CV) - Battery characterization
40	Co-PI	Nuclear Regulatory Commission	$383,247	8/01/2015-7/31/2018	Ohio State University fellowship program
41	Co-PI	NSF	$249,974	5/1/2017 – 4/30/2020	IRES: Forming and Manufacturing Research in Germany

STUDENT ADVISING:

Dr. Cao has graduated **14 PhD students** and **18 MS students**, He has also mentored **7 post-doctorate researchers** and **30+ undergraduate students**. Dr. Cao is currently advising **8 PhD students** and **2 undergraduate students.**

Ph.D. Supervision Completed: 14

	Name	Status/position	Graduation time
1.	Praneeth Kandlakunta	Research Assistant Professor, The Ohio State University	May 2014
2.	Adib Samin	Assistant Professor, Air Force Institute of Technology	August 2014
3.	Jinghui Wang	Physicist at Varian Medical Systems	August 2014
4.	Danyal Turkoglu	Ultra Safe Nuclear Corporation	December 2014
5.	Padhraic Mulligan	Staff Scientist, Oak Ridge National Lab	December 2015
6.	Chuting Tan	Staff Scientist, Idaho National Lab	December 2017
7.	Josh Jarrell	Staff Scientist, Lawrence Livermore National Lab	May 2018

8.	William Chuirazzi	Staff Scientist, Idaho National Lab	May 2020
9.	Sha Xue	Research Scientist, AwareAbility Technologies, LLC	May 2020
10.	Lei Pan	Post-doc, Lawrence Berkeley National Lab	May 2021
11.	Neil Taylor	Staff Scientist, Oak Ridge National Lab	May 2021
12.	Ibrahim Oksuz	Research Scientist, AwareAbility Technologies, LLC	July 2022
13.	Ryan Gallagher	Kairos Power	December 2022
14.	Matt Bisbee	MPR	December 2023
15.	Matt Van Zeil	OSU Nuclear Reactor Lab	Spring 2024

Ph.D. Supervision in Progress: 8

	Name	**Status/position**	**Graduation time**	**Thesis topic**
1.	Matt Van Zeil	GRA	Spring 2024	Molten mass determination
2.	Xander Bart	GRA	December 2025	SMR for hydrogen production
3.	Daryl Giglio	GRA	December 2024	SiC detector
4.	Jarod Remy	GRA	Spring 2025	Ga_2O_3 detector
5.	Wyatt Panaccione	GRA	Spring 2025	Perovskite for gamma detection
6.	Jack Lanza	DOE UNLP Fellow	Spring 2026	Rad-hard GaN wireless emitter
7.	Andrew Maier	GRA	Spring 2026	Scintillating Perovskite
8.	Luke Sheon	University Fellow	Spring 2027	Nuclear battery

Postdoctoral researcher completed: 7

M.S. Supervisions Completed: 18

	Name	**Status/position**	**Graduation time**
1.	Richard Shawger	Assistant Professor, United States Military Academy	June 2016
2.	Padhraic Mulligan	Staff scientist, Oka Ridge National Lab	December 2015
3.	Michael Kurth	Techman Sales, Inc	August 2015
4.	Praneeth Kandlakunta	Research Associate, University of Washington in St. Louis	May 2014
5.	Adib Samin	Research Associate, Ohio State University	August 2014
6.	Dandan He	China National Nuclear Power Company	June 2014
7.	Jinghui Wang	Research Associate, Stanford University	December 2013
8.	Danyal Turkoglu	Research Associate, NIST	December 2013
9.	James Ralston	Total Quality Logistics	May 2013

10.	Jonathon Lin	Accenture	June 2012
11.	Walt Powell	Defense Information Systems Agency	June 2013
12.	Chuting Tan	Research Scientist, Idaho National Lab	June 2015
13.	Doug Hardtmayer	Industry	December 2017
14.	Matt Van Zeil	OSU Nuclear Reactor Lab	Spring 2020
15.	Zuolong Zhu	OSU	Spring 2020
16.	Chris Heckert	Industry	Spring 2023
17.	Matt Bisbee	OSU	Spring 2023
18.	Daryl Giglio	OSU	Spring 2022

Undergraduate Student Supervisions in Progress: 2

	Name	Status/position	Graduation time	Thesis topic
1.	Jacob Sklebar	Undergraduate Research Assistant	Spring 2024	Tritium gas detector
2.	Hetric Quinnan	Undergraduate Research Assistant	Spring 2024	Machine learning for neutron noise

PROPOSAL REVIEWER AND PANELIST:

U.S. Department of Energy
U.S. Department of Energy/NNSA-NA22
U.S. National Science Foundation
U.S. Nuclear Regulatory Commission
U.S. Department of Homeland Security
U.S. Department of Defense, Defense Threat Reduction Agency
U.S. Department of Energy, National Nuclear Security Administration
Canada National Research Council
Research Council of Norway
Israel PAZY foundation

JOURNAL REVIEWER:

Nature Photonics
Nature Materials
Journal of Applied Physics
IEEE Transactions on Nuclear Science
Nuclear Instruments and Methods in Physics Research A
Nuclear Instruments and Methods in Physics Research B
Journal of Radioanalytical and Nuclear Chemistry
Applied Radiation and Isotopes
Nuclear Technology
Journal of Vacuum Science and Technology

Review of Scientific Instrumentation
ACS Applied Materials & Interfaces

GOVERNOR'S APPOINTMENTS
TO BOARDS AND COMMISSIONS

Appointment Date: 8/2/2024

Name of Appointee: Lei Raymond Cao

Address:
4710 Bayford Ct
Upper Arlington, OH 43220
Franklin County
(H): 2404490612
(W): 6142478701
(M): 2404490612
(E): cao.152@osu.edu; xpha@yahoo.com

Name of Commission: Ohio Nuclear Development Authority
(P):
(E):

Term Begins: 8/2/2024
Term Ends: 8/1/2029
Party Affiliation: Republican
Senate Confirmation: Appointed by the Governor, confirmed by the Senate
Financial Disclosure:
Vice: