

Ross W. Barnowski, Ph.D

Senior Research Software Engineer
Biology and Biological Engineering, Caltech

CONTACT INFORMATION

California Institute of Technology
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RESEARCH INTERESTS

open-source software, scientific computing, scientific Python, image reconstruction, nuclear instrumentation, gamma-ray spectroscopy and imaging, nuclear medicine (diagnostic imaging, radiotherapy), robotics, sensor fusion, SLAM

EDUCATION

University of California, Berkeley - Berkeley, California 09/2010 - 06/2016
Ph.D, Nuclear Engineering - August 2016 — GPA: 3.98/4.0

- **Dissertation:** “*Development and Evaluation of Real-Time Volumetric Compton Gamma-Ray Imaging*”
- **Advisor:** Kai M. Vetter
- **Coursework:** Advanced Radiation Instrumentation Laboratory, Radiation Transport Simulation and Modelling, Medical Imaging Signals and Systems, Computer Vision, Applications in Parallel Computing, Python for Scientific Computation

University of Michigan - Ann Arbor, Michigan 09/2006 - 04/2010
B.S.E. Nuclear Engineering and Radiological Science - April 2010 — GPA 3.98/4.0

Coursework: Nuclear Reactor Design, Radiation Detection and Measurement, Nuclear Reactor Kinetics, General Radiation Laboratory, Nuclear Physics, Quantum Mechanics, C++ for Sci/Eng

EXPERIENCE

California Institute of Technology

Senior Research Software Engineer — Biology and Biological Engineering (BBE) 12/2022 - Present

Research software development, maintenance and systems administration supporting AI/ML research for spatialomics applications. In this role, I also directly contribute to the open-source scientific Python ecosystem which is actively used in the lab’s research.

Research software development and maintenance Supporting various projects across the lab with reproducible, scalable analysis of spatialomics data.

- Deep learning for single-cell and tissue data, including cell segmentation and cell-type determination from multiplexed imaging modalities.
- Maintenance of the [Deepcell](#) suite of open-source libraries for single-cell analysis.

NumPy and NetworkX core maintainer

- Active maintainer of NumPy (array computation) and NetworkX (graph theory and network analysis) libraries.
- Code development, maintenance, and (most importantly) review; community organization, and project infrastructure.

Infrastructure and systems administration

- Manage distributed, on-prem compute infrastructure for the lab comprising > 10 machines, > 30 GPUs, and > 300TB with > 30 users.

University of California, Berkeley

Scientific Software Developer — Berkeley Institute for Data Science 11/2019 - 11/2022

Scientific Python Ecosystem Scientific Python Ecosystem coordination and development: <https://scientific-python.org>

- Support development and scientific computing applications of the scientific Python ecosystem, comprising NumPy, SciPy, Matplotlib, scikit-learn, scikit-image, NetworkX, etc.

- Improve ecosystem coordination and robustness via community development, implementing cross-project decision-making processes, and general support of ecosystem projects.

NumPy and NetworkX core maintainer

- Active maintainer of NumPy (array computation) and NetworkX (graph theory and network analysis) libraries.
- Code development, documentation & testing, code review, community organization, and project infrastructure.

Mentorship & Outreach

- Mentor for outreach/onboarding programs such as Google season of code (NetworkX 3x), Google season of docs (NumPy 2x), and Outreachy (NetworkX 1x).
- Open source development outreach program for the African Masters in Machine Intelligence (AMMI) program from the African Institute for Mathematical Sciences (AIMS): https://bids-numpy.github.io/workshop_site_AIMS_2021/

*Assistant Research Scientist*¹ — *Department of Nuclear Engineering* 08/2018 - 03/2019

Project: Basic Research - Plastic Scintillator for Unmanned Aerial Systems

- Preliminary investigation of the incorporation of plastic scintillation material as structural material in unmanned aerial systems.
- Led acquisition and initial characterization of plastic scintillator material, including development of data acquisition and analysis pipeline for plastic scintillators capable of pulse-shape discrimination for particle identification.

Student Mentorship

- Graduate student mentorship for the development and maintenance of radiation instrumentation systems, including gamma-ray imaging devices based on high-purity germanium and inorganic scintillators.
- Training for graduate students on cryogenics, vacuum systems, and front-end electronics.

Data Analysis and Technical Support

- Image reconstruction and data analysis in support of projects related to the mapping of nuclear contamination in Fukushima and Chernobyl.
- Simulation studies in support of gamma-ray imaging for material studies related to uranium enrichment and storage.
- Continued firmware/software development and integration support for the PRISM instrument (see LBNL postdoc description).

Lecturer — *Department of Nuclear Engineering* 08/2018 - 12/2018

Course: NE 204: [Advanced Concepts in Radiation Detection and Measurement](#)

- Graduate-level, 3 credit-hour laboratory course on radiation instrumentation and measurement.
- Lecture component emphasizing digital signal processing, physics and operation of semiconductor and scintillation-based detectors, and spectroscopic and imaging applications of radiation instrumentation.
- Laboratory component emphasizing digital signal processing for radiation spectroscopy and timing applications, and multi-channel radiation detectors for neutron and gamma-ray detection, spectroscopy, and imaging.
- Computational component emphasizing reproducible and collaborative workflows with git, L^AT_EX, and the scientific python ecosystem.

Lawrence Berkeley National Laboratory, Berkeley, CA

Postdoctoral Researcher — *Applied Nuclear Physics* 09/2016 - 07/2018

Project: Portable Radiation Imaging Spectroscopy and Mapping (PRISM)

- Development of software for multichannel data acquisition system. Firmware integration and testing; network communication for control and data I/O. Full system integration including

¹The period from 08/2018-12/2018 consisted of a joint role comprising a 60% appointment as assistant research scientist, and a 40% appointment as lecturer.

front-end design for HW/FW developers (engineering interface) and users. Device applications in source search and gamma-ray mapping — enhanced imaging and localization capabilities.

- Development and implementation of gamma-ray imaging modalities including Compton and proximity-based localization algorithms. Direct application to nuclear contamination remediation in Fukushima, Japan.

Project: Small-Animal Molecular Imaging

- Near-field, high-resolution Compton tomography for molecular imaging with small-animal models. Development and assembly of tomographic system as well as data analysis and image reconstruction algorithms. Proposed applications for radionuclide uptake studies and theranostics for radiopharmaceutical development.

Graduate Student Researcher — Applied Nuclear Physics

06/2011 - 05/2016

Project: Volumetric Gamma-Ray Imaging

- Develop and evaluate real-time 3D gamma-ray imaging techniques based on sensor fusion and real-time SLAM algorithms.
- Approach successfully demonstrated with portable high-purity germanium imager as well as hand-portable imager based on room-temperature semiconductor gamma-ray detectors.
- Software contributions include multithreaded application framework written in Python/C for interfacing with commercial DAQ hardware and implementing real-time gamma-ray imaging analysis.

Lawrence Livermore National Laboratory, Livermore, CA

Undergraduate Researcher — Nuclear Data Group

06/2009 - 08/2009 & 06/2010 - 07/2010

Project: Benchmarking of Evaluated Nuclear Data Library (ENDL) with Monte Carlo & deterministic particle transport codes

- Generate simulations using Monte Carlo & deterministic code packages for benchmarking nuclear cross-section data in the (ENDL) libraries.
- Scripting for automation of simulation input and data analysis. Experience with SLURM for job submission on cluster systems.
- Listed as co-author on release of ENDL2011.

Argonne National Laboratory, Argonne, IL

SULI Summer Intern

05/2008 - 08/2008

Project: Millimeter-wave radar for remote detection of plumes of ionizing radiation from illicit nuclear reprocessing activities.

- Technical report selected for publication in Journal of Undergraduate Science (1 of 18 winners out of 600 applicants).
- Winner of national SULI poster competition at AAAS conference.

PUBLICATIONS

Millman K. J. , Brett M. , **Barnowski R.** , and Poline J.-B. . Teaching computational reproducibility for neuroimaging. *Frontiers in Neuroscience*, 12:727, 2018.

Vetter K. , **Barnowski R.** , Haefner A. , Joshi T. H. , Pavlovsky R. , and Quiter B. J. . Gamma-ray imaging for nuclear security and safety: Towards 3-d gamma-ray vision. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 878:159–168, 2018.

Haefner A. , **Barnowski R.** , Luke P. , Amman M. , and Vetter K. . Handheld real-time volumetric 3-d gamma-ray imaging. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 857:42–49, 2017.

Barnowski R. , Haefner A. , Mihailescu L. , and Vetter K. . Scene data fusion: Real-time standoff volumetric gamma-ray imaging. *Nuclear Instruments and Methods in Physics Research*

Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 800:65–69, November 2015.

Haefner A. , Gunter D. , **Barnowski R.** , and Vetter K. . A filtered back-projection algorithm for 4π compton camera data. *IEEE Transactions on Nuclear Science*, 62(4):1911–1917, August 2015.

Brown D. , Beck B. , Descalles M. , Escher J. , Hoffman R. , Mattoon C. , Navratil P. , Nobre G. , Ormand W. , Summers N. , and **Barnowski R.** . 2011 release of the evaluated nuclear data library (endl2011. 0). Technical report, Lawrence Livermore National Laboratory (LLNL), Livermore, CA (United States), May 2015.

Barnowski R. . In-sourcing nuclear medicine. *Journal of Science Policy and Governance*, 1, 2011.

Barnowski R. , Gopalsami N. , and others . Remote detection of radioactive plumes using millimeter wave technology. *Journal of Undergraduate Research*, 9, 2009.

CONFERENCE PRESENTATIONS

Barnowski R. . High resolution compton tomography for small animal molecular imaging. In *Symposium on Radiation Measurement and Applications (SORMA)*, Ann Arbor, MI, June 2018.

Barnowski R. . 3d gamma-ray imaging with hpge detectors. In *International Germanium Detector Technology Workshop*, Berkeley, CA, December 2017.

Barnowski R. . Scene data fusion: Advances and applications in real-time volumetric gamma-ray imaging. In *University Industry Technical Interchange (UITI)*, Raleigh, NC, June 2016.

Barnowski R. . Evaluation of volumetric imaging systems with scene data fusion. In *IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC)*, San Diego, CA, November 2015.

Barnowski R. . Scene data fusion: Enabling real-time volumetric gamma-ray imaging. In *University Industry Technical Interchange (UITI)*, Ann Arbor, MI, June 2015.

Barnowski R. and Haefner A. . A python framework for gamma-ray imaging. In *Scipy*, Austin, TX, July 2014.

Barnowski R. . Near real-time fusion of gamma-ray imaging with 3d scene data for volumetric imaging. In *IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC)*, Seoul, Republic of South Korea, November 2013.

TEACHING²

Lecturer — UC Berkeley NE 204	Fall 2018
Graduate: Advanced Concepts in Radiation Detection and Measurement	
Graduate Student Instructor — UC Berkeley STAT 159/259	Fall 2015
Upper Division ³ /Graduate: Reproducible and Collaborative Statistical Data Science	
Graduate Student Instructor — UC Berkeley NE 92	Fall 2014
Lower Division: Introduction to Nuclear Engineering	
Graduate Student Instructor — UC Berkeley NE 120	Fall 2012
Upper Division: Nuclear Materials	
Graduate Student Instructor — UC Berkeley NE 120	Fall 2011
Upper Division: Nuclear Materials	
Graduate Student Instructor — UC Berkeley NE 104	Spring 2011
Upper Division: Nuclear Instrumentation Laboratory	

²All graduate student instructor (GSI) positions were full 20 hr/week appointments

³Upper Division = Juniors/Senior-level, Lower Division = Freshman/Sophomore-level

	Graduate Student Instructor — UC Berkeley NE 101	Fall 2010
	Upper Division: Introduction to Nuclear Physics	
HONORS AND AWARDS	Best Oral Presentation Award - University Industry Technology Interchange Nuclear Science and Security Consortium Fellow American Nuclear Society Graduate Scholarship UC Berkeley Outstanding GSI Award University of Michigan Joseph M. Geisinger Scholar University of Michigan Class of 1931E Honors Scholar Sustainable Energy Fellowship Program Awardee, Cornell University NEUP Scholarship Recipient American Nuclear Society National Scholarship Recipient	2016 2014 - 2016 2014 2012 2006 - 2010 2007 - 2010 2010 2009 - 2010 2007 - 2010
ACTIVITIES	The Hacker Within, UC Berkeley Chapter <i>Participant/Contributor</i> <ul style="list-style-type: none"> Contributed presentations/breakout sessions on scientific computing with python, including machine learning (scikit-learn), data visualization, distributed computing, and extending python (cython & the Python C-API). www.thehackerwithin.org/berkeley/previous.html Nuclear Engineering Graduate Student Association — NEGSA <i>Co-founder & Officer</i> <ul style="list-style-type: none"> Officer position: Secretary/Treasurer Organized graduate student visit weekends and intra-departmental educational and social events. Initiated computing seminars for discussion of advanced computing topics relevant for nuclear engineers (merged with The Hacker Within, 2014). American Nuclear Society (ANS)	2014-2016 2012-2015 2012-2014 2007-2015 Officer Positions <ul style="list-style-type: none"> Social Chair (UCB) Vice President (UM) Student Conference Volunteer Coordinator (UM) Outreach Chair (UM)