

REBECCA Coles
Curriculum Vitae
11/14/2023

Brookhaven National Laboratory
Detector System and Application Support
Upton, NY 11973 USA

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BNL: bnl.gov/staff/rcoles

GitHub (personal): github.com/racoles

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Google Scholar: scholar.google.com/citations?hl=en&user=Wyd4aTMAAAAJ

SPIE: spie.org/profile/Rebecca.Coles-4092890

Academia.edu: rebeccacoles.academia.edu/

EDUCATION

- 2016 Ph.D. Physics
 Department of Physics and Astronomy
 Wayne State University
- 2012 M.S. Physics
 Department of Physics and Astronomy
 Wayne State University
- 2007 B.S. Physics (Minor in Mathematics)
 Department of Physics and Astronomy
 Wayne State University

GRANTS AND AWARDS

- 2023 Department of Energy Grant: Ethics and AI
 Principle Investigator
 Brookhaven National Laboratory
 Award: FY23 \$168k
 Term length: 2 years
- 2023 Department of Energy Grant: Bench-top X-ray Particle Analysis
 Principle Investigator
 Brookhaven National Laboratory
 Award: FY23 \$143k
 Term length: 3 years

- 2023 Brookhaven National Laboratory Spotlight Award
Awarded for hosting BNL Cyber Expo 2023
Award: \$1000
- 2015 Department of Energy Grant: Office of Science Graduate Student Research (SCGSR)
Brookhaven National Laboratory
Award: \$36k + \$4k for travel
Term length: 12 months
science.osti.gov/wdts/scgsr
- 2014 American Association of Physics Teachers Award (Gustafson Memorial)
Wayne State University
Award: \$750
clas.wayne.edu/physics/news/category/awards

RELEVANT FIRST AUTHOR PUBLICATIONS **(More Publications Listed in Research Experience Section)**

- 2023 Rebecca A. Coles, Biays Bowerman, Steven Glozek, and Susan Pepper "Development of Nuclear Forensics using Synchrotron Radiation-Based Analysis at the National Synchrotron Light Source-II" Annual Meeting Proceedings, Institute of Nuclear Materials Management (INMM) Atoms for Peace and Global Nonproliferation 2023
resources.inmm.org/annual-meeting-proceedings/development-nuclear-forensics-using-synchrotron-radiation-based-analysis
- 2022 Rebecca A. Coles, Biays Bowerman, Martin Schoonen, Juergen Thieme, and Andrew Duffin "Automation of submicron resolution x-ray spectroscopy measurements and analysis using supervised and unsupervised machine learning algorithms", Proc. SPIE 12227, Applications of Machine Learning 2022, 122270K (3 October 2022)
<https://doi.org/10.1117/12.2633459>
- 2022 Rebecca A. Coles, Biays Bowerman, Steven Glozek, and Susan Pepper, "Development of Nuclear Forensics using Synchrotron Radiation-Based Analysis at the National Synchrotron Light Source-II". Proc. LLNL NCV-ASAP-2022. Lawrence Livermore National Laboratory Internal Paper
- 2021 Rebecca Coles, Biays Bowerman, Lynne Ecker, Ericmoore Jossou, Juergen Thieme, Martin Schoonen, Mehmet Topsakal, "Evaluation of Use of Synchrotron-based High-Resolution Chemical and Structural Analysis Techniques for Customs and Border Protection Law Enforcement Applications," Department of Homeland Security Internal Paper (September 15, 2021)

- 2020 Oleg Chubar, Rebecca Coles, Lutz Wiegart, Andrei Fluerasu, Maksim Rakinin, James Condie, Paul Moeller, Rob Nagler, "Simulations of coherent scattering experiments at storage ring synchrotron radiation sources in the hard x-ray range," Proc. SPIE 11493, Advances in Computational Methods for X-Ray Optics V, 1149310 (August 21, 2020)
doi.org/10.1117/12.2568833
- 2018 R. Coles; M. Derwent; P. Martini; T. O'Brien; A. Ross; S. Tie. DESI Commissioning Instrument Metrology. Proc. SPIE 10706, Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation III, 107061L (July 10 2018);
arxiv.org/abs/1807.09283
- 2017 R. Coles; J. Chiang; D. Cinabro; J. Haupt; H. Neal; A. Nomerotski; P. Takacs. An automated system to measure the quantum efficiency of CCDs for astronomy. Journal of Instrumentation, 12.04 C04014 (April 18, 2017);
dx.doi.org/10.1088/1748-0221/12/04/C04014
- 2012 C. J. Bebek ; R. A. Coles ; P. Denes ; F. Dion ; J. H. Emes ; R. Frost ; D. E. Groom ; R. Groulx ; S. Haque ; S. E. Holland ; A. Karcher ; W. F. Kolbe ; J. S. Lee ; N. P. Palaio ; N. A. Roe ; C. H. Tran ; G. Wang; CCD research and development at Lawrence Berkeley National Laboratory . Proc. SPIE 8453, High Energy, Optical, and Infrared Detectors for Astronomy V, 845305 (September 25, 2012);
dx.doi.org/10.1117/12.926606

RESEARCH EXPERIENCE

2023-2024 Ethics and AI:

Brookhaven National Laboratory, Upton NY
Staff Physicist, Principle Investigator (Current Position):

- Developed ethical guidelines for applying artificial intelligence to International Atomic Energy Agency (IAEA) Safeguards. These considerations revolve around aspects such as bias and fairness, transparency and explainability, accountability, governance, and privacy. Currently I am further validating the ethical AI framework and identified its potential implementation through a phased approach, making it valuable for the IAEA's mission.

2023-2024 Bench-top X-ray Particle Analysis:

Brookhaven National Laboratory, Upton NY
Staff Physicist, Principle Investigator (Current Position):

- Developed bench-top X-ray devices and software tailored for nuclear forensics applications, integrating these instruments into the sub-micron

beamlines at NSLS-II. The accompanying software uses both supervised and unsupervised machine learning techniques to streamline and automate the workflow.

- My investigation primarily emphasized X-ray Fluorescence (XRF) to achieve precise elemental analysis of particles. The primary objective is to discern minor components through elemental analysis, which serves as a crucial tool for establishing the origin of a specimen. Additionally, I explored supplementary capabilities, such as high-resolution radiography, which can provide morphology details about larger particles. Furthermore, I incorporated X-ray Diffraction and X-ray Absorption techniques into our automated software.

Publications:

- Development of Nuclear Forensics using Synchrotron Radiation-Based Analysis at the National Synchrotron Light Source-II
<https://resources.inmm.org/annual-meeting-proceedings/development-nuclear-forensics-using-synchrotron-radiation-based-analysis>

2023-2024 Machine Learning for Real-Time Video Authentication:

Brookhaven National Laboratory, Upton NY

Staff Physicist:

- Developed an innovative, all-encompassing video authentication model capable of identifying various manipulation techniques, even those not encountered during training.
- My model excelled at recognizing forged videos altered through a range of methods, such as deep learning, traditional image processing, lens tampering, and splicing.
- Produced and curated a specialized datasets, incorporating diverse video manipulation techniques.

2022-2024 Developer for National Nuclear Data Center Continuous Integration System:

National Nuclear Data Center (NNDC)

Brookhaven National Laboratory, Upton NY

Staff Physicist (Current Position):

- ADVANCE project to automate all the testing needed for the ENDF/B-VII.1 We quickly realized that the quasi-automated suite could be completely automated and turned into a continuous integration (CI) system.
- Added automated data output to ENDF/B-VII.1 GitLab Wikipedia repositories for completed jobs and pipelines (GitLab API)

Software:

- ADVANCE Evaluated Nuclear Data File (ENDF/B)

<https://www.nndc.bnl.gov/endl-dev/qa/>
● Evaluated Nuclear Data Files (ENDF/B-VII.1)
<https://www.nndc.bnl.gov/endl>

2020-2022 Automation of Nuclear Forensics using Synchrotron X-rays
Nonproliferation and National Security: Detector Systems and Applications
Brookhaven National Laboratory, Upton NY
Staff Physicist:

- Created SnapPy (Synchrotron Network Automation Program in Python) software for using machine learning and synchrotron beamline controls to create non-destructive chemical analysis and elemental maps of environmental samples for nuclear forensics (Python and Qt).
- Automating the workflow for rapidly measuring and producing elemental maps of large-area samples using the Submicron Resolution X-ray Spectroscopy Beamline (SRX) at the National Synchrotron Light Source II, Brookhaven National Laboratory, through a novel combination of supervised and unsupervised machine learning algorithms.

Publications:

- Automation of submicron resolution x-ray spectroscopy measurements and analysis using supervised and unsupervised machine learning algorithms
doi.org/10.1117/12.2633459
- Development of Nuclear Forensics using Synchrotron Radiation-Based Analysis at the National Synchrotron Light Source-II. Proc. LLNL NCV-ASAP-2022
- Development of synchrotron-based analyses of environmental samples. Proc. INMM (2022)

2019-2020 Simulations of X-ray Scattering
Experimental Development at National Synchrotron Light Source II (NSLS-II)
Brookhaven National Laboratory, Upton NY
Post-Doc:

- Created Python package to generate randomized 3D samples to simulate actual nano-materials/glass/colloids/etc. that are studied at various beamlines (C++ and Python)
- Set up GPU for simulation processing (CUDA, Imod, Conda, MPI processing).
- Created machine learning algorithm to automatically select propagation parameters for a user input of a beamline sample for the Synchrotron Radiation Workshop software (Reinforcement Learning, SVM, but also attempted instance based kNN).

- Wrote software to access HDF5 x-ray scattering data from beamlines at NSLSII. The software handled: data acquisition from the beamline servers, displaying images and beamline data, adding scaling and image cropping functions (h5py).
- Created simulations of samples for the NSLSII CHX beamline to prepare beamline scientists for future experiments, as well as to verify experimental data (C++, Python, NSLSII BlueSky).
- Created educational video tutorials for the Sirepo Simulation software (Camtasia).

Publications:

- Analysis of Hard X-Ray Focusing by 2D Diamond CRL
doi.org/10.1117/12.2568980
- Simulations of Coherent Scattering Experiments at Storage Ring Synchrotron Radiation Sources in the Hard X-Ray Range
doi.org/10.1117/12.2568833

Software:

- Synchrotron Radiation Workshop (SRW)
github.com/ochubar/SRW
- SRW 2D Random Objects
github.com/racoles/SRW_2D_random_objects
- NSLSII CHX Data Acquisition from BlueSky
github.com/NSLS-II-CHX/srw-image-tools
- Sirepo Simulations
beta.sirepo.com/srw#/simulations

2018-2019 Sloan Digital Sky Survey (SDSS-V)
Imaging Science Laboratory
Ohio State University, Columbus OH
Post-Doc:

- Created mechanical and software apparatus for thermometry testing of computer system cold temperature survivability (C++, Python, wagoIO).

Software:

- Centroid Machine Learning Software
github.com/racoles/centroiding

2017-2018 Dark Energy Spectroscopic Instrument (DESI)
Imaging Science Laboratory
Ohio State University, Columbus OH
Post-Doc :

- Analyze DESI Commissioning Instrument images using my custom deep learning metrology software (R and PyTorch).
- Aligned and focused the DESI Commissioning Instrument for use on the DESI telescope by writing and implementing metrology software and procedures (Python with Tkinter GUI).

Publications:

- DESI Commissioning Instrument Metrology

doi.org/10.1117/12.2312592

- The Commissioning Instrument for the Dark Energy Spectroscopic Instrument

doi.org/10.1117/12.2312885

Software:

- DESI Metrology software

github.com/racoles/DESI_CI_MET

2015-2017 Large Synoptic Survey Telescope (LSST)

Instrumentation Division

Brookhaven National Laboratory, Upton NY

Graduate Researcher:

- Construction of camera LSST camera (CCD sensor installation, electronics, and testing systems).
- Installing and imaging X-ray sources and testing camera readout electronics.
- Focal plane metrology using SmartScope metrology measurements and analysis.
- Develop and maintain LSST Camera Control Software (CCS) along side construction of backside illuminated CCD camera (CCD sensor installation, electronics, and testing systems).
- Construction of quantum efficiency testing apparatus for LSST CCDs, including mechanical design and construction of electro-optical hardware, and programming.
- Perform residual gas analysis (RGA) on LSST cryostats, including use of vacuum and cryo systems, and experience in designing systems that use such equipment.

Publications:

- LSST: from Science Drivers to Reference Design and Anticipated Data Products

iopscience.iop.org/article/10.3847/1538-4357/ab042c

Software:

- Metrology software
github.com/racoles/RSA_Metrology
- CCD surface debris detection software
github.com/racoles/lint

2011-2013 Baryon Oscillation Spectroscopic Survey (BigBOSS)
Microsystems Laboratory
Lawrence Berkeley National Laboratory, Berkeley CA
Graduate Researcher:

- Identified limitations and redesigned quantum efficiency testing apparatus to fit BigBOSS CCDs.
- Design and installation of X-ray sources for system calibration.
- Construction of quantum efficiency testing apparatus for LSST CCDs.
- Experience in vacuum, optics, electronics, and cryo systems, and frequent CCD handling.
- On programming team for the quantum efficiency testing apparatus automation,
- Developed a program to map the quantum efficiency of BigBoss CCDs (IDL).

Publications:

- CCD Research and Development at Lawrence Berkeley National Laboratory
doi.org/10.1117/12.926606

2008-2011 Wayne State University
Department of Physics and Astronomy
Detroit MI
Scientific Analyst:

- Supernova data analysis.
- Wrote programs that use principle component analysis to reduce supernova data (R).
- Built and maintained a Beowulf scientific server to provide computing resources for the university's physics department.

Software:

- Supernova Principle Component Analysis
sites.google.com/view/sdsspca

- 2008 Tevatron Particle Accelerator
Particle Accelerator Division
Fermilab, Batavia IL
Particle Accelerator Technician:
- Performed stabilization measurements on quadruple and dipole magnets in the Tevatron Particle Accelerator.
- 2007 Supernova Acceleration Probe (SNAP)
Particle Astrophysics Division
Fermilab, Batavia IL
Science Associate:
- Programmed and tested voltage regulating board prototype FRIC0 (Fermilab Regulator Integrated Circuit).
- 2006 Sloan Digital Sky Survey (SDSS)
Particle Astrophysics Division
Fermilab, Batavia IL
National Science Foundation (NSF) Associate:
- Organized spectroscopic data on supernova candidates.
 - Created a mysql database and web application to host supernova candidate data.

PROGRAMING LANGUAGES

Frequently used programming languages:

Python, Java, C++, MATLAB, Qt, COBOL (for personal projects)

General experience programming languages:

IDL, R, C, Mathematica, SQL, PHP

Documenting languages:

YAML, \LaTeX , Sphinx, SLAC eTraveler, Confluence, JIRA, Jupyter Notebook

RELATED PROFESSIONAL SKILLS

Certified Analyst for BlueDragon Hyper-Integrated Causal Analysis Problem

Solving Methodology:

bluedragon-hca.com

CAD Software:

Autodesk Inventor, SolidWorks, OpenSCAD

Video Recording and Editing Software:

Camtasia, Filmora

3D printers:

Fablicator, Makerbot, MakerGear, Anet A8, FlashForge

3D printing and model rendering software:

Cura, Flashprint, Autodesk Meshmixer, Simplify3D, 3DF Zephyr

Optical design software:

Zemax

Entrepreneurial Training for Department of Energy Researchers:

Opportunity Analysisiologist training in PSW-lite

CONFERENCE ACTIVITY AND SYMPOSIUMS

- 2023 Institute of Nuclear Materials Management (INMM) Atoms for Peace and Global Nonproliferation
Second Annual INMM and ESARDA Joint Annual Meeting, Vienna, Austria
Guest Presenter (talk)
<https://resources.inmm.org/annual-meeting-proceedings/development-nuclear-forensics-using-synchrotron-radiation-based-analysis>
- 2022 Association of Materials-Centric Engineers and Scientists (ASM) Joint Meeting with the American Nuclear Society (ANS)
Association of Materials-Centric Engineers and Scientists (ASM) Conference, New York
Invited Speaker (talk)
<http://DoL1.eng.sunysb.edu/asm/>
- 2022 SPIE Optical Engineering + Applications: Applications of Machine Learning 2022
Conference 12227, San Diego
Guest Presenter (talk)
doi.org/10.1117/12.2633459
- 2021 Synchrotron Radiation-Based Capabilities in Support of the Nuclear Forensics and Nonproliferation Mission
International Atomic Energy Agency Conference, New York
Guest Presenter (Interview)
<https://vimeo.com/brookhavernationallab/review/567881200/98232dfd5a>
- 2021 Consortium for Monitoring Technology and Verification
University of Michigan, Michigan
Guest Presenter (talk)
mtv.engin.umich.edu

- 2019 Gordon Research Conferences for X-Ray Science
Stonehill College: Easton, Massachusetts
Presenter (poster)
grc.org/x-ray-science-conference/2019
- 2019 National Synchrotron Light Source II (NSLS-II) Seminar
Brookhaven National Laboratory (BNL): Upton, New York
Guest Speaker (talk)
bnl.gov/nsls2/seminars
- 2018 Particle, Astro, and Nuclear Physics Seminar (PAN)
Wayne State University: Detroit, Michigan
Guest Speaker (talk)
clas.wayne.edu/physics/seminars/pan
- 2018 SPIE Astronomical Telescopes + Instrumentation
Austin, Texas
Presenter (talk)
spie.org/conferences-and-exhibitions/past-conferences-and-exhibitions/astronomical-instrumentation-and-telescopes-2018
- 2016 Precision Astronomy with Fully Depleted CCDs (PACCD)
Brookhaven National Laboratory (BNL): Upton, New York
Presenter (poster)
bnl.gov/paccd2016
- 2016 American Astronomical Society (AAS) 227th Conference
Kissimmee, Florida
Presenter (poster)
aas.org/meetings/aas227
- 2015 LSST Project and Community Workshop
Bremerton, Washington
lsst.org/news/events
- 2008 Baryon Acoustic Oscillations (BAO) Telescope Conference
Fermilab: Batavia, Illinois
Host (assistant)
cerncourier.com/a/conference-probes-the-dark-side-of-the-universe
- 2007 Gravitations Lensing Conference
Fermilab: Batavia, Illinois
Host (assistant)
astro.fnal.gov/events/conferences

TEACHING EXPERIENCE

2014 Astronomy: Graduate Teaching Assistant

2009-2013 Electrodynamics: Graduate Teaching Assistant

SERVICE TO PROFESSION

2020-2024 Mentor in Science Undergraduate Laboratory Internship program (SULI):

- Fall 2023: Ethics in AI
 - Summer 2023: Machine Learning in Nuclear Forensics
 - Fall 2022: Cluster Analysis Testing
 - Spring 2022: Synchrotron Image Analysis
 - Fall 2021: Synchrotron Image Analysis
 - Spring 2021: Data Parsing for Analysis
 - Summer 2020: Simulation of Experiments
- science.osti.gov/wdts/suli

2023 Scholarly Partnership in Nuclear Security (SPINS) Oral Presentations
Three talks at the Scholarly Partnership in Nuclear Security (SPINS) consortium to enhance the development of the next-generation technical workforce of underrepresented minority men and women.

- Basic Information That Engineers and Scientists Should Know About AI and ML
- Nuclear Forensics and Machine Learning (ML) at the National Synchrotron Light Source II (NSLS-II)
- My Career Path to Working in the Nonproliferation and National Security Department

2019-2021 Department of Energy's CyberForce Competition (Brookhaven National Laboratory)

Cyber defense competitions to exercise interactive and scenario-based events.

- 2021 (Red Team)
- 2020 (Red Team)
- 2019 (Red Team)

cyberforcecompetition.com

2017 STEM-Prep Summer Institute (Brookhaven National Laboratory)
Presentation Title: LSST and the History of Dark Energy and Dark Matter
bnl.gov/education/programs

2016 Girls Inc. (Brookhaven National Laboratory)
Presentation Title: LSST and the Universe
bnl.gov/newsroom/news.php?a=213027

- 2016 Science National Laboratory Day (Washington DC)
Presentation Title: Big Data for LSST
bnl.gov/newsroom/news.php?a=26331
- 2015 PubSci: The Dark Universe (Brewology Pub in Long Island, New York)
Presentation Title: The Dark Universe
bnl.gov/pubsci
- 2015 Custer Observatory (Long Island, New York)
Presentation Title: Dark Matter and Dark Energy
custerobservatory.org

AFFILIATIONS

Institute of Nuclear Materials Management (INMM): Member
<https://inmm.org>

The International Society for Optics and Photonics(SPIE): Member
<https://spie.org/profile/Rebecca.Coles-4092890>

Brookhaven Women In Science (BWIS): Lifetime Member
bnl.gov/bwis/

Consortium for Monitoring, Technology, and Verification (MTV): Member
mtv.engin.umich.edu

Consortium for Enabling Technologies and Innovation (ETI): Member
eti.gatech.edu

Dark Energy Science Collaboration (DESC): Member
lsstdesc.org

American Astronomical Society (AAS): Member
aas.org