Benjamin Colmey

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Personal Website
Department of Materials Science, University of Cambridge
27 Charles Babbage Rd, Cambridge CB3 0FS

Education

University of Cambridge, Queens' College (Oct 2024 – May 2027)
PhD in Materials Physics and AI
Awards: Stamps Scholarship

McGill University (2021 – 2023)
Master of Science in Physics: Experimental Condensed Matter
Thesis: Generating Massive Bursts of keV Electrons for Ultrafast Electron Microscopy

McGill University (2015 – 2020)
Bachelor of Science in Physics

Publications

- **Spatiotemporal walk-off and improved focusing of plasma THz sources**
  R.T. Paulino, B. Colmey, D.G. Cooke
  Optics Express, 32(15), 26351-26358, 2024.
- **Sub-cycle Nanotip Field Emission of Electrons Driven by Air Plasma Generated THz Pulses**
  B. Colmey, R.T. Paulino, D.G. Cooke
  arXiv preprint arXiv:2409.07196, 2024.

Research Experience

Researcher in Materials Physics, Electron Microscopy Group (Fall 2024 – Present)
University of Cambridge, Cambridge, United Kingdom

- Investigating machine learning approaches to enhance the analysis of scanning transmission electron diffraction images, identifying key microstructural and crystallographic features
- Performing quantum mechanical simulation of electron propagation for ML-assisted inverse structure reconstruction

Researcher in Experimental Condensed Matter, Cooke Group (2021 – 2023)
McGill University, Montreal, Canada

- Conducted research for McGill's Quantum Dynamics Lab, working on R&D for a novel electron microscope

- Designed ultra-high vacuum and sample manipulation systems using AutoCAD and SolidWorks, while simulating vacuum and pumping conditions to achieve pressures below 10^{-12} Torr
- Simulated quantum electron wave packet dynamics in Python with the finite-difference time-domain (FDTD) method

Research Assistant in Quantum Optics in Fraser Group (May – Sept 2020)
Queen's University, Kingston, Canada

- Explored the application of InAsP semiconductor quantum dots (QDs) as efficient single-photon sources for quantum computing and secure communication
- Performed Monte Carlo simulations in Python to model QDs, efficiently simulating Poissonian emission events and Hanbury Brown and Twiss (HBT) and Hong-Ou-Mandel (HOM) experiments

Research Project in Optics in Cooke Group (Jan – May 2020)
McGill University, Montreal, Canada

- Designed and tested an achromatic optical cone to transform circularly polarized terahertz light into radially polarized beams, suitable for electron acceleration
- Employed MATLAB's Linear Algebra Package (LAPACK) algorithms for modeling of polarization state manipulations with Jones matrices

Additional Relevant Experience

Machine Learning Project: Using ML to Inpaint Corrupted Piano Audio (2023)

- Applied machine learning to restore audio in vintage piano recital recordings, enhancing their clarity and listenability
- Utilized Short-Time Fourier Transform (STFT) for signal processing, experimenting with various custom loss functions and network architectures

Teaching and Extra Curricular Experience

Demonstrator, University of Cambridge (Fall 2024 – Present)

- Facilitated undergraduate Part 1A practicals, providing hands-on guidance in laboratory techniques and ensuring adherence to safety protocols.

Volunteer: National Autistic Society, Cambridge Branch (Fall 2024 – Present)

- Participated in regular meet-ups, fostering meaningful conversations and providing a supportive social environment for members.

Math & Physics Tutor (2021 – 2023)

- Provided personalized 1:1 tutoring in high school physics and math, focusing on problem-solving and conceptual understanding.

Teaching Assistant, McGill University (2021–2023)

- Led tutorials and conducted weekly office hours, providing individual support and clarification of complex topics to undergraduate students. Courses assisted: Optics, Electronics, Physics 101, Physics 102

Student Mentor, McGill Physics Hackathon (2022, 2023)

- Mentored high school and undergraduate students during programming competitions, aiding in problem solving and coding

Volunteer: Friendship Circle Montreal (2021–2024)

- Provided mentorship and support to students with disabilities, organizing engaging activities and sports to foster skills development and social integration.

Skills and Courses

Technical Skills:

- Python (including NumPy, Pandas, PyTorch, Pyspark, Keras, Scikit-learn, TensorFlow)
- Data Visualization (using Plotly, Matplotlib, Seaborn)
- Software Proficiency: Linux OS, Labview, GIT, AutoCAD, COMSOL

Certifications:

- PyTorch for Deep Learning, Convolutional Neural Networks in Python - Computer Vision, Python for Data Science

Languages:

- Bilingual in English and French, advanced in Spanish

Referees

Prof. Paul Midgley Dept of Material Science, University of Cambridge
pam33@cam.ac.uk

Prof. David Cooke Dept of Physics, McGill University
david.cooke2@mcgill.ca

Prof. James Fraser Dept of Physics, Queen's University
james.fraser@queensu.ca

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