

# Andrew B. Cudd

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## Work Experience

- 2020–present **Postdoctoral Research Associate**, *University of Colorado Boulder*, Boulder, CO
- Performing research on several projects (see below), including data analysis and software design, development, implementation, and validation.
  - Lead of multiple analysis teams for several projects (see below), each with 6-10 people on average. Responsible for scheduling and running meetings, guiding and coordinating the efforts of the group, and reporting on progress.
  - Utilizing the NERSC Perlmutter high-performance computing cluster to submit jobs to run analysis and simulation code, including GPU equipped nodes.
  - Contributions to open source simulation software and collaborative software development
  - Mentoring graduate students and undergraduates, providing guidance for their research along with technical support for their work.
  - Presenting results at conferences, writing and publishing papers, and peer review of analyses.
- 2014–2020 **Teaching and Research Assistant**, *Michigan State University*, East Lansing, MI
- Performed research on several projects (see below), primarily the T2K experiment, culminating in a doctoral thesis.
  - Performed software design, development, implementation, and validation of physics analysis software and infrastructure.
  - Mentored undergraduates in our research group, teach them about our research and providing technical support for their projects.
  - Presented results at conferences and writing and publishing papers.
  - Taught several classes, including electronics lab for physics majors and general physics I (mechanics) lab. Responsible for guiding students through the experiments, answering questions, and grading lab reports and homework sets.
- 2012–2014 **Teaching and Research Assistant**, *Missouri University of Science & Technology*, Rolla, MO
- Performed research utilizing ion beams and high vacuum systems. This included maintaining and reconfiguring the system.
  - Performed data analysis utilizing spreadsheet software.
  - Taught general physics II (electricity and magnetism) lab. Responsible for guiding students through their experiments, answering questions, and grading lab reports.

## Projects & Research

- DUNE** The Deep Underground Neutrino Experiment (DUNE) is a neutrino physics experiment hosted in the US and currently being developed and constructed. Co-lead of a small group focused on developing software tools for physics analysis and uncertainty propagation. Lead of a small team working on a specific physics measurement. Tasks on DUNE include software development of simulation software (including GPU-accelerated code using CuPy/Numba), working on physics analyses, part of the production team responsible for generating large simulations of the experiment, and writing technical documentation of software and procedures.
- 2020–present

Responsible for recent performance optimizations of CPU and GPU routines for a detector simulation package, including profiling using Nsight Systems.

**T2K** 2014–present The Tokai-to-Kamioka (T2K) experiment is a neutrino physics experiment hosted in Japan that has been running since 2009. Co-led a sub-group focused on guiding and coordinating cross-section physics analysis before being promoted to co-lead the entire cross-section group. Served as the head developer of the C++ software framework used for cross-section analyses, overhauling the code to increase performance (including parallelism via OpenMP), and adding new functionality for more complex analyses. Performed a cross-section analysis using advanced statistical techniques, such as maximum likelihood parameter estimation and Monte Carlo methods, that was published. Additional software development and production of the neutrino beam simulation.

**Machine Learning** 2022–present Collaborating with several colleagues on applying new machine learning techniques to neutrino physics analyses. This work is TensorFlow-based and uses deep neural networks and transformers to perform classification of neutrino events and likelihood-ratio estimation. Built data preparation and feature extraction pipeline to prepare inputs for the ML network. Training is distributed over multiple GPUs using Horovod and runs on the NERSC Perlmutter computing cluster.

## Computer skills

Languages C/C++, Python, Bash/C-shell, Rust, R, FORTRAN, HTML, CSS, JavaScript, SQL, LaTeX  
Software Linux, Git, TensorFlow/PyTorch, Jupyter, scikit-learn/scipy/numpy, pandas, matplotlib, SLURM, OpenMP, CUDA/CuPy/Numba, NVIDIA Nsight Systems, MS Office, CMake, MPI, MongoDB, ROOT  
Embedded Raspberry Pi, Arduino, Teensy, Atmel AVR  
Certifications High-Performance Computing Certificate through the MSU CMSE department.

## Other skills

Language Basic Japanese

## Education

2014–2020 **Ph.D. Physics**, *Michigan State University*, East Lansing, MI  
Earned the High-Performance Computing Certificate through the MSU CMSE department.  
2010–2014 **B.S. Physics**, *Missouri University of Science and Technology (S&T)*, Rolla, MO  
Graduated *Summa Cum Laude* with a Mathematics Minor and Computer Engineering Minor.

## Ph.D. Thesis

Title *Measurement of the charged current muon neutrino differential cross section on scintillator with zero pions in the final state with the T2K on/off-axis near detectors*  
Supervisor Dr. Kendall Mahn

## Additional Information

References and curriculum vitae (CV) available upon request