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Positions

2020–present **Postdoctoral Research Associate**, *University of Colorado Boulder*, Boulder, CO.

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.

Thesis

Thesis *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

Description A simultaneous cross-section measurement on scintillator (CH) targets using both the of the T2K on-/off-axis near detectors. Neutrino detectors measure total rate, which is a convolution of flux and cross-section effects. Because both detectors are exposed to neutrinos from the same beamline, many uncertainties in the neutrino flux prediction will be correlated. This fact combined with the different neutrino energy spectra seen in each detector will improve the sensitivity to the flux and cross-section degeneracy. This analysis is the first cross-section measurement in T2K to use samples from multiple detectors in the same beamline.

Research

DUNE **ND-LAr** Currently involved in the research and development of the liquid argon TPC (ND-LAr) near detector for DUNE. Primarily involved in design and prototyping of the electric field shaping structure (the field cage) for the TPC modules. This required building small-scale models to test design elements and running finite-element simulations for the electric field. I am part of the leadership team for the ND-Prototypes Analysis group as a convener of the Analysis Tools group. I am working on the ND-LAr 2x2 Demonstrator Prototype, mainly focussed on improvements to simulation chain, developing the software for physics analysis, and coordination between the different software packages. Finally I am part of the team working on one of the first analyses for the 2x2, a measurement of neutrino interactions with no detected mesons.

ND-GAr Participated in the research and development of a high-pressure gas TPC (ND-GAr) as a near detector for DUNE. Primarily involved in improving the detector simulation (e.g. implementing non-uniform magnetic fields), running simulations of the drift gas properties (drift velocity, ionization, etc.), and production of Monte Carlo samples for analysis. I also made significant contributions to the design and performance characterization of the ND-GAr-Lite concept as a day-one near detector for DUNE.

T2K	**Cross sections** Currently a convener for one of the T2K cross-section groups (Late Stage Analysis) focussed on the statistical fit and analysis validation, and a supervisor for several on-going cross-section analyses. Head developer and maintainer of the current generation likelihood-based fit software for measuring cross sections using the T2K near detectors, which also serves as the foundation for the upcoming upgrade of the software. I performed the first joint cross-section measurement using the on-/off-axis near detectors on T2K, which is nearing publication.
	Beam/flux MC Previous work as a software developer of the T2K neutrino flux simulation. Installed and configured new versions of the base Monte Carlo packages, fixed several issues in the simulation, and produced the official flux prediction for the T2K 2016 winter oscillation analysis.
	Model systematics Investigated the effect of different multinucleon neutrino interaction models (Nieves *et. al.* and Martini *et. al.*) on the T2K oscillation analysis through Monte Carlo studies. Helped develop model systematic uncertainties for the oscillation analysis based on the comparisons, which have been in use since 2017. Additionally I help the cross-section group interface with the software used for evaluating neutrino interaction uncertainties.
	Horn construction Assisted with the construction and assembly of one of the focussing electromagnets (called magnetic horns) for the T2K beamline. The magnetic horns focus the secondary beam particles that decay in to the neutrino beam. I was involved primarily with the assembly of the seals between the outer and inner conductors, the pipes for the water cooling, and final connections to the frame before it was shipped to Japan.
Analysis techniques	Investigating and applying new techniques for measuring neutrino cross sections and performing the unfolding of the result. Collaborating with a group at Lawrence Berkeley National Labratory and the University of Kyoto to use a machine-learning method (based on neural networks) to perform unbinned unfolding of neutrino data. Adapting the method and performing data analysis toward publication(s) as well as developing a tool for the neutrino interaction community.
STAR	Performed data and model comparisons between the longitudinal double-spin asymmetry of inclusive jet production for polarized proton collisions to the predictions using the parton distribution functions from the NNPDF group. Incorporated the effect of the STAR jet data on the extracted gluon polarization distribution of the proton using a procedure developed by the NNPDF group.
LArIAT	Helped design and build an embedded system to program/initialize the cold pre-amplifiers for the LArIAT experiment liquid argon TPC at Fermilab. The system utilized a Teensy 2.0 microcontroller with a terminal interface and API written in C that I wrote, and was successfully integrated into the LArIAT data acquisition system. Ran without issue over the course of the experiment.

Talks and Posters

Talks	NuSTEC NuXtract Workshop (Oct. 2023, CERN): Machine Learning-Assisted Unfolding for Neutrino Cross-section Measurements
	SLAC FPD Experimental seminar (Apr. 2023, Stanford, CA): A magnetized high-pressure gaseous argon time projection chamber (ND-GAr) for the Phase II DUNE Near Detector
	Michigan State University HEP seminar (Feb. 2023, East Lansing, MI): Neutrino–nucleus interactions at T2K and recent results

University of Colorado HEP seminar (Dec. 2022, Boulder, CO): Neutrino–nucleus interactions at T2K

LBL INPA seminar (Sep. 2022, Lawrence Berkeley National Lab, CA): Neutrino–nucleus interactions at T2K

NuFACT 2022 (Aug. 2022, Snowbird, UT): T2K latest results on neutrino-nucleus cross sections

NuSTEC CEWG seminar (Apr. 2021, Online): What we measure when measure σ: template fitting as a cross-section extraction technique at T2K

APS April Meeting 2021 (Apr. 2021, Online): Neutrino cross-section measurement capabilities and prospects for the DUNE gaseous argon near detector (ND-GAr)

NuSTEC NDNN Workshop (Mar. 2021, Online): Recent Results and Future Prospects from the T2K Experiment

Seminar at University of Texas–Arlington (Jan. 2020, Arlington, TX): Combined on/off-axis cross-section measurement with the T2K near detectors

Seminar at University of Colorado (Dec. 2019, Boulder, CO): Combined on/off-axis cross-section measurement with the T2K near detectors

APS April Meeting 2019 (Apr. 2019, Denver, CO): Combined on/off-axis cross-section measurement with the T2K near detectors

APS DPF 2015 (Aug. 2015, Ann Arbor, MI): Neutrino CCQE cross section discrepancies with data and generators

Posters   NuInt 2017 (Toronto, Canada): Multinucleon excitation (2p2h) model comparison

JSPS Summer 2016 (Sokendai, Japan): Simulating the T2K neutrino and proton beam

APS DNP CEU 2013 (Newport News, VA): Exploring gluon polarization in the proton with NNPDF and STAR

Awards and Fellowships

- NuFACT 2022 Presentation Award
- MSU Dissertation Completion Fellowship in Fall 2019
- DPF Student Travel Grant to present at the APS April meeting in 2019
- URA Visiting Scholars Program Fellowship to attend the NuSTEC school at Fermilab in 2017
- JSPS/NSF EAPSI Fellowship to study in Japan at University of Tokyo Kavli IPMU for the summer in 2016
- Fuller undergraduate poster competition second place in 2013 and 2014
- NSF REU program to conduct research at the Texas A&M Cyclotron in 2013

Outreach and Leadership positions

- DUNE ND-Prototypes Analysis Tools subgroup convener (2023–present)
- T2K cross-section convener for the Late Stage Analysis group (2020–present)
- T2K-Young representative (2020-2022)
- CU/JILA PISEC University educator and volunteer (2022–present)
  - University educator for Sunset Middle School (Spring 2022)
  - I Have a Dream Foundation Halloween Science Night
  - Lab tours for visiting students (middle and high school)
- Women and Minorities in the Physical Sciences (WaMPS) Outreach Co-chair (2017-2018)
  - MSU Girls STEM Day
  - MSU Middle school Girls Math & Science Day

- Beagle Elementary Science Night
- Physics & Astronomy Day at Impression 5 science museum
o MSU Physics Graduate Organization (PGO) Seminar Organizer (2017-2018)
o Science and Leadership at Michigan State (SL@MS) Demonstration Coordinator (2017 & 2018)
o MSU REU student mentoring (2015 & 2017)
o S&T Society of Physics Students (SPS) Treasurer (2012-2014)
o Liquid nitrogen demonstration for visiting high-school students, assisting Dr. Pringle at S&T (2010-2014)
o Science Olympiad at S&T event judge (2010-2013)

Teaching and Mentoring

Summer 2018	General Physics I Lab (mechanics) for MSU Phys 241
Fall 2015	MSU Physics Help Room general tutoring
Fall 2014	Electronics Lab for MSU Phys 440
Spring 2014	General Physics II Lab (E&M) for S&T Phys 26
CU Boulder	Mentoring current graduate students (M. Reh, B. Schuld) on T2K and DUNE along with several undergraduates
MSU	Mentored graduate students, with one obtaining their doctorate recently (J. Calcutt 2021)

References

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