XIANGYANG JU

Education

Ph.D University of Wisconsin-Madison, March 2018
Dissertation topic: Observation of a Standard Model Higgs boson and search for additional heavy scalars in the $\ell^+\ell^-\ell^+\ell^-$ final state with the ATLAS detector.
Advisor: Prof. Sau Lan Wu

B.S. Nanjing University, July 2009
Thesis: Measurement of the Top mass using the ATLAS detector
Advisor: Prof. Shenjian Chen

Employment

August 2025 — Present, Computing System Engineer (Career), Lawrence Berkeley National Laboratory, US

November 2021 — August 2025, Computing System Engineer (Termed), Lawrence Berkeley National Laboratory, US

April 2018 — November 2021, High Performance Computing Postdoctoral Scholar, Lawrence Berkeley National Laboratory, US

August 2011 — March 2018, Research/Teaching assistant, University of Wisconsin-Madison, US

August 2009 — August 2011, Research assistant, University of Regina, Canada

Award

- Distinguished Researcher Award from the US ATLAS Center, August 2017.

Responsibilities and Leaderships

Sep, 2024 — present, Technical lead of the Scaling Machine Learning group in High Energy Physics — Center for Computational Excellence

October, 2024 — present, ATLAS ML architectures and infrastructure Facilitator

June, 2023 — present, Affiliate of the "Accelerated AI Algorithms for Data-Driven Discovery" (**A3D3**) institue funded by NSF under the Harnessing the Data Revolution program.

Research Experience

2024 — present, Token-based Transformer for particle tracking in HEP

- TrackingBERT, a language model for particle tracking. It treats the tracking hits as words and tracks as sentences. It is pre-trained on simulated data with BERT-like self-supervised learning. PROC-CTD2023-33

- TrackSorter: a Transformer-based sorting algorithm for track finding. It uses the GPT-style training to directly predict the track labels of hits in an event. arXiv:2407.21290

2023 — present, ATLAS Machine Learning Inference Infrastructure

- Led the efforts in building a common machine learning inference infrastructure for the ATLAS experiment using ONNX Runtime.
- Led the efforts in developing the Inference as a Service (IaaS) infrastructure in Athena using NVIDIA Triton Inference Server. ATL-SOFT-PROC-2025-026
- Developed the ExaTrkX tracking as a service and integrated the pipeline to Athena. arXiv:2402.09633, JINST 20 (2025) P06002
- Working on leveraging the IaaS infrastructure for ATLAS DAOD production.

2022 — present, Exa.TrkX tracking pipeline for ATLAS ITk

- Pioneered the efforts in bringing R&D ExaTrkX tracking pipeline to ATLAS experiment for particle tracking in ITk.
- Led the integration of ExaTrkX tracking pipeline into the ATLAS software framework Athena.
- Explored different approaches, such as using GNN for pixel hits and CKF for track extrapolation, to improve computing performance.

2023 — 2024, Deep Generative Models for Fast Simulation
I applied the normalizing flow (NF) models to various simulation tasks in High Energy Physics.

- *Hadronic interaction simulation with Normalizing Flows (NFs)*: Developed NF models to enumerate hadronic interactions simulated by Geant4. EPJ Web of Conferences 295, 09034 (2024).
- *Generating Drell-Yan events with Normalizing Flows for ATLAS*: Used the same NF models to generate Drell-Yan events for the ATLAS experiment. The model achieves high fidelity in generating events and is much faster than traditional Monte Carlo generators. ATL-SOFT-PROC-2023-037.
- *Generative machine learning for detector response modeling with a conditional normalizing flow*: Applied the same NF models to model the detector response of the ATLAS electromagnetic calorimeter. The model achieves high fidelity in modeling the detector response and is much faster than traditional Geant4 simulation. JINST 19 P02003.

2019 — 2022, Geometry Learning for Event Reconstructions

My research work advances the event reconstructions in the High Energy Physics by adopting graph neural network (GNN).

- *Tracking reconstruction*: Developed an machine learning (ML)-based end-to-end tracking pipeline (i.e. Exa.TrkX tracking pipeline) for the High-Luminosity LHC (HL-LHC). Its core part is the Interaction Network. It scales better than traditional tracking algorithm, making it a promising candidate for future experiments. arXiv:2103.06995; JINST 16 P05001; arXiv:2007.00149; arXiv:2003.11603.
- *Supervised jet clustering*: Traditional jet clustering methods are unsupervised. For the first time, we demonstrated that it is advantageous to use supervised methods based on ML to do jet clustering. The same Interaction Network was used! Phs. Rev. D 102, 075014 (2020).

- *Top reconstruction*: It is a combinatorial problem to reconstruct all hadronically decayed top quarks. Preliminary studies show that GNN achieves promising results. A preprint is under preparation.

2018 — 2020, Generator and detector simulation tuning with detector-level data using HPC

- Developed a configurable fast detector-simulation package for the ATLAS and CMS detectors under the Rivet analysis framework.

- First demonstrated that generator parameters can be tuned with detector-level data using the above package.

- The two developments allow a great deal of new data to event generator tuning applications and offer an automatic way to examine detector resolutions and efficiencies in complex kinematic phase spaces. A preprint is under preparation.

- Developed a performant Message Passing Interface (MPI)-based parallelism for efficiently running Pythia8 generators in an HPC environment, arXiv:2103.05748, Apprentices, and I integrated the MPI parallelism into a fast-simulation workflow that helped ATLAS experiment to generate billions of simulated events for the search for the Higgs boson in the dimuon events. PowhegInlineGen.

- Developed a JAX-based auto-tune package for tuning generator parameters. It accepts customized objective functions and minimizes the function via gradient-based optimization methods.

2019 — 2020, Search for new physics using the Higgs boson as a portal

- *Search for the Higgs boson in the di-muon final state*: To control the statistic uncertainties of the background events at a desirable level, I generated billions of fast simulated events within a day by using up to 2048 CPU cores in super computer center, thanks to the package I developed for High Performance Computers. As a result, the search sensitivities was increased by 3 to 5%. It would not be possible for ATLAS to generate so many events in such a short amount of time. Phys. Lett. B 812 (2021) 135980

- *CP properties of Higgs boson interactions with top quarks using $H \to \gamma\gamma$*: Machine learning architectures, specifically the Boost Decision Tree, were used not only to better reject background events but also to separate CP-even and CP-odd events. I provided technical support in training the BDTs. Phys. Rev. Lett. 125. 061802

- *Search for heavy resonances decaying into a pair of Z boson*: Deep learning architectures, including multilayer perceptrons and recurrent neural network, were used to distinguish signal events from the background events. 20 to 40% improvement in the search sensitivities was achieved. Eur. Phys. J. C 81, 332 (2021).

2016 — 2019, Search for beyond the Standard Model resonances in di-boson final states

- **Search for heavy ZZ resonances in the $\ell^+\ell^-\ell^+\ell^-$ and $\ell^+\ell^-\nu\bar{\nu}$ final states**
  Led the analysis team as analysis contact person and publication editor. Several novel techniques were first time introduced to this analysis: using analytic functions to model the four-lepton invariant mass for signal and background events, interpreting results for large-width hypotheses, and properly taking into account the interference effects. I made the combination of the $\ell^+\ell^-\ell^+\ell^-$ and $\ell^+\ell^-\nu\bar{\nu}$ final states. I am one of the three publication editors for this analysis using full LHC Run 2 data. Eur. Phys. J. C 78 (2018) 293

- **Search for heavy resonances in the diphoton events at $\sqrt{s} = 13$ TeV**
  Led the efforts in measuring the purity of prompt diphoton events in signal regions as an internal note editor. Prepared for the analysis team with pre-selected data that ensures consistency and correctness among all analyzers. Estimated the global significance of an excess with diphoton invariant mass around 750 GeV based on the 2D Random Field method and pseudo-experiments. Phys. Lett. B 775 (2017) 105

- **Search for heavy ZZ resonances in the $\ell^+\ell^-qq$ and $\nu\nu qq$ final states**
  Combined the results from the $\ell^+\ell^-qq$ and $\nu\nu qq$ final states. JHEP 03 (2018) 009

- **Search for heavy resonances in bosonic final states**
  Combined the results from the $\ell^+\ell^-\ell^+\ell^-$, $\ell^+\ell^-\nu\nu$, $\ell^+\ell^-qq$ and $\nu\nu qq$ final states. Phys. Rev. D 98 (2018) 052008

2015 — 2017, Search for dark matter (DM) in mono-jet and mono-Higgs final states

- I was one of the editors for the "white paper" published by the LHC Dark Matter forum. Studied experimental features of the DM Benchmark Models, particularly the mono-Higgs models. Proposed and implemented the parameters for the mono-Higgs models that later served as the back-bone of the DM searches at the LHC. Phys. Dark Univ. 27 (2020) 100371

- **Search for DM in the final state with an energetic jet and large missing transverse momentum** (mono-jet)
  Optimized the event selections for 13 TeV data. Studied signal modeling. Used jet-smearing method to estimate the multiple-jets background. Checked the control regions for W/Z/$t\bar{t}$ backgrounds to make sure all the background modelings are correct. JHEP 01 (2018) 126

- Made first public result on the search for DM in the mono-Higgs final state using the first 13 TeV pp collisions data for the End of Year Event 2015. ATLAS-CONF-2015-059.

- Led a team in developing a statistical analysis framework for $H \to ZZ$ analysis. It builds a combined likelihood model of the ZZ events in multiple categories, based on either analytic functions or Monte Carlo templates or simply number of events. It is used for all the publications of the $\ell^+\ell^-\ell^+\ell^-$ analyses since 2015.

2012 — 2014, Measurement of the Higgs boson properties in the $\ell^+\ell^-\ell^+\ell^-$ final state

- Introduced and implemented an innovative two-dimensional fitting method for Higgs coupling measurement. This method reduces the error of the signal strength by 25% in the VBF production in the $\ell^+\ell^-\ell^+\ell^-$ final state. Phys. Rev. D 91 (2015) np.1, 012006

- Performed first measurements on the signal strengths of various Higgs boson production modes in the $\ell^+\ell^-\ell^+\ell^-$ final states.

- Served as one of the internal note editors for the publication of the Higgs coupling measurement in the $\ell^+\ell^-\ell^+\ell^-$ final state in 2013.

- Proposed an innovative two-dimensional fitting method for the Higgs mass measurement. The innovative method reduces the statistical error by 8% leading to the best Higgs mass measurement in the $\ell^+\ell^-\ell^+\ell^-$ final state at that time.

2011 — 2012, Discovery of the Standard Model Higgs boson in the $\ell^+\ell^-\ell^+\ell^-$ final state

- Optimized the $\ell^+\ell^-\ell^+\ell^-$ event selections for the Higgs boson discovery.

- Proposed and implemented a novel method for evaluating the reducible background in the $4e$ and $2\mu 2e$ channels for the Higgs boson discovery.
- Processed data and delivered the statistical results for all ATLAS public results on the $\ell^+\ell^-\ell^+\ell^-$ analyses between 2011 and 2012, including the final statistical significance for the Higgs boson discovery on July 4, 2012. Phys. Lett. B 716 (2012) 1-29
- Gave the approval talk for the Higgs discovery on behalf of the four-lepton analysis team in the Higgs working group on June 15, 2012.

2009 — 2011, Detector performance studies with early LHC data with University of Regina, Canada

- Measured the electron efficiency for the first observation of the W and Z bosons in ATLAS with 280 nb^{-1} $\sqrt{s} = 7$ TeV data.

Publication Lists

Refereed Journal Articles

1. A. Akram, X. Ju, M. Papenbrock and others, “Application of Geometric Deep Learning for Tracking of Hyperons in a Straw Tube Detector”, arXiv:2503.14305, March 2025.
2. H. Zhao and others, “Track reconstruction as a service for collider physics”, JINST 20 (2025) P06002, January 2025.
3. Y. Melkani and X. Ju, “TrackSorter: A Transformer-based sorting algorithm for track finding in High Energy Physics”, arXiv:2407.21290, July 2024.
4. H. Zhao and others, “Graph Neural Network-based Tracking as a Service”, arXiv:2402.09633, February 2024.
5. A. Huang and others, “A Language Model for Particle Tracking”, arXiv:2402.10239, February 2024.
6. M. Gökçen, M. Garcia-Sciveres, X. Ju, “An Application of HEP Track Seeding to Astrophysical Data”, arXiv:2401.06011, January 2024.
7. J. Chan, X. Ju, A. Kania and others, “Integrating Particle Flavor into Deep Learning Models for Hadronization”, arXiv:2312.08453, December 2023.
8. J. Burleson and others, “Physics Performance of the ATLAS GNN4ITk Track Reconstruction Chain”, ATL-SOFT-PROC-2023-047, November 2023.
9. J. Schroff and X. Ju, “Event Generator Tuning Incorporating Systematic Uncertainty”, arXiv:2310.07566, October 2023.
10. T. M. Pham and X. Ju, “Simulation of Hadronic Interactions with Deep Generative Models”, arXiv:2310.07553, October 2023.
11. S. Caillou and others, “Physics Performance of the ATLAS GNN4ITk Track Reconstruction Chain”, ATL-SOFT-PROC-2023-038, September 2023.
12. J. Chan, X. Ju, A. Kania and others, “Fitting a deep generative hadronization model”, JHEP 09 (2023) 084, May 2023.

13. S. Qiu and others, "Parton labeling without matching: unveiling emergent labelling capabilities in regression models", Eur. Phys. J. C 83 (2023) 622, April 2023.

14. R. Liu and others, "Hierarchical Graph Neural Networks for Particle Track Reconstruction", arXiv:2303.01640, March 2023.

15. A. Xu, S. Han, X. Ju and others, "Generative machine learning for detector response modeling with a conditional normalizing flow", JINST 19 (2024) P02003, March 2023.

16. A. Huang, X. Ju, and others, "Heterogeneous Graph Neural Network for identifying hadronically decayed tau leptons at the High Luminosity LHC", JINST 18 (2023) P07001, January 2023.

17. X. Ju and others, "Benchmarking GPU and TPU Performance with Graph Neural Networks", arXiv:2210.12247, October 2022.

18. A. Akram and X. Ju, "Track Reconstruction using Geometric Deep Learning in the Straw Tube Tracker (STT) at the PANDA Experiment", arXiv:2208.12178, August 2022.

19. V. Dumont, X. Ju, J. Mueller, "Hyperparameter Optimization of Generative Adversarial Network Models for High-Energy Physics Simulations", arXiv:2208.07715, August 2022.

20. S. Caillou and others, "ATLAS ITk Track Reconstruction with a GNN-based pipeline", ATL-ITK-PROC-2022-006, July 2022.

21. A. Ghosh and others, "Towards a Deep Learning Model for Hadronization", arXiv:2203.12660, March 2022.

22. M. Bhattacharya and others, "Portability: A Necessary Approach for Future Scientific Software", arXiv:2203.09945, March 2022.

23. S. Qiu and others, "A Holistic Approach to Predicting Top Quark Kinematic Properties with the Covariant Particle Transformer", arxiv:2203.05687, March 2022.

24. C. Wang and others, "Reconstruction of Large Radius Tracks with the Exa.TrkX pipeline", arxiv:2203.08800, March 2022.

25. A. Lazar and others, "Accelerating the Inference of the Exa.TrkX Pipeline", arxiv:2202.06929, March 2022.

26. W. Wang and others, "BROOD: Bilevel and Robust Optimiation and Outlier Detection for Efficient Tuning of High-Energy Physics Event Generators", SciPost Phys. Core 5, 001 (2022), January 2022.

27. X. Ju and others, "Physics and Computing Performance of the Exa.TrkX TrackML Pipeline", Eur. Phys. J. C 81 (2021) 876, October 2021.

28. J. Hewes and others, "Graph Neural Network for Object Reconstruction in Liquid Argon Time Projection Chambers", arXiv:2103.06233, March 2021.

29. M. Krishnamoorthy, H. Schulz, X. Ju and others, "Apprentice for Event Generator Tuning", arXiv:2103.05748, March 2021.

30. P. Fox and others, "Beyond 4D Tracking: Using Cluster Shapes for Track Seeding", JINST 16 P05001, December 2020.

31. ATLAS Collaboration, "CP Properties of Higgs Boson Interactions with Top Quarks in the $t\bar{t}H$ and tH Processes Using $H \to \gamma\gamma$ with the ATLAS Detector", Phys. Rev. Lett. 125, 061802, August 2020.

32. ATLAS Collaboration, "A search for the dimuon decay of the Standard Model Higgs boson with the ATLAS detector", Phys. Lett. B 812 (2021) 135980, July 2020.

33. N. Choma, D. Murnane, X. Ju and others, "Track Seeding and Labelling with Embedded-space Graph Neural Networks", arXiv:2007.00149, June 2020.

34. X. Ju and others, "Graph Neural Networks for Particle Reconstruction in High Energy Physics detectors", NeurIPS, arXiv:2003.11603, March 2020.

35. D. Abercrombie and others, "Dark Matter Benchmark Models for Early LHC Run-2 Searches", Phys. Dark Univ. 27 (2020) 100371, January 2020.

36. ATLAS Collaboration, "Combination of searches for heavy resonances decaying into bosonic and leptonic final states using 36 fb^{-1} of proton-proton collision data at $\sqrt{s}$=13 TeV …", Phys. Rev. D 98 (2018) 052008, September 2018.

37. ATLAS Collaboration, "Searches for heavy ZZ and ZW resonances in the $\ell\ell qq$ and $\nu\nu qq$ final states …", JHEP 03 (2018) 009, March 2018.

38. ATLAS Collaboration, "Search for dark matter and other new phenomena in events with an energetic jet and large missing transverse momentum using the ATLAS detector", JHEP 01 (2018) 126, January 2018.

39. ATLAS Collaboration, "Search for heavy ZZ resonances in the $\ell^+\ell^-\ell^+\ell^-$ and $\ell^+\ell^-\nu\bar{\nu}$ final states using proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector", Eur. Phys. J. C 78 (2018) 293, December 2017.

40. ATLAS Collaboration, "Search for new phenomena in high-mass diphoton final states using 37 fb^{-1} of proton–proton collisions at $\sqrt{s} = 13$ TeV", Phys. Lett. B 775 (2017) 105, July 2017.

41. ATLAS Collaboration, "Search for new phenomena in final states with an energetic jet and large missing transverse momentum in pp collisions at 13 TeV using the ATLAS detector", Phys. Rev. D 94 (2016) 032005, April 2016.

42. ATLAS Collaboration, "Search for resonances in diphoton events at $\sqrt{s} = 13$ TeV with the ATLAS detector", JHEP 1609 (2016) 001, June 2016.

43. ATLAS Collaboration, "Measurements of the Higgs boson production cross section at 7, 8 and 13 TeV centre-of-mass energies …", ATLAS-CONF-2015-059, December 2015.

44. ATLAS Collaboration, "Fiducial and differential cross sections of Higgs boson production …", Phys. Lett. B 738, November 2014.

45. ATLAS Collaboration, "Measurement of the Higgs boson mass from the $H \to \gamma\gamma$ and $H \to ZZ^* \to 4\ell$ channels …", Phys. Rev. D 90, September 2014.

46. ATLAS Collaboration, "Measurements of Higgs boson production and couplings in the four-lepton channel…", Phys. Rev. D 91, August 2014.

47. ATLAS Collaboration, "Observation of an excess of events in the search for the Standard Model Higgs boson …", ATLAS-CONF-2012-169, December 2012.

48. ATLAS Collaboration, "Observation of a new particle in the search for the Standard Model Higgs boson ...", Phys. Lett. B 716, September 2012.

49. ATLAS Collaboration, "Search for the SM Higgs boson in $H \to ZZ^* \to 4\ell$...", Phys. Lett. B 710, April 2012.

50. ATLAS Collaboration, "Combined search for the Standard Model Higgs boson...", Phys. Lett. B 710, March 2012.

51. ATLAS Collaboration, "Observation of an excess of events...", ATLAS-CONF-2012-092, July 2012.

52. ATLAS Collaboration, "Search for the SM Higgs boson in the decay channel $H \to ZZ^* \to 4\ell$", Phys. Lett. B 705, September 2011.

53. ATLAS Collaboration, "Search for pair production of first or second generation leptonquarks...", Phys. Rev. D 83, April 2011.

54. ATLAS Collaboration, "Observation of $W \to \ell\nu$ and $Z/\gamma^* \to \ell\ell$...", ATLAS-CONF-2010-044, July 2010.

Talks

1. "Event Generator Tuning Incorporating MC Systematic Uncertainty ", 26th International Conference on Computing High Energy and Nuclear Physics, Norfolk, USA, May 9, 2023.

2. Poster, "Graph Neural Network for Particle Reconstruction in High Energy Physics detectors", 33rd Annual Conference on Neural Information Processing Systems, December 14, 2019

3. "HEP.TrkX Charged Particle Tracking using Graph Neural Network", Connecting The Dots / Intelligent Trackers, Valencia Spain, April 3, 2019.

4. "A novel workflow of generator tunings in HPC for LHC new physics searches", Physics Event Generator Computing Workshop, CERN, Nov 27, 2018.

5. "Search for heavy ZZ resonances in the $\ell^+\ell^-\ell^+\ell^-$ and $\ell^+\ell^-\nu\bar{\nu}$ final states with the ATLAS detector", Meeting of APS Division of Particle and Field, Fermi Accelerator National Laboratory, August 3, 2017.

6. "Search for BSM physics including dark matter at ATLAS", UCLA Dark Matter 2016, Los Angeles, USA, Febrary 18, 2016.

7. "Observation and measurements of the Higgs boson in the $H \to ZZ^* \to 4\ell$ decay mode", International Symposium on Higgs Physics, Beijing, China, August 15, 2013

8. Poster, "Observation of the new Higgs-like particle in the four lepton decay channel with the ATLAS detector", Large Hadron Collider Committee 2013, CERN, Switzerland, March 13, 2013

Teaching Activities

#	Name	Research	Start Date	End Date	Current Position	Paper	Project
26	**Yuta Roy Ioriya**	LLM for HEP	Feb 2025	May 2025			URAP
25	**Pranav Subbarayan**	ML for Gaia data	Apr 2024	Jan 2025			SEED
24	**Chenning (Annette) Huang**	Language model for HEP	Jan 2024	Nov 2024	CMU Master student		URAP
23	**Eric Ju**	Language model for HEP	Jan 2024	May 2024			URAP
22	**Megan Ho**	Tracless B-tagging	Aug 2023	Dec 2023			DS Discovery 2023
21	**Tanay Appannagari**	Tracless B-tagging	Aug 2023	Dec 2023			DS Discovery 2023
20	**Heaven Klair**	Tracless B-tagging	Aug 2023	Dec 2023			DS Discovery 2023
19	**Curtis Hu**	Deep generative model for hadronic interactions	Aug 2023	Jan 2024			URAP
18	**Elizabeth Weaver**	Language model for HEP	Jul 2023	Jan 2024			N/A
17	**Yash Melkani**	Language model for HEP	Nov 2022	Dec 2024		arXiv:2402.10239, arXiv:2407.21290	N/A
16	**Har Vey Yuen**	development of `jax` based MC Tuner	Sep 2022	May 2023			URAP
15	**Allen Chen**	development of `jax` based MC Tuner, hadronic interactions simulation	Aug 2022	Jan 2024			URAP
14	**Tuan Minh Pham**	Deep Generative Models for Hadronic Interactions	Feb 2022	Nov 2022		arXiv:2310.07553	Co-supervised
13	**Allison Xu**	GNN for Top physics and Generative Models for HEP	Jan 2022	May 2023	Graduate Student @ Stanford	arXiv:2303.10148	Co-supervised with Prof. Haichen Wang
12	**Jeffae Schroff**	MC Tuning with MC Uncertainties, `jax` based MC Tuner	Sep 2021	May 2023		arXiv:2310.07566	URAP
11	**Ian Wang**	Apply ExaTrkX pipeline to Large Radius Tracking (LRT)	Jul 2021	Sep 2022	Industry	J. Phys. Conf. Ser. 2438 (2023) 012117	Co-supervision with Prof. Shih-Chieh Hsu
10	**Landon Reed**	Graph Neural Network for Tau identification	Jun 2021	Jun 2022	Cisive	JINST 18 (2023) P07001	Exchange
9	**Andris Huang**	Heterogeneous GNN and Language Models for HEP	Apr 2021	Jun 2023	physics Ph.D candidate @ UC, Berkeley	JINST 18 (2023) P07001, arXiv:2402.10239	URAP
8	**David Lin**	Development of `root_gnn` software package	Feb 2021	Aug 2021			URAP
7	**Anthony Ding**	Development of `root_gnn` software package	Feb 2021	Aug 2021	MS in CS @ Columbia University		URAP
6	**Adeel Akram**	GNN for particle trackin in PANDA experiment	Nov 2020	Jun 2023		arXiv:2208.12178	Exchange
5	**Yaoyuan Xu**	Accelerate ExaTrkX Inference with GPUs	Oct 2020	Aug 2021		Eur. Phys. J. C 81 (2021) 876	Co-supervised with Kesheng Wu
4	**Alex Ballow**	Accelerate ExaTrkX Inference with GPUs	Oct 2020	Aug 2021	CS Graduate Student @ Montana State U.	Eur. Phys. J. C 81 (2021) 876	Co-supervised with Prof. Alina Lazar
3	**Aditi Chauhan**	Robustness of the Exa.TrkX Tracking pipeline to noise hits	Aug 2020	Aug 2021		Eur. Phys. J. C 81 (2021) 876	Co-supervised with Prof. Shih-Chieh Hsu
2	**Shangqing Huang**	Cluster Shape for Tracking Reconstruction	Mar 2020	Nov 2021		JINST 16 (2021) P05001	URAP
1	**Jacob Lyons**	Machine Learning for High Energy Physics	Aug 2018	Aug 2022	Graduate Student @ UC Santa Barbara	JINST 18 (2023) P07001	URAP