SICONG LU, PHD CANDIDATE

209 South 33rd Street, Philadelphia, PA 19104 | (650)296-0681 | siconglu@upenn.edu
LinkedIn: sicong-lu-phd | Google Scholar: Sicong Lu | SCOPUS: 57203570060 | ORCID: 0000-0002-8814-1670

EDUCATION

PhD Candidate in Physics & Astronomy, University of Pennsylvania   *Aug. 2018 – Dec. 2024*
GPA: 3.97/4.00 | **Thesis (Defended)**: Search for Higgsinos in compressed mass spectra using neural networks in the ATLAS detector and design verification of the AMAC ASIC for the ITk upgrade
Advisor: Prof. I. Joseph Kroll

Bachelor of Arts in Physics, Mathematics, University of California, Berkeley   *Aug. 2014 – Dec. 2017*
GPA: 3.83/4.00 | **Honors Thesis**: Application of Boosted Decision Trees in Improving the Sensitivity of $ttH \rightarrow \gamma\gamma$ analysis with the ATLAS Detector
Research Mentor: Prof. Haichen Wang, Prof. Marjorie Shapiro
Honors: Distinction in General Scholarship, Dean's List multiple terms, Honors in Physics

RESEARCH EXPERIENCE

Search of Higgsinos in Compressed Spectra using Displaced Tracks with Neural Networks   *2020 – Present*
Advisor: *Prof. I. Joseph Kroll, ATLAS group, University of Pennsylvania*

- Analyzed datasets from 40 million proton-proton collisions per second using the ATLAS detector to search for rare Higgsino signals (Natural SUSY & Dark Matter candidate).
- Developed fully connected neural networks in PyTorch for event & tracks, introducing a novel loss function optimized for small datasets, improving sensitivity by 80-400% (sensitivity-equivalent luminosity increase).
- Applied data-driven correction to Monte Carlo simulation.
- Cross-validated the neural network model to prevent overtraining & bias, and used orthogonal validation regions to verify kinematics modeling.
- Used PyHF for simultaneous likelihood fitting to constrain systematic uncertainties.
- Cut-based results were published in Physical Review Letters, and results using the neural network approach were presented at multiple APS conferences, currently under ATLAS collaboration review and

Autoencoding Galaxy Spectra (Collaboration with Princeton Astro Data Lab)   *2020 – 2023*
Collaborators: *Ms. Yan Liang and Prof. Peter Melchior, Department of Astrophysics, Princeton University*

- Refined machine learning models by introducing physically-motivated loss functions to improve the robustness of low-dimensional representations of high-dimensional galaxy spectra datasets.
- Developed a spectrum-latent similarity loss and latent space metric, enhancing model interpretability, feature extraction, and redshift invariance.
- Advised on training strategies that improved the convergence of high-quality generative models, later applied to pattern recognition, reconstruction, and anomaly detection.
- Identified outliers representing rare astrophysical phenomena and instrument anomalies.
- Results published in *The Astronomical Journal* and presented at the NeurIPS 2022 Workshop on Machine Learning and the Physical Sciences.

Verification & Testing of AMAC ASIC for HL-LHC ATLAS Upgrade *2018 – 2023*
Advisor: *Prof. I. Joseph Kroll, ATLAS group, University of Pennsylvania*
Instrumentation Group: *Mitchell Newcomer, Paul T. Keener, Adrian Nikolica, Godwin Mayers*

- Collaborated with the engineering teams to design low-latency chips and managed key aspects of testing system software.
- Verified AMACStar design through Python cocotb simulations, with a focus on radiation hardness and stability in high-radiation environments.
- Conducted prototype and pre-production testing for AMACv2a and AMACStar, analyzing analog functionality and performance under high-risk conditions.
- Developed a Python-based testing repository for circuit simulation, including Single-Event Effects injection tests (over 88 million events), ensuring chip integrity and robustness.
- Led the development of automated quantitative characterization and grading procedures for ~25,000 ASICs post-production, identifying core design flaws and enhancing chip reliability.
- Presented testing and verification results at AMAC Final Design Reviews and APS DPF 2021; credited in five TWEPP 2022 presentations and subsequent publications. Standalone AMAC paper in preparation.

Searching for SUSY Particles with R-parity Violation in Multijet Final State *2017 –2018*
Supervised by Prof. Marjorie Shapiro and Prof. Haichen Wang, ATLAS Group, LBNL

- Targeted multijet final states using jet mass template method.
- Performed data analysis and statistical interpretation;
- Published in *Physics Letters B*.

SELECT PUBLICATIONS (MAJOR CONTRIBUTION)

Search for Nearly Mass-Degenerate Higgsinos Using Low-Momentum Mildly Displaced Tracks in pp Collisions at $\sqrt{s}$ = 13 TeV with the ATLAS Detector
ATLAS Collaboration, *Phys. Rev. Lett.*, **132**, 221801 (2024).
DOI: 10.1103/PhysRevLett.132.221801

Autoencoding Galaxy Spectra. II. Redshift Invariance and Outlier Detection
Yan Liang, Peter Melchior, Sicong Lu, Andy Goulding, Charlotte Ward, The Astronomical Journal, **166***, 75 (2023).*
DOI: 10.3847/1538-3881/ace100

Search for R-parity violating supersymmetric particles in multi-jet final states produced in pp collisions at 13 TeV using the ATLAS detector at the LHC
ATLAS Collaboration, *Physics Letters B*, **785**, 136-158 (2018).
DOI: 10.1016/j.physletb.2018.08.036

Quality Control Testing of the AMAC ASIC for the HL-LHC ATLAS ITk Strip Detector
T.C. Gosart et al., *Journal of Instrumentation*, **18** (2023).
DOI: 10.1088/1748-0221/18/02/C02013

Verification of Simulated ASIC Functionality and Radiation Tolerance for the HL-LHC ATLAS ITk Strip Detector
W.J. Ashmanskas et al., *Journal of Instrumentation*, **18** (2023).
DOI: 10.1088/1748-0221/18/01/C01029

Irradiation Testing of ASICs for the HL-LHC ATLAS ITk Strip Detector
J.R. Dandoy et al., *Journal of Instrumentation*, **18** (2023).
DOI: 10.1088/1748-0221/18/02/C02044

Quality Control Testing of the HCC ASIC for the HL-LHC ATLAS ITk Strip Detector
J.R. Dandoy et al., *Journal of Instrumentation*, **18** (2023).
DOI: 10.1088/1748-0221/18/02/C02026

Testing of the HCC and AMAC Functionality and Radiation Tolerance for the HL-LHC ATLAS ITk Strip Detector
J.R. Dandoy et al., *Journal of Instrumentation*, **18** (2023).
DOI: 10.1088/1748-0221/18/03/C03017

SELECTED PUBLICATIONS (ATLAS Collaboration)

Qualified Author of ATLAS Collaboration since 2020.

A detailed map of Higgs boson interactions by the ATLAS experiment ten years after the discovery
ATLAS Collaboration, *Nature*, **607**(7917), 52–59 (2022).
DOI: 10.1038/s41586-022-04893-w

Search for chargino–neutralino pair production in final states with three leptons and missing transverse momentum in $\sqrt{s}=13$ TeV pp collisions with the ATLAS detector
ATLAS Collaboration, *European Physical Journal C*, **81**(12), 1118 (2021).
DOI: 10.1140/epjc/s10052-021-09749-7

Search for charginos and neutralinos in final states with two boosted hadronically decaying bosons and missing transverse momentum in pp collisions at $\sqrt{s}=13$ TeV with the ATLAS detector
ATLAS Collaboration, *Physical Review D*, **104**(11), 112010 (2021).
DOI: 10.1103/PhysRevD.104.112010

Search for long-lived charginos based on a disappearing-track signature using 136 fb^{-1} of pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector
ATLAS Collaboration, *European Physical Journal C*, **82**(7), 606 (2022).
DOI: 10.1140/epjc/s10052-022-10489-5

Measurement of the Higgs boson mass with $H \rightarrow \gamma\gamma$ decays in 140 fb^{-1} of pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector
ATLAS Collaboration, *Physics Letters B*, **847**, 138315 (2023).
DOI: 10.1016/j.physletb.2023.138315

Full list of publications available on SCOPUS: 57203570060

SEMINAR & INVITED TALKS

Search for Higgsinos using Neural Networks and ASIC Verification *Feb. – Aug. 2018*
Special Elementary Particle Experiment Seminar, University of Washington
https://indico.cern.ch/event/1384659/

AWARDS & SCHOLARSHIP

APS DPF April '23 Meeting Travel Award	*2023*
APS DPF April '22 Meeting Travel Award	*2022*
Undergraduate Student Assistantship *(LBNL, ATLAS Group)*	*2017 – 2018*
Berkeley Physics Undergraduate Research Scholars	*2016 – 2018*
Dean's Honor List	*2014 – 2015*
IYPT Gold Medal, National Team of China	*2014*
International Young Physicists' Tournament (27th), Shrewsbury, United Kingdom	
Silver Medal, Team Captain, China Young Physicists' Tournament (CYPT)	*2014*
National competition, Nankai, China	
Bronze Prize, S.-T. Yau High School Science Award (Physics)	*2013*
Clifford Swartz Trophy, Team Captain, US Invitational Young Physicists' Tournament (USIYPT)	*2013*

CONFERENCE PRESENTATIONS AS MAIN PRESENTER

APS April Meeting 2023 "Quark to Cosmos"
Search for Higgsinos in Compressed Mass Spectra using Neural Networks in $\sqrt{s}$=13 TeV pp Collisions with the ATLAS Detector
Link to Session | Presentation

NeurIPS 2022 Workshop in Machine Learning and the Physical Sciences
Interpretable Encoding of Galaxy Spectra
Link to Session |Poster| Peer-Reviewed Paper

APS April Meeting 2022 "Quark to Cosmos"
Search for Semi Long-Lived ElectroWeakinos/Higgsinos Decaying into Charged Particles in the ATLAS Detector with LHC Run 2 Data
Link to Session

2021 Meeting of the Division of Particles and Fields of the American Physical Society (DPF 2021)
AMAC ASIC for the ATLAS ITk Silicon Strip Detector Design and Verification
Link to Session

EMPLOYMENT HISTORY & FUNDING

Research Assistant (Tuition & Stipend) *UPenn, Department of Physics & Astronomy*	*2018 – Present*
Post-Baccalaureate Researcher *UCSD, CMS Group, Department of Physics*	*2018*
Note-taker for Disabled Students *UC Berkeley, Disabled Student Program*	*2017 – 2018*