Shih-Chieh Hsu

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Education

2003-2008   **Ph.D. in Elementary Particle Physics**
University of California San Diego, La Jolla, CA 92093
Thesis Advisor: Prof. Frank Würthwein
Thesis Title: *A Study of WW, ZZ and Higgs Production in $ll + \not{E}_T$ Channel at CDF Run II*

1999-2001   **Master of Science in Physics**
National Taiwan University, Taipei, Taiwan
Thesis Advisor: Prof. Paoti Chang
Thesis Title: *Study of the Charmless Hadronic Decay $B \to \eta' K$ with the Belle Detector*

1995-1999   **Bachelor of Science in Physics**
National Taiwan University, Taipei, Taiwan

Professional Appointments

2021 -   **Directpr**
NSF HDR Institute: Accelerated Artificial Intelligence Algorithms for Data-Driven Discovery (A3D3)

2018 -   **Associate Professor**
University of Washington, Physics, Seattle, WA 98195, USA

2018 -   **Adjunct Associate Professor**
National Tsing Hua University Physics, HsinChu, Taiwan

2012 - 2018   **Assistant Professor**
University of Washington, Physics, Seattle, WA 98195, USA

2012 - 2018   **Adjunct Assistant Professor**
University of Washington, Elec. & Comp. Engineering, Seattle, WA, USA

2008-2012   **Chamberlain fellow**
Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA

Honors and Awards

2020	Special Recommendation Award for Youth Science Popularization - Chinese Translation of "We have no idea"
2016	DOE early career award
2015	UW undergraduate research mentor award
2014	US ATLAS scholar
2008-2012	Owen Chamberlain Fellowship in experimental particle physics and cosmology
2007	NSF/CERN Awards for the Young Scientist Forum in the 42nd Electroweak Moriond Conference
2003-2004	Graduate Academic Performance Scholarship, UCSD

Leadership and Service

2021	Director, NSF HDR Institute: A3D3
2020	Co-Chair, Snowmass 2022 (Seattle, USA)
2020	Organization Committee, Fast Machine Learning (USA)
2019	Local chair, Dark Matter @ Large Hadron Collider 2019 (Seattle, USA)
2018	Local chair, Connecting The Dots Workshop 2018 (Seattle, USA)
2018-	Coordinator, FASER tracking reconstruction
2017	Local Organization Committee, Advanced Computing and Analysis Techniques in Physics Research Conference (Seattle, USA)
2017-	Manager, US ATLAS Analysis Center at LBNL
2016	Organization Committee, BSM Higgs Workshop 2016 (Hsing-Chu, Taiwan)
2015	Local chair, US ATLAS Hadronic Final State Forum 2015 (Seattle)
2015	Organization Committee, ATLAS Tracking Workshop 2015 (Chamonix, France)
2015	Reviewer, Run1 Top differential cross-section, PRD93 (2016) 072004
2015-2017	Co-convener, ATLAS Tracking Combined Performance
2015	Co-convener, EWK and Higgs session, DPF 2015 (Ann Arbor)
2015	Co-coordinator, ATLAS IBL Mechanical Stability Task force
2015	Co-editor, ATLAS 8 TeV mono-H search; Boosted W-tagging in Run1
2015-	Member, UW Research Experience for Undergraduate
2014	Reviewer, Run1 $WW\gamma$ and $WZ\gamma$ cross section, PRD90 (2014) 032008
2014	Local chair, US ATLAS Annual Meeting 2015
2013-2015	Co-coordinator, ATLAS Inner Detector Alignment
2013-2017	Member, UW Graduate Admission Committee
2012-	Mentor, UW QuarkNet Center
2011-2012	Contact, LHC Electroweak Diboson group
2011-2012	Co-convener, ATLAS Electroweak group

Research Activities

Physics Analysis

2012 -

- Analysis Contact, "Search for Dark Matter pair Production in Association with a Scalar Decaying to $b\bar{b}$ final state"

- Advisor of Senior, Jakub Filipek, as primary developer of SQUID for Quantum Machine Learning [2].

- Co-Advisor of Ph.D. student, Yue Xu, as primary analyzer of Generic Heavy Higgs search [4].

- Advisor of Ph.D. student, Nikola Whallon, as editor of mono-h summary JHEP **1905**, 142 (2019) [arXiv:1903.01400 [hep-ex]].

- Co-supervisor of Ph.D. students, Gang Zhang and Aaron Soffa, for FASER tracking reconstruction and performance study, [arXiv:1901.04468 [hep-ex].

- Advisor of postdoc, Sam Meehan, as lead editor of Machine Learning W-jet tagger and top-jet tagger [7]

- Advisor of Ph.D. student, Zach Montague, on development of Telescoping Jetsubstructure technique [arXiv:1711.11041 [hep-ph]].

- Advisor of postdoc, Sam Meehan, as contact editor of mono-h [8]

- Advisor of undergraduate student, Firdaus Soberi, to work on generator study of $Z\gamma$ quartic coupling, JHEP 07 (2017) 107, [arXiv:1705.01966 [hep-ex]]

- Analyzer of discovery sensitivity of muon-jet in LHC Phys. Rev. D **95**, no. 3, 035012 (2017) [arXiv:1607.07550 [hep-ph]].

- Developer of Deep Learning flavor tagging [9]

- Advisor of postdoc, Sam Meehan, as lead analyzer of mono-V (Phys. Lett. B **763**, 251 (2016) [arXiv:1608.02372])) and $\nu\bar{\nu}qq$ resonance search (JHEP **1609**, 173 (2016) [arXiv:1606.04833 [hep-ex]])

- Main editor of Dark matter search in mono-h final state at $\sqrt{s} = 8$ TeV, Phys. Rev. D **93**, no. 7, 072007 (2016), [arXiv:1510.06218 [hep-ex]]

- Main editor of Boosted W Boson Identification and performance paper, Eur. Phys. J. C **76**, no. 3, 154 (2016), [arXiv:1510.05821 [hep-ex]]

- Advisor of Ph.D. student, Nikola Walloon, on the mono-h EFT session of Dark Matter Benchmark Models for Early LHC Run-2 Searches: Report of the ATLAS/CMS Dark Matter Forum, [arXiv:1507.00966]

- Main editor of Studies of Vector Boson Scattering And Triboson Production with an Upgraded ATLAS Detector at a High-Luminosity LHC, [ATL-PHYS-PUB-2013-006]

- Advisor of undergrad Alex Emerman on the kkW search section of Warped Extra Dimensional Benchmarks for Snowmass 2013, [arXiv:1309.7847]

- Lead analyst of Vector Boson Scattering And Triboson Production for Snowmass reports, [arXiv:1309.7452], [arXiv:1310.6708]

- Advisor of postdoc, Marilyn Marx, as co-editor of Performance and Validation of Q-Jets at the ATLAS Detector in pp Collisions at $\sqrt{s}=8$ TeV in 2012, [ATLAS-CONF-2013-087]

2008-2012

- Co-editor and analysis contact of the first measurement of the ZZ production cross section and the most stringent neutral Triple Gauge Couplings (nTGC) at LHC [10]

- Lead analyst of the first four lepton exotic searches at 7 TeV with ATLAS and published in Phys.Lett. B712 (2012) 331-350 [1203.0718 [hep-ex]]

- Member of the task force responsible for the event optimization and systematics studies of the first WW cross-section measurement at ATLAS [11]

- Lead analyst to make the first observation of Z bosons in the dimuon channel during the first heavy-ion collision run at ATLAS and to make the first preliminary result of the centrality dependence of J/ψ production with detailed systematic studies, Phys. Lett. B **697** 294 (2011) [arXiv:1012.5419 [hep-ex]].

- Lead analyst for the tracking efficiency measurement and background composition studies for Υ production cross-section measurement at ATLAS, Phys. Lett. B **705**, 9 (2011) [arXiv:1106.5325 [hep-ex]].

2005-2008

- Core developer of the Matrix Element method which calculates the event probability density function using all reconstructed kinematic information and improves observation sensitivity by 30% with respect to the cut-base method. This technique is applied to three Phy. Rev. Lett. publications.

  - The most stringent Standard Model Higgs production limit at CDF in summer 2009, Phys. Rev. Lett. **102** 021802 (2009) [0809.3930 [hep-ex]].
  - The most precision WW cross-section measurement at CDF, Phys. Rev. Lett. **104**201801 (2010) [arXiv:0912.4500 [hep-ex]]
  - The 4.4σ observation of ZZ production at CDF, Phys. Rev. Lett. **100**, 201801 (2008) [arXiv:/0801.4806 [hep-ex]]

- Member of the task force responsible for the lepton and missing transverse energy performance studies for the first observation of WZ at CDF, Phys. Rev. Lett. **98**, 161801 (2007) [hep-ex/0702027].

Detector & Performance

2012-

- Advisor of Dustin Werran on quantization and optimization of Top-tagging ResNet-50 model using MicroSoft Brainwave framework [5].

- Co-convener of ALTAS Inner Detector combined performance group, responsible for charged particle reconstruction with Inner Detector and Inner Tracker Upgrade. There are 2 combined performance papers, 4 conference notes and 12 public notes released during my 2 years convenership.

- Advisor of Nikola Whallon to develop software emulator for the RD53A pixel chip and YARR software [3].

- Advisor of Lev Kurilenko to develop hardware emulator for the RD53A pixel chip.

- Co-editor of Study of the mechanical stability of the ATLAS Insertable B-Layer, ATL-INDET-PUB-2015-001

- Advisor of Nick Dreyer for the DAQ software development of Pixel L1/L2 ROD Upgrade

- Advisor of Dr. Lynn Marx who is responsible for the IBL Stave Quality Assurance task and IBL DAQ software firmware development.

- Advisor of Nikola Whallon for Pixel offline analysis study, optimization of Pixel Run2 operation parameter and RD53 software emulator

- Co-supervisor of Joseph Mayer, Logan Adams, and Dustin Werran with UW EE Prof. Scott Hauck for development of FPGA/HDL firmware for the Pixel L1/L2 ROD upgrade and RD53 hardware emulator for ITk PhaseII upgrade

- Co-supervisor of Bing Chen with UW EE Prof. Scott Hauck for development of FPGA/HDL firmware for the IBL Read Out Driver.

- Advisor of Max Golub to develop a DAQ system for T3MAPS CMOS sensor

- Advisor of Jimin Kim to setup VME ROD in UW

Teaching, Supervising and Outreach

2021	• PHYS123 and 119 Lab instructors
	• NTHU PHYS51000: Hands-on Artificial Intelligence for Physics
	• Postdoc: Elham E. Khoda
	• Graduate: John Spencer
2020	• PHYS123 and 119 Lab instructors
2019	• PHYS123 and 119 Lab instructors
	• UW Engineering Discovery Days: LHC booth
	• LHC Masterclass 2019
	• Postdoc: Ke Li
2018	• PHYS123: Waves, Optics, and Heat
	• UW Engineering Discovery Days: LHC booth
	• LHC Masterclass & QuarkNet Cosmic Ray Workshop 2018
2017	• PHYS123: Waves
	• PHYS433: Modern Physis Lab
	• Pacific Science Center weekend: LHC booth
	• LHC Masterclass & QuarkNet Cosmic Ray Workshop 2017
	• Graduate: Zach Montague (1st year)
2016	• Postdoc: Sam Meehan
	• Graduate: Nikola Whallon (General exam Apr 25), Alex Hostiuc (3rd year)
	• Mary Gates Schollar: Max Golub
	• Gifted Internship from Interlake High: Ruta Dhaneshwar
	• PHYS428/PHYS576: advanced techniques in experimental particle physics
	• Paws-on-Science 2016 in Pacific Center - "Smashing Proton"
	• LHC Masterclass & QuarkNet Cosmic Ray Workshop 2016
2015	• Postdoc: Marilyn Marx (Mar), Samuel Meehan (since Aug)
	• Graduates: Nikola Whallon, Alex Hostiuc
	• Mary Gates Scholar: Tun Sheng Tan, Firdaus Soberi, John Spencer
	Gifted Internship from Interlake High: Chunyun Ding
	• LHC Masterclass & QuarkNet Cosmic Ray Workshop 2015
	• Paws-on-Science 2015 in Pacific Center - "Smashing Proton"
	• PHYS600A: Ali Ashtari, Nikola Whallon, Alex Hostiuc
	• PHYS248C: Unraveling Dark Universe with the Large Hadron Collider
2014	• Postdoc: Marilyn Marx
	• PHYS121B: Mechanics
	• Gradaute: Nikola Whallon
	• Mary Gates Scholar: Kevin Jamison, UW REU: Michael Cambria, Honor Porgam in Experiential Research (CSE major): Jack Conger, Alexis Hooper Gifted Internship from Interlake High: Darren Leung
	• LHC Masterclass & QuarkNet Cosmic Ray Workshop 2014
	• Paws-on-Science 2014 in Pacific Center - "Smashing Proton"
	• PHYS600A: Ali Ashtari
	• PHYS248C LHC: the discovery machine
2013	• Postdoc: Marilyn Marx
	• Mary Gates Scholar: William Johnson, NASA SURF fellow: Kevin Jamison, CERN REU: Tony Burrus, CERN Semester Fellow: Alex Emerman
	• PHYS600A: Aaron Feinberg, Zhanglu Wang, Jordan Raisher
	• LHC Masterclass & QuarkNet Cosmic Ray Workshop 2013
	• PHYS123A Waves
	• PHYS422A Introduction to Particle and Nuclear Physics
	• PHYS294A Introduction to Physics Research
	• PHYS428A/576B Advanced Technology for Experimental Particle Physics
2012	• PHYS485A/494A Senior Honors Seminar

Invited Talks, Conferences and Workshops

Mar 2021	"Accelerating Particle Physics Discovery with Artificial Intelligence", Colloquium, National Cehng Kung University, Tainan
Dec 2020	"Summary of Fast ML for Science Workshop", HFS Trigger Workgroup
Jan 2020	"New LHC Experiments for Long-lived Particle Search", 16th Reconstres du Vietnam TEM 2020, Quy Nhon
Nov 2019	"Accelerating Discovery at the LHC with Machine Learning", Colloquium, Tsinghua University, Beijing
May 2019	"Searches for dark matter", LHCP 2019, Puebla, Mexicao
May 2019	"FASER – a new LHC detector for Long Lived Particles", Fermilab Wine and Cheese
Jan 2019	"FASER: ForwArd Search ExpeRiment at the LHC", IAS HEP 2019, Hong Kong
Dec 2018	"Tracking and Jet Substructure", HFSF 2018, LBNL
Apr 2018	"Dark Matter Search at the LHC using the Standard Model candles", Workshop, DM@LHC 2018, Heidelberg
Jan 2018	"ATLAS Inner Tracker Upgrade", Conference, IAS HEP 2018, Hong Kong
Oct 2017	"LHC Electroweak Physics", Workshop, Brookhaven Forum, BNL
Sep 2017	"Dark Matter with Boosted Higgs Boson", Seminar, Rugers, UPenn, and Stony Brook
Aug 2017	"Dark Matter with Jet substructure" (Invited Plenary), NTHU BSM workshop, Hsin-Chu, Taiwan
Apr 2017	"Dark Matter with Boosted Higgs Boson", Colloquium, ISU, Ames
Oct 2016	"Search for New Physics through the Higgs Boson" (Invited Plenary), KIAS workshop, Gwangju, Korea
Aug 2016	"Hunting for Dark Matter with Boosted Boson and Higgs in ATLAS", Wine & Cheese Seminar, FNAL
Aug 2016	"Exotics Physics Summary" (Invited Plenary), ICHEP 2016, Chicago
Nov 2015	"Mono-Higgs: an alternative probe for dark matter in the ATLAS", HEP seminar, Zurich
Oct 2015	"Boosted Boson identification in the ATLAS", HEP seminar, Stockholm
Aug 2015	"Performance of the ATLAS Pixel Detector Upgrade in Run2", DPF 2015, Ann Arbor
Aug 2014	"Status of Triboson and Vector Boson Scattering" (Invited Plenary), Physics at the LHC and Beyond 2014, Quy-Nhon, Vietnam
Mar 2014	"LHC Physics" (Invited lectures), Spring School of Particle and Field, Chang-Gen, Taiwan
Nov 2013	"The LHC, The Enrgy Frontier and the Next Big Discovery" (Colloquium), Chung-Li and Hsin-Chu, Taiwan
June 2013	"Study of Quartic Boson Coupling for Snowmass", Snowmass Energy Frontier All Hands-on Workshop, Seattle
Apr 2013	"Review of Top, W&Z and other Precision Measurement from ATLAS and CMS (Invited Plenary)", APS 2013, Boudler, Colorado (declined due to VISA issue)
Mar 2013	"New Physics Search in Multi-Gauge Boson Final State" (Invited Plenary), Cross-Strait Meeting on Particle Physics and Cosmology 2013, Chung-Li, Taiwan
Feb 2013	"Experimental Signatures of Vector Boson Scattering and Vector Boson Coupling", Snowmass Electroweak Working group in Duke, NC
Feb 2013	"Higgs Discovery" (Invited), Art Institute in Seattle, WA
Nov 2012	"Recent Diboson Update from ATLAS" (Invited), LHC Seminar, CERN, Geneva, Swiss
Oct 2012	"Vector Boson Scattering and Diboson search" (Invited), ATLAS Higgs Jamboree, LBNL, Berkeley, CA

Publications, Conference Notes and Proceedings

High Energy Physics is an international collaboration with a large number of people. I have in total **32** journal papers at BELLE, **215** journal papers at CDF, **969** journal papers at ATLAS, **2** journal papers at FASER, and **2** journal papers at FastML, In addition, I have 3 phenomenology papers with a few collaborators and 8 conference notes (proceedings). Here I highlight **10** journal publications that I am one of the primary authors with significant contributions and/or the main editor.

Journal Publications (10 representatives)

[1] J. Filipek, S.-C. Hsu, A. Roggero, N. Wiebe, "Quantum Machine Learning with SQUID," [arXiv:2105.00098 [quant-ph]].

[2] FASER Collaboration, "First neutrino interaction candidates at the LHC," [arXiv:2105.06197 [hep-ex]].

[3] ATLAS Collaboration, "Search for Dark Matter Produced in Association with a Dark Higgs Boson Decaying into $W^{\pm}W^{\mp}$ or ZZ in Fully Hadronic Final States from $\sqrt{s} = 13$ TeV pp Collisions Recorded with the ATLAS Detector," Phys. Rev. Lett. **126**, no.12, 121802 (2021) doi:10.1103/PhysRevLett.126.121802 [arXiv:2010.06548 [hep-ex]].

[4] X. Chen, **S.-C. Hsu**, *et al.*, "Search for a generic heavy Higgs at the LHC," Phys. Lett. B **804**, 135358 (2020) doi:10.1016/j.physletb.2020.135358 [arXiv:1905.05421 [hep-ph]].

[5] J. Duarte, **S.-C. Hsu**, *et al.*, *et al.*, "FPGA-accelerated machine learning inference as a service for particle physics computing," Comput. Softw. Big Sci. **3**, no. 1, 13 (2019) doi:10.1007/s41781-019-0027-2 [arXiv:1904.08986 [physics.data-an]].

[6] FASER Collaboration, "FASER's physics reach for long-lived particles," Phys. Rev. D **99**, no. 9, 095011 (2019) doi:10.1103/PhysRevD.99.095011 [arXiv:1811.12522 [hep-ph]].

[7] ATLAS Collaboration, "Performance of top-quark and W-boson tagging with ATLAS in Run 2 of the LHC," Eur. Phys. J. C **79**, no. 5, 375 (2019) [arXiv:1808.07858 [hep-ex]].

[8] ATLAS Collaboration, "Search for Dark Matter Produced in Association with a Higgs Boson Decaying to $b\bar{b}$ using 36 fb^{-1} of pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector," Phys. Rev. Lett. **119**, 181804 (2017) [arXiv:1707.01302 [hep-ex]].

[9] D. Guest, J. Collado, P. Baldi, **S.-C. Hsu**, G. Urban and D. Whiteson, "Jet Flavor Classification in High-Energy Physics with Deep Neural Networks," Phys. Rev. D **94**, no. 11, 112002 (2016) [arXiv:1607.08633 [hep-ex]].

[10] ATLAS Collaboration, "Measurement of the ZZ production cross section and limits on anomalous neutral triple gauge couplings in proton-proton collisions at $\sqrt{s} = 7$ TeV with the ATLAS detector," Phys. Rev. Lett. **108**, 041804 (2012), [arXiv:1110.5016 [hep-ex]].

[11] ATLAS Collaboration, "Measurement of the $W^{+}W^{-}$ Cross Section in $\sqrt{s} = 7$ TeV pp Collisions with ATLAS," Phys. Rev. Lett. **107**, 041802 (2011), [arXiv:1104.5225 [hep-ex]].

Book

[1] **S.C. Hsu**, S.-L. Yeh, "We Have No Ideas - Chinese translation," Taiwan (2017), ISBN:9789864793471

Workshop Report

[1] D. Abercrombie *et al.*, "Dark Matter Benchmark Models for Early LHC Run-2 Searches: Report of the ATLAS/CMS Dark Matter Forum," arXiv:1507.00966 [hep-ex].

Conference Notes and Proceedings

[1] G. Zhang, B. Nachman, S. C. Hsu and X. Chen, "The Measurement of Position Resolution of RD53A Pixel Modules," arXiv:1908.10973 [physics.ins-det].

[2] A. Schuy, L. Heinrich, K. Cranmer and S. C. Hsu, "Extending RECAST for Truth-Level Reinterpretations," arXiv:1910.10289 [physics.data-an].

[3] N. L. Whallon, T. Heim, M. Garcia-Sciveres, A. Sautaux, H. Oide, K. Potamianos and **S.-C. Hsu**, "Upgrade of the YARR DAQ system for the ATLAS Phase-II pixel detector readout chip," PoS TWEPP **-17** (2018) 076.

[4] ATLAS Collaboration, "Variable Radius, Exclusive-k_T, and Center-of-Mass Subjet Reconstruction for Higgs($\to b\bar{b}$) Tagging in ATLAS", ATL-PHYS-PUB-2017-010

ATLAS Collaboration, "Performance of Top Quark and W Boson Tagging in Run 2 with ATLAS", ATLAS-CONF-2017-064

[5] ATLAS Collaboration, "Search for diboson resonances in the $\nu\nu qq$ final state in pp collisions at $\sqrt{s}$ =13 TeV with the ATLAS detector", ATLAS-CONF-2015-068

[6] ATLAS Collaboration, "Search for dark matter produced in association with a hadronically decaying vector boson in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector at the LHC," ATLAS-CONF-2015-080

[7] S.-C. Hsu [ATLAS Collaboration], "Measurement of the ZZ production cross section and limits on anomalous neutral triple gauge couplings in proton-proton collisions at sqrts =7 TeV with the ATLAS detector," arXiv:1109.6670 (DPF2011)

[8] S.-C. Hsu [ATLAS Collaboration], "Alignment of the ATLAS inner detector tracking system," Nucl. Phys. Proc. Suppl. **215**, 92 (2011).

[9] S.-C. Hsu [ATLAS Collaboration], " J/ψ production in p-p and in Heavy Ions in ATLAS," PoS(BEAUTY 2011)028.

[10] S.-C. Hsu (for the CDF Collaboration), "Searching for $H \to WW^{(*)}$ and Other Diboson Final States at CDF," arXiv:0706.2200.