# 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

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

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

| | |
|---|---|
| 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 -**

- Co-Advisor of Ph.D. student, Yue Xu, as primary analyzer of Generic Heavy Higgs search [1].
- Advisor of Ph.D. student, Nikola Whallon, as editor of mono-$h$ summary [3]
- 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 [5]
- 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-$h$ [6]
- 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 [7]
- Developer of Deep Learning flavor tagging [8]
- 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 [9]
- 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 [10]
- 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 $J/\psi$ 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 $\Upsilon$ 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 4.4$\sigma$ 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 [2].
- 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

2020
- PHYS123 and 119 Lab instructores

2019
- PHYS123 and 119 Lab instructores

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

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| 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 and **925** journal papers at ATLAS. 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] 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]].

[2] 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]].

[3] ATLAS Collaboration, "Constraints on mediator-based dark matter and scalar dark energy models using $\sqrt{s} = 13$ TeV $pp$ collision data collected by the ATLAS detector," JHEP **1905**, 142 (2019) [arXiv:1903.01400 [hep-ex]].

[4] 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]].

[5] 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]].

[6] 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]].

[7] J. Chang, K. Cheung, **S.-C. Hsu** and C. T. Lu, "Detecting multimuon jets from the Higgs boson exotic decays in the Higgs portal framework," Phys. Rev. D **95**, no. 3, 035012 (2017) [arXiv:1607.07550 [hep-ph]].

[8] 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]].

[9] 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]].

[10] 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], " $J/\psi$ 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.