Dr. Suyog Shrestha — Curriculum Vitae

Contact Information

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Positions

Assistant Professor of Physics, Washington College	May 2022 - Present
Adjunct Assistant Professor, The Ohio State University	Sep 2022 - Present
Postdoctoral Researcher, CERN & The Ohio State University	2014 - 2021
Research Assistant, CERN & Iowa State University	2011 - 2014

Education

Iowa State University, Ames, Iowa, USA
Ph.D., Experimental Particle Physics, July 2014

Grinnell College, Grinnell, Iowa, USA
B.A., Physics, May 2006

Grants

Int'l Particle Physics Outreach Group Grant, CERN	2023
National Science Foundation US-ATLAS Grant, USA	2023
ICTP Physics Without Frontiers Outreach Travel Grant, Italy	2023
National Science Foundation US-ATLAS Outreach Grant, USA	2022
National Science Foundation US-ATLAS Outreach Grant, USA	2019
ICTP Physics Without Frontiers Outreach Travel Grant, Italy	2019
National Science Foundation US-ATLAS Outreach Grant, USA	2018
Science & Technology Facilities Council Travel Grant, UK	2018
CERN International Relations Travel Grant, CERN	2017
International Centre for Theoretical Physics Travel Grant, Italy	2015
CERN & ICTP Physics Without Frontiers Outreach Grant, CERN & Italy	2015
CERN & ICTP Physics Without Frontiers Outreach Grant, CERN & Italy	2014

Honors/Awards

Grinnell College Alumni Award, Grinnell College	2023
Faculty Enhancement Award, Washington College	2023
John S. Toll Fellowship Awards, Washington College	2023
John S. Toll Fellowship Awards, Washington College	2022
Physics Mentor Award, The Ohio State University	2021
John S. Toll Fellowship Awards, Washington College	2021
John S. Toll Fellowship Awards, Washington College	2020
Graduate College Teaching Excellence Award, Iowa State University	2009
Richard G. Patrick Outstanding Teaching Award, Iowa State University	2009
Outstanding First Year Teaching Award, Iowa State University	2008
H. George Apostle Outstanding Senior Award in Physics, Grinnell College	2006
First runner-up, Iowa Collegiate Mathematics Competition	2005
International Merit Scholarship, Grinnell College	2003

Colloquia and Seminars

"Higgs at 10! Ten Years of Measurements of the Most Recently Discovered Elementary Particle & Contribution of Nepali Researchers," Physics Colloquium, Tribhuvan University, Nepal, May 2022

"Unraveling the mysteries of the Universe one particle at a time ," Physics Colloquium, The College of the Holy Cross, MA, USA, October 2020

"Higgs Boson as a Tool in the Search for New Physics," Physics Seminar, Washington College, MD, USA, January 2020

"Final Test of the Standard Model," High Energy Physics Seminar, Ohio State University, OH, USA, January 2020

"Higgs Boson as a Probe in the Search for New Physics," Physics Seminar, Marietta College, OH, USA, January 2020

"Higgs Boson as a Probe in the Search for New Physics," Physics Seminar, University of Sussex, UK, April 2019

"Higgs Boson as a Tool to Discover New Physics and New Physicists," Physics Seminar, Grinnell College, Iowa, September 2018

"Arresting God Particle in Kathmandu," Public Seminar, Oxford University, UK, March 2018

"Pushing the Frontiers of Knowledge at CERN's Large Hadron Collider," Physics Colloquium, St. Olaf College, Northfield, MN, USA, September 2017

"Borders and Their Human Impacts Colloquium Series: Science Without Borders at CERN," Public Colloquium, Washington and Lee University, Lexington, VA, USA, September 2017

"Search for Pair Production and Rare Decay of the Higgs Boson With the ATLAS Detector," High Energy Physics Seminar, Iowa State University, Ames, IA, USA, September 2017

"Higgs Boson as a Probe in the Search for Physics Beyond the Standard Model," High Energy Physics Seminar, The Ohio State University, Columbus, OH, USA, September 2017

"Get Inspired: Pushing the Frontiers of Knowledge at CERN," Public Talk, United States Education Fund, Nepal, June 2017

"Taking High Energy Physics to Higher Altitudes," Public Seminar, ETH Zurich, April 2017

"Voyage to the Heart of Matter," Public Colloquium, Kathmandu University, Nepal, January 2016

"Search for New Heavy Quarks at ATLAS," University of Maryland, MD, USA, May 2014

"Search for a heavy, vector-like top-quarks decaying into W-boson and light quark," University of Texas-Dallas, USA, May 2014

Invited Talks in Conferences & Workshops

"Latest Di-Higgs Results from ATLAS," American Physical Society, April Meeting, Minneapolis, 2023

"ATLAS results on Di-Higgs," Higgs Hunting, Orsay-Paris, France, July 2019

"Overview of ATLAS Results on Di-Higgs Search in bbVV Channel," Di-Higgs Workshop, Göttingen, Germany, May 2019

"B-tagging trigger signature for Run3," Trigger Workshop 2019, Elba, Italy, May 2019

"Status and Prospect of Run2 Di-Higgs Analyses in $bbWW$ and $WWWW$ Channels," DBL-HBSM Workshop, Annecy, France, November 2017

"Search for Rare and Exotic Higgs Boson Decay Modes and Higgs Boson Pair Production With the ATLAS Detector," ICNFP2017, Crete, Greece, August 2017

"Prospects for the Search of Higgs Boson Pair Production in pp Collisions at $\sqrt{s} = 13$ TeV With the ATLAS Detector," HH Orsay Workshop, Orsay, France, January 2016

"Analysis of Events With b-jets and a Pair of Leptons of the Same Charge in pp Collisions at $\sqrt{s} = 8$ TeV With the ATLAS Detector," PASCOS 2015, Trieste, Italy, June 2015

"Understanding material distribution in the ATLAS inner detector with Run2 data," ATLAS Tracking Plenary, CERN, Switzerland April 2015

"Search for new heavy quarks that decay into a W boson and a light quark," U.S. ATLAS Workshop, Chicago, July 2013

"Search for new heavy quarks that decay into a W boson and a light quark," ATLAS Physics and Performance Week (Exotics Plenary), CERN, May 2013

"Search for New Heavy Quarks at ATLAS," CIPANP 2012, St. Petersburg, FL, USA, May 2012

"Measurement of W boson helicity in top quark decay," APS Prairie, Iowa, November 2009

Research Experience

Lead Analyser, Group Co-coordinator, & Contact Editor: b-jet trigger performance 2017 - 2021

I led the study of the b-jet trigger performance in Run2 LHC data, deriving data-based correction to simulated studies. I was also selected the group co-coordinator to manage a team of about 30 researchers from 17 institutes. The work was published in European Physical Journal (**Eur. Phys. J. C 81 (2021) 1087**). Based on my extensive contribution, I was selected to be the contact editor (equivalent of corresponding author in smaller collaborative papers) of the published paper.

Lead Analyser, Analysis Coordinator & Contact Editor: Di-Higgs 1-lepton analysis 2015 - 2019
I was a lead analyser, analysis coordinator, and contact editor of an analysis that searched for pair produced Higgs bosons in $bbWW$ final state. I led a team of 20 researchers from 7 institutes to publish the result in **JHEP 04 092 (2019)**. This is the first result from ATLAS in $bbWW$ channel. This channel was previously deemed too challenging because of large background, and had not been tackled. My work demonstrated that the backgrounds can be controlled, and this channel could be a potential new way to study the Di-Higgs process.

Lead Analyser & Analysis Coordinator: Di-Higgs 2-lepton analysis 2017 - 2019
Building on the success of the 1-lepton channel, I initiated the effort to include the 2-lepton channel. The analysis targeting only the non-resonant SM Higgs pair production in the $bbll + MET$ final state has been submitted to **Phys. Lett. B 801 135145 (2020)**, in which I demonstrated a great improvement in sensitivity to the signal by employing deep neural networks.

Data Quality Monitoring in the ATLAS Control Room 2012 - 2016
I monitored the performance of different sub-systems of the ATLAS detector and the luminosity infrastructure, identified any potential problem, and coordinated among system shifters, ensuring high-quality data for the ATLAS experiment. Data taken during this period have resulted in several highly cited publications, among them the measurements of the Higgs boson properties.

Lead Analyser: Detector Simulation 2015 - 2017
I developed the framework for mapping the material distribution in the ATLAS detector using secondary hadronic interactions. This result, published in **JINST 11 11020 (2017)** significantly improved the uncertainties associated with tracking.

Lead Analyser: Charged-particle multiplicities in the ATLAS detector 2015 - 2016
As a lead analyser of the analysis that measured the charged-particle multiplicity in proton-proton collisions, I validated simulated sample and measured the systematic uncertainty on the tracking efficiency. The paper is published in **Phys. Lett. B 758 67 (2016)**.

Lead Analyser, Analysis Coordinator & Contact Editor: Vector-Like Quark Analysis 2013 - 2015
I was a lead analyser, analysis coordinator, and contact editor of an analysis that searched for pair produced vector-like quarks in the $Hq/Zq/Wq$ final states. Leading a team of 8 researchers from 3 institutes, I improved the previous limit on the mass of the new particle by 350 GeV, and also produced the first result on the mass of a VLQ in the two dimensional plane of BR($Q \to Wq$) versus BR($Q \to Hq$). The analysis was published in **Phys. Rev. D 92, 112007 (2015)**.

Likelihood-based kinematic fitting package 2013 - 2017
I developed a likelihood-based kinematic fitter for reconstruction of top-quark events. I also defined a log likelihood ratio discriminant that distinguishes new, heavy quarks from the main background, top-quarks. In 2017, I supervised a student to derive transfer functions at a higher center-of-mass energy for a kinematic fitting package, extensively used to reconstruct top-quark events in ATLAS.

Data Production and Validation 2009 - 2011
I produced simplified format for both simulated and actual proton-proton collision data. I significantly expanded the prototype data validation package, and validated the official data-making software. I investigated codes across different groups and documented the data content for the entire collaboration of 3000 physicists. This work was critical in my qualification as an author of the

ATLAS collaboration's Higgs boson discovery paper, which resulted in the Nobel Prize in Physics in 2013.

Leadership

***De facto* National Contact: Nepal @ CERN** 2013 - Present
I worked with the Ministry of Science and the Ministry of Foreign Affairs to accomplish the signing of International Cooperation Agreement with CERN. I coordinated the actions between CERN and researchers from Nepal and contributed to the grant proposal submitted to the European Commission. I work with CERN Education and Outreach to recruit students and teachers from Nepal for training programs.

Organizer: Supercomputing Workshop, Kathmandu University October 2019
I organized a high performance computing workshop at Kathmandu University with 3 guest scientists from CERN and several local scientists. Subsequently, given the available technical expertise and resources, Kathmandu University intends to join the ATLAS collaboration as a technical institute.

Convener: Di-Higgs Kickoff Workshop, CERN February 2019
As a chair of the Di-Higgs search session, I prepared the agenda, invited the speakers, led the discussion, and prepared the summary of the session. As a result, 6 distinct analyses are underway targeting distinct topologies. Each analysis is expected to result in a paper between 2020 and 2021.

Convener: HH Production at Colliders Workshop, Fermilab September 2018
As a convener of the $bbVV$ session, I prepared the agenda, invited the speakers, led the discussion, and prepared the summary of the session. Subsequently, I edited a chapter of the workshop white paper, **arXiv:1910.00012**.

Organizer: SAHEPI Workshop June 2017
I organized the first South Asian High Energy Physics Instrumentation (SAHEPI) Workshop. This was the first of a series of workshops to be held across South Asia to strengthen the region's ties with CERN. Following the workshop, I led a partnership with CERN to establish a high performance computing facility at Kathmandu University, the first of its kind in Nepal.

Teaching Experience

Teaching Assistant, Iowa State University 2007- 2010
Conducted recitations and labs for algebra-based and calculus-based physics courses. Clarified weekly lectures, created conceptual problems and quizzes, graded assignments, quizzes, and lab reports, and proctored exams. Evaluated student performance.

Math Instructor, Shattuck-St. Mary's School, MN 2006 - 2007
Taught introductory and advanced calculus, and compulsory algebra. Supervised students and served on an accreditation gender and diversity committee.

Student Supervision

I have immensely enjoyed working with students. In a big collaboration such as ATLAS, there are several self-contained and well-defined projects to which students can make significant contributions. Below is a list of select students I have supervised and links to their research reports. All of these works have contributed to papers we have published, or will publish.

- Mr. Jason Ikenaga, REU 2022 (Washington College, USA)
- Ms. Eniya Jaber, REU 2022 (Washington College, USA)
- Mr. Tapas Kumar, REU 2022/2023 (Washington College, USA)
- Mr. Xiang Zhang, REU 2021 (Ohio State University, USA)
- Mr. Jacob Borison, REU 2021 (Ohio State University, USA)
- Ms. Shiksha Pandey, CERN Summer Student 2021 (Bryn-Mawr College, USA) (PhD student at Pennsylvania State University)
- Mr. Dmitriy Zubov, CERN Summer Student 2021 (National University of Nuclear Research, Russia)

- Mr. Pratik Kafle, REU 2020 and 2021 (Reed College, USA) (PhD student at Michigan State University)
- Ms. Sneha V. Dixit, REU 2021/2022/2023 (Washington College, USA)
- Mr. Peyton Stewart, REU 2020 (Washington College, USA) (PhD student at Clemson University)
- Ms. Rasmita Timalsina, CERN Summer Student 2020 (Amrit Science College, Nepal)
- Mr. Zhenyu Wu, REU 2019 (The Ohio State University, USA) (PhD student at University of Virginia)
- Mr. Chaosong Chen, REU 2019 (PhD student at Pennsylvania State University, USA)
- Ms. Caeley Pittman, CERN Summer Student 2019, Report Link (PhD student at Boston University in Fall 2020.)
- Mr. Roshan Joshi, CERN Summer Student 2019, Report Link (PhD student at The Ohio State University, USA)
- Ms. Rami Dhungana KC, CERN Summer Student 2018, Report Link (Master's student at St. Xavier's College, Nepal)
- Ms. Jessica Sydnor, CERN Summer Student 2018, Report Link (PhD student at Western Virginia University, USA)
- Mr. Anthony Ciavarella, REU 2017, Thesis Link (PhD student at University of Washington, USA)
- Ms. Kalpanie Liyanage, CERN Summer Student 2017, Report Link (PhD student at University of Ruhuna, Sri Lanka)
- Ms. Stephanie Fouts, REU 2016 (graduated from Washington & Lee University, USA)
- Mr. Mahesh Thakuri, CERN Summer Student 2016, Report Link (Master's student at Tribhuvan University, Nepal)
- Mr. Santosh Parajuli, CERN Summer Student 2015, Report Link. I also directed Santosh's master thesis, which he completed from Tribhuvan University, Nepal. CERN Thesis Link (PhD student at Southern Methodist University, USA)

In addition, I have also supervised the works of several Ph.D. students during their stay at CERN. Below is a list of select Ph.D. students whose research I supervised and whose theses have been completed.

- Mr. Roshan Joshi, The Ohio State University
- Mr. Santosh Parajuli, Southern Methodist University
- Dr. Benjamin Tannenwald, The Ohio State University (Postdoc at the University of Virginia, then Data Scientist at AstraZeneca)
- Dr. Nurfikri Norjoharuddeen, University of Oxford (Faculty at the University of Malaya)
- Dr. John Myers, University of Oregon (Data Scientist in Financial Institution in Oregon)
- Dr. Giovanni Bartolini (Defended thesis in November 2020 at CPPM, France)

Education and Outreach

Organizer: Particle Physics Winter School, Kathmandu University December 2018

I organized a Particle Physics Winter School in Nepal in partnership with ICTP (Italy) and US ATLAS Outreach Program of the National Science Foundation (USA). I gave lectures on particle physics to undergraduate students, and led hands-on session to analyse LHC data. I discussed career choices for physics students and reviewed their resumes.

Coordinator: Particle Physics @ CERN, Washington & Lee University 2016 - 2018

As the coordinator for the CERN visit of the spring term particle physics course given at Washington & Lee University, I prepared the visit agenda, gave lectures, invited guest lecturers from various CERN experiments, and moderated scientific and career-related discussions for students.

Organizer: Physics Without Frontiers-Nepal 2014 - 2016
I organized the first (2014-15) and second (2015-16) Physics Without Frontiers programs in Nepal in partnership with ICTP (Italy) and CERN. I gave lectures on particle physics and led hands-on session to analyse LHC data. I also moderated a video conference with scientists in the ATLAS Control Room, and discussed career choices for physics students and reviewed resumes. As part of the program, I visited high schools in rural Nepal, engaged the general public by screening the movie, Particle Fever, and served on the panel discussing the importance of basic science.

Particle Physics Masterclass 2013 - 2016
I moderated video conference from CERN to high schools across the world within the framework of the International Particle Physics Masterclass program. I led the student discussion on the hands-on analysis of LHC data that the students carried out, and discussed career options for physics majors.

Service to Community

Reviewer: *National Science Foundation* 2023 - Present
I review proposals submitted to NSF.

Referee: *Journal of Instrumentation (JINST)* 2017 - Present
I review manuscripts on instrumentation in high energy and medical physics.

Member: HPC Steering Committee, Kathmandu University 2019 - Present
I served on the high performance computing (HPC) steering committee, which drafted the directives and usage policy for the computing facility for university-wide use. I also coordinated between the experts at CERN and the local team to maintain and operate the HPC facility.

Panelist: Roadmap for Sustainable Development, EPFL, Switzerland August 2017
I presented a case for the need to invest in basic science for sustainable development and the immediate need to establish a high performance computing facility in Nepal in order to digitize, collect, preserve, and analyse data on all fronts so as to inform policy-making.

Editorial Board Member: Vector-Like Quark Search 2016 - 2017
I was an editorial board member of an ATLAS analysis that searched for pair-produced vector-like quark in the ZtX final state, resulting in 2 conference papers and 1 peer-reviewed paper, **JHEP 08 052 (2017)**.

Public Articles/ Interviews

- Physicists work to bring more undergrads into research
  - https://www.symmetrymagazine.org/article/physicists-work-to-bring-more-undergrads-into-research
- Voice of America Science Edition: CERN's Large Hadron Collider
  - https://www.voaafrica.com/a/6659770.html
- From Nepal to Grinnell to Switzerland and beyond
  - https://campaign.grinnell.edu/our-stories/suyog
- The Internship Must Go On
  - https://www.washcoll.edu/stories/peyton-stewart.php
- Physics in a second language, Symmetry Magazine
  - https://www.symmetrymagazine.org/article/physics-in-a-second-language
- Sharing CERN with Nepal, Symmetry Magazine
  - https://www.symmetrymagazine.org/article/sharing-cern-with-nepal
- A Career in Quantum Physics, Sujhaab Chautaari
  - https://chautaari.com/career-quantum-physics
- Physics Diplomacy, ICTP News

- https://www.ictp.it/about-ictp/media-centre/news/2016/2/physicswithoutfrontiersnepal.aspx

- Taking CERN Physics to South Asia, CERN Bulletin
  - https://cds.cern.ch/journal/CERNBulletin/2015/04/News%20Articles/1981524
- Representatives from CERN to Visit W&L, The Columns
  - https://columns.wlu.edu/representatives-from-the-european-organization-for-nuclear-research-to-visit-wl

Selected Peer-Reviewed Publications (Major Contribution)

I am a member of the ATLAS collaboration, which publishes about 100 papers each year. To many of these, I contribute through data-taking operations, trigger performance studies, detector calibration and simulation, and executing other responsibilities. However, below is a list of publications where I have made major contributions.

"Configuration and performance of the ATLAS b-jet triggers in Run 2," European Physical Journal C, 81, 1087 (2021). Contribution: Performance studies, Contact Editor, Group Coordinator

"Search for a heavy Higgs boson decaying into a Z boson and another heavy Higgs boson in the $\ell\ell bb$ and $\ell\ell WW$ final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector," European Physics Journal C **81** 396 (2021). Contribution: Editorial Board Member

"Combination of searches for Higgs boson pairs in pp collisions at $sqrts? = 13$ TeV with the ATLAS detector," Physics Letter B **800** 135103 (2020). Contribution: Lead Analyser and Contact Editor of bbWW channel

"Higgs boson potential at colliders: Status and perspectives," Reviews in Physics **5** 100045 (2020). Contribution: Chapter editor

"Search for Higgs boson pair production in the dileptonic WWbb channel in pp collisions at $\sqrt{s} =$ 13 TeV," Phys. Lett. **B801** 135145 (2020). Contribution: Analysis Coordinator, Analyser

"Search for Higgs boson pair production in the $bbWW^*$ final state at $\sqrt{s} = 13$ TeV with the ATLAS detector," JHEP **04** 092 (2019). Contribution: Lead Analyser, Analysis Coordinator, Paper Contact Editor

"Search for Higgs boson pair production in the $WW^{(*)}WW^{(*)}$ decay channel using ATLAS data recorded at $\sqrt{s} = 13$ TeV," JHEP **05** 124 (2019). Contribution: ATLAS Higgs-group designated reviewer

"Search for pair production of vector-like top quarks in events with one lepton, jets, and missing transverse momentum in $\sqrt{s} = 13$ TeV pp collisions with the ATLAS detector," JHEP **08** 052 (2017). Contribution: Editorial Board Member

"Measurement of the material of the ATLAS Inner Detector using Run-2 data from the LHC," JINST **12** P12009 (2017). Contribution: Lead Analyser

"Charged-particle distributions in $\sqrt{s} = 13$ TeV pp interactions measured with the ATLAS detector at the LHC," Phys. Lett. **B758** 67 (2016). Contribution: Lead Analyser

"Search for pair production of new heavy quarks that decay into a W boson and a light quark in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector," Phys. Rev. **D92** 112007 (2015). Contribution: Lead Analyser, Analysis Coordinator, Paper Contact Editor

Selected Analyses in Preparation for Peer-Reviewed Publications (Major Contribution)

"Search for a heavy Higgs boson decaying into a Z boson and another heavy Higgs boson in the $llbb$ and $llWW$ final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector," Contribution: Editorial Board Chair

"Search for Higgs boson pair production in the final state with 2 b-quarks, 2 charged leptons, and missing transverse energy at $\sqrt{s} = 13$ TeV with the ATLAS detector," Contribution: Lead Analyser

"Search for Higgs boson pair production in the $bbVV^*$ final state with 0 or 1 charged lepton at $\sqrt{s} = 13$ TeV with the ATLAS detector," Contribution: Lead Analyser

Selected ATLAS Public Notes (Major Contribution)

Conference notes and other documents published by the ATLAS collaboration are subject to a high level of peer-review within the collaboration, and signed off by collaboration-designated responsible

persons who represent almost 3000 authors. These are the notes in which I have made major contributions.

"Higgs boson pair production at colliders: status and perspectives," arXiv:1910.00012, Contribution: Editor

"Measurement of the ATLAS b-jet trigger efficiency in 2017 data," ATL-COM-DAQ-2019-077, Contribution: Lead Analyser

"Search for pair production of vector-like top partners in events with one lepton and an invisibly decaying Z boson at $\sqrt{s} = 13$ TeV pp collisions at the ATLAS detector," ATLAS-CONF-2017-015 (2017). Contribution: Editorial Board Member

"Search for pair production of vector-like top partners in events with exactly one lepton, at least four jets and large missing transverse momentum ,"ATLAS-CONF-2016-101 (2016). Contribution: Editorial Board Member

"Studies of the ATLAS Inner Detector material using $\sqrt{s} = 13$ TeV pp collision data," ATL-PHYS-PUB-2015-050 (2015). Contribution: Lead Analyser

"Charged-particle distributions in $\sqrt{s} = 13$ TeV pp interactions measured with the ATLAS detector at the LHC," ATLAS-CONF-2015-028 (2015). Contribution: Analyser

Search for 4th Generation Quarks with the ATLAS Detector at the LHC," S. Shrestha, AIP Conference Proceeding, 1560 (2013), Author