

BIJAY SHRESTHA

Physicist | Professor | Data Scientist

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EDUCATION

The University of Oklahoma <i>Ph.D. in Experimental High Energy Physics</i> Advisor: Michael G. Strauss Dissertation Topic: "Legacy Analysis of Standard Model Higgs boson in the $H \rightarrow WW^* \rightarrow \ell^-\bar{\nu}_\ell \ell^+ \nu_\ell$ decay channel from pp collisions at $\sqrt{s}=13$ TeV with the ATLAS detector at the LHC"	Norman, OK Aug. 2017 – Dec. 2024
Southeastern Louisiana University <i>Bachelor of Science in Physics, Minor in Mathematics</i> Advisor: Hye-Young Kim Dissertation Topic: "Development of Coarse-Grained Model of Self-assembled Structures of VECAR"	Hammond, LA Aug. 2013 – May 2017

RESEARCH INTEREST

Experimental: Granular convection and size segregation in vibrated systems; rheology, pattern formation and non-equilibrium dynamics in granular matter; applications to sustainability
Computational: Machine learning applications in experimental physics; computational physics simulations; high-performance computing; data analysis pipeline development

RESEARCH EXPERIENCE

Visiting Assistant Professor Catawba College	Aug. 2025 – Present Salisbury, NC
<ul style="list-style-type: none">Established an experimental granular convection research lab, from initial design through data acquisition, investigating pattern formation and size segregation in vibrated granular materials.Developing computational models to complement experimental studies, including discrete element method (DEM) simulations and machine learning approaches for pattern recognition and classificationCurrently mentoring 3 undergraduate researchers in experimental design, Python-based data analysis, uncertainty quantification, and scientific communication.Collaborated with faculty across departments to promote STEM retention and outreach, reaching over 100 local students through events and open labs.	
Postdoctoral Researcher European Organization for Nuclear Research (CERN)	Jan. 2025 – Jul. 2025 Remote
<ul style="list-style-type: none">Led data preservation initiative for ATLAS Higgs physics results, collaborating with over 15 groups to curate datasets for HEPdata repository and ensure long-term reproducibility.Streamlined large-scale data analysis workflows for Run 3 Analysis; authored over 3 internal notes for collaboration reviewMentored 3 graduate students on Python-based data analysis, version control, ML workflows, and other CERN software tools.	
Doctoral Researcher The University of Oklahoma and European Organization for Nuclear Research (CERN)	Aug. 2017 – Dec. 2024 Norman, OK
<ul style="list-style-type: none">Project 2: Run 2 Legacy Analysis for Two ggF jets<ul style="list-style-type: none">Engineered a data science pipeline to analyze the Run II dataset for precision measurement of Higgs boson production in the gluon-gluon fusion channel with two jets, contributing to multiple published papers.Implemented and trained Deep Neural Networks (DNN) models using TensorFlow, achieving 25% reduction in misidentified background events while maintaining signal efficiency.Investigated the correlation between P_t^{ll} and DNN output to assess the model's effectiveness in minimizing sensitivity to the known Z_{ll} mis-modeling, with findings subsequently adopted by over 10 analysis groups.	

- **Project 1:** Cost Optimization of Bjet Triggers

- Developed and integrated an automated CPU consumption analysis for b-jet trigger algorithms, enabling nightly performance evaluations that reduced processing time by 28% on average.
- Investigated the impact of 5 tracking parameters on resource consumption by developing Python and C++ scripts, yielding actionable insights in the workflows of 7 analysis teams.
- Identified and resolved critical bugs in the High-Level Trigger (HLT) reconstruction code; compiled a comprehensive report to streamline analysis processes for the 7 analysis groups.

Undergraduate Research Assistant

Jan. 2014 – May 2017

Southeastern Louisiana University

Hammond, LA

- Processed and analyzed large-scale molecular dynamics (MD) dataset using Hadoop, improving data accessibility and computational efficiency across distributed nodes.
- Wrangled 2TB of MD dataset using SQL to model and visualize the behavior and stability of self-assembled micelles of a novel molecule using LONI supercomputers; published in a peer-reviewed journal.
- Developed and validated a coarse-grained force field for VECAR, containerized with Docker, to enable simulations of the interactions with lipid bi-layer membranes; experimentally validated and used in 3 subsequent studies.
- Mentored three high school students in computational biophysics research projects; one student earned the “Best Research” award for their project.

TEACHING EXPERIENCE**Visiting Assistant Professor** Aug. 2025 – Present*Catawba College* Salisbury, NC

- Promoted collaborative learning through structured group work and peer instruction, emphasizing quantitative reasoning and critical thinking.
- Fostered an inclusive, dialogue-based classroom by actively gathering student feedback on clarity, pacing, and instructional approach, and adapting instruction in real time.
- Integrated hands-on demonstrations, interactive simulations, and real-world examples to provide multiple pathways for extensive engagement and highlight the relevance of physics.
- Expanded laboratory curriculum to strengthen connections between theory, experiment, and quantitative reasoning.

*Courses Taught:***PHYS 2521: General Physics I**

Introductory physics course covering mechanics, waves, and fluids.

PHYS 2522: General Physics II

Introductory physics course covering electricity and magnetism, optics, and thermodynamics.

Instructor of Record Aug. 2017 – May 2021*The University of Oklahoma* Norman, OK

- Supervised and trained a team of 5-6 Teaching Assistants on best practices for classroom management, assessment practices, and effective demonstration techniques
- Redesigned entire curriculum for remote learning during the COVID-19 pandemic (Spring 2020), incorporating video lectures, interactive problem-solving sessions, and virtual labs
- Established a feedback loop with over 100 students per semester to identify and resolve recurring issues.

*Courses Taught:***PHYS 2514: Physics for Engineering and Science Majors**

Introductory physics course covering mechanics, waves, electricity and magnetism, optics, and thermodynamics.

PHYS 1311: Physics for Engineering and Science Majors

Experiments in basic law of mechanics and thermodynamics.

PHYS 1321: Physics for Engineering and Science Majors

Experiments in basic laws of electricity, magnetism, and optics.

PHYS 3043: Physical Mechanics I (Teaching Assistant)

Differential equations based continuum mechanics: Newtonian particle mechanics, driven and damped oscillations, vibrations and waves, and their application to other linear systems, non-linear oscillations, Lagrange's equations.

PHYS 2203: Introductory Physics III: Modern Physics (Teaching Assistant)

An introduction to and overview of key concepts in contemporary physics, with emphasis on the contrast between classical and modern ways of thinking about the physical universe.

FUNDING & RESEARCH SUPPORT

- **Internal College Research Funding (2025)** supporting the establishment of an experimental granular convection research program.

MENTORING EXPERIENCE**Granular Convection Research Laboratory, Catawba College**

Fall 2025 – Present

- **Luke Bardinas** (Fall 2025 – Present): Dependence of Container Geometry and Fill Height on Granular Convection Patterns (experimental)
- **Nikita Poliakov** (Fall 2025 – Present) Horizontal Segregation Patterns in Shallow Vibrated Granular Bed (experimental)
- **Christopher Brown** (Spring 2026 – Present) Effect of Particle Density Contrast on Vertical Segregation in Vibrated Granular Systems (experimental)

SELECTED HONORS & AWARDS**Breakthrough Prize in Fundamental Physics, 2025**

Awarded to the ATLAS and CMS Collaborations for the detailed measurements of Higgs boson properties

Role: Researcher, ATLAS Collaboration (2017–2025)

Provost Certification of Distinction in Teaching, 2020 at The University of Oklahoma

Awarded to graduate students who demonstrated outstanding professional interaction with students and faculty as a graduate teaching assistant.

Student Ambassador for College of Science and Technology, 2016 at Southeastern Louisiana University

Awarded to students willing to promote the benefits of experiential learning.

Honor Research Scholar, 2017 at Southeastern Louisiana University

A distinction awarded to students who have done more than 2 semesters of research, presented their findings, and written an undergraduate thesis (reviewed by a panel of scholars).

Undergraduate Physics Research Award, 2015-2017 at Southeastern Louisiana University

Awarded three times for accomplishments in undergraduate physics research.

Norman Higginbotham Scholarship, 2015-2017 at Southeastern Louisiana University

Awarded three times for academic performance and involvement in physics outside of the classroom.

SELECTED PUBLICATIONS

- [1] ATLAS Collaboration (including **B. Shrestha**), "Software and computing for Run 3 of the ATLAS experiment at the LHC," *Eur. Phys. J. C* 85, 234 (2025).
- [2] ATLAS Collaboration (including **B. Shrestha**), Configuration, Performance, and Commissioning of the ATLAS b -jet Triggers for the 2022 and 2023 LHC data-taking periods. *JINST* 20 Po3002 (2025).
- [3] ATLAS Collaboration (including **B. Shrestha**), "Characterising the Higgs boson with ATLAS data from the LHC Run-2," *Phys. Rept.* 1116, 4–56 (2025).
- [4] ATLAS Collaboration (including **B. Shrestha**), "Measurements of Higgs boson production via gluon-gluon fusion and vector-boson fusion using $H \rightarrow WW^* \rightarrow \ell\nu\ell'\nu$ decays in pp collisions with the ATLAS detector and their effective field theory interpretations," *Eur. Phys. J. C* 85, 1403 (2025).
- [5] ATLAS Collaboration (including **B. Shrestha**), Measurements of the Higgs boson production cross-section via ggf and VBF in $H \rightarrow WW^* \rightarrow \ell^-\bar{\nu}_\ell\ell'^+\nu_\ell$ with 140 fb^{-1} of data collected with the ATLAS detector at $\sqrt{s} = 13$ (2025).

- [6] ATLAS Collaboration (including **B. Shrestha**), "The ATLAS trigger system for LHC Run 3 and trigger performance in 2022," arXiv:2401.06630 (2024).
- [7] ATLAS Collaboration (including **B. Shrestha**), "Interpretations of the ATLAS measurements of Higgs boson production and decay rates and differential cross-sections in pp collisions at $\sqrt{s} = 13$ TeV," *JHEP* **11** (2024) 089.
- [8] Kim, H. Y., Novak, B. R., **Shrestha, B.**, Lee, S. E., & Moldovan, D., The role of the asymmetric bolaamphiphilic character of VECAR on the kinetic and structural aspects of its self-assembly: A molecular dynamics simulation study. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 523, 9–18 (2017).
- [9] **B. Shrestha**, Development of Coarse-Grained Model of Self-assembled Structures of VECAR. Undergraduate Honors Thesis. SLU Digital Commons (2017).

Additional ATLAS publications: As a member of the ATLAS Collaboration (2017-2025), contributed to 100+ publications on Higgs boson physics, and detector performance. Full list: [Google Scholar Profile](#)

SELECTED TALKS AND PRESENTATIONS

- Jun 15, 2019 | *An Analysis of Vector-like Quark* (oral), US ATLAS Computing CAMPFIRE, Argonne National Laboratory, IL
- March 13-17, 2017 | *Coarse-Grained Force Field Development of Novel Bolaamphiphilic Molecules: VOTCA or Martini?* (oral), APS March Meeting, New Orleans, LA
- Feb 12-14, 2016 | *Large-scale Computational Study of Biomolecular Self-Assembly Systems: Undergraduate Research* (poster), 14th Annual LBRN Meeting, Monroe, LA
- Jan 9-12, 2016 | *Computational Study of Self-Assembly of VECAR in Water* (poster), AAPT Winter Meeting, NOLA
- MAR 5, 2015 | *Self Assemblies of Novel Molecule, VECAR* (oral), APS March Meeting, San Antonio, TX

SERVICE

Professional Service:

- ATLAS Collaboration Service Work, CERN (2022-2024): Served on the Inner Detector (ID) performance monitoring team, providing control room shift coverage during LHC data-taking periods.

Institutional Service:

- Academic Planning and Assessment (APA) Committee, Catawba College (2025–present) : Reviewer for Learning Enhancement Progress Reports (LEPR); evaluated departmental learning outcomes, assessment methods, and evidence of student learning.

OUTREACH AND VOLUNTEER

Conferences for Undergraduate Women in Physics (CUWiP), University of Oklahoma (2019)

Designed the event website, moderated research talks and panels, and facilitated logistics to ensure a smooth and inclusive experience for all attendees.

You Be the Chemist, Girl Scout and CaPPS, Southeastern Louisiana University (2013-2017)

Fielded and inspired students toward science through demonstrations and explanations.

Science Olympiad, Southeastern Louisiana University (2015 & 2016)

Facilitated and promoted the University's 2015 and 2016 Regional Science Olympiad environment.

Volunteer Teacher, Sunlight English Secondary School (2012-2013)

Taught physics and mathematics to middle and secondary schoolers.

PROFESSIONAL DEVELOPMENT

US ATLAS Physics Workshop (2018, 2019) : Advanced analysis techniques and machine learning applications

TECHNICAL SKILLS

Languages: Python, C++, FORTRAN, Bash, SQL (MySQL, Postgres), MongoDB, SAS, Java, LaTeX, Mathematica

Developer Tools: Git, GitLab CI/CD, Docker, Jupyter, VS Code, Mattermost, Jira

Teaching skills: Research Supervision, Course Design, Student-Centered Learning, Lab expertise, Conflict Resolution

Molecular Dynamics skills: GROMACS, LAMMPS, VOTCA, VMD

Experimental Skills: Design & Setup, OpenSCAD, 3D modeling and printing, Arduino, COMSOL Multiphysics, LIGGGHTS

Data Science Techniques: Tableau, Hadoop, Spark, Excel, Data science pipeline (wrangling, visualization, statistical modeling, and interpretation), Machine Learning, Statistics, Hypothesis Testing, A/B Testing, Time Series

PROFESSIONAL MEMBERSHIPS

American Physical Society (APS): Division of Soft Matter (DSOFT), Division of Fluid Dynamics (DFD)

American Association of Physics Teachers (AAPT)

Sigma Pi Sigma (SPS)