

Saptaparna Bhattacharya

Assistant Professor
Southern Methodist University
Department of Physics and Astronomy,
3215 Daniel Ave Fondren Science Building,
Dallas, TX 75205

Email: saptaparnab@smu.edu

Employment

- ⇒ Assistant Professor, August, 2024-present
[Southern Methodist University](#)
 - ⇒ Pre-faculty Fellow and Deputy Team Leader of the CMS group, October, 2023-present
[Wayne State University](#)
 - ⇒ Humboldt Fellow, September, 2022-present
[DESY](#)
 - ⇒ Postdoctoral Research Associate, 2015-2023
[Northwestern University](#)
-

Education

- ⇒ Ph.D. Physics (2009-2015),
Brown University,
Area of Research: Experimental Particle Physics
Thesis topic: "Search for SuperSymmetry (SUSY) in low transverse momenta oppositely charged di-lepton final states with parked data collected at $\sqrt{s} = 8$ TeV using the Compact Muon Solenoid (CMS) detector"
Advisor: Prof. Greg Landsberg
 - ⇒ Sc.M, Physics (2007-2009),
Brown University.
 - ⇒ M. Sc Physics (2005-2007),
Indian Institute of Technology, Madras.
 - ⇒ B. Sc Physics (Hons.) (2002-2005),
St. Xavier's College, University of Calcutta.
-

Awards and Fellowships

- ⇒ CMS Award for "inspirational work in the CMS Event Generators group"
- ⇒ University of California, Berkeley, Rising Star in Physics 2023.

- ⇒ **Recipient of the Alexander von Humboldt Fellowship for 2022-2024.**
 - ⇒ **Selected to deliver the inaugural Sievert Lectures in 2022 at Northwestern University. The lectures are aimed at the general public and consist of a set of eight talks focusing on “Particle Physics after the discovery of the Higgs boson”.**
 - ⇒ **Awarded the LHC Physics Center Distinguished Researcher Award** for 2019 and 2020.
 - ⇒ Invited to join the US LHC Users Association delegation to Washington D.C. in March, 2014 and March, 2018-2020 to lobby with the **United States Congress** for increased funding to **STEM** disciplines.
 - ⇒ Awarded the PASI2012 - Exploring the Terascale and Beyond travel grant for a particle physics school at Buenos Aires, Argentina.
 - ⇒ Received \$10,000 as travel grant from the LHC Physics Center at Fermilab.
 - ⇒ **Awarded the Universities Research Association Fellowship at Fermilab for the year 2010-2011.**
 - ⇒ Awarded the Institute Merit Scholarship for the entire duration of my M.Sc. program at the Indian Institute of Technology, Madras.
-

Grants

- ⇒ Received salary support from USCMS operations budget (\$41,436) to deploy GPU based event generator workflows on High Performance Computing facilities.
 - ⇒ Received travel support as an early career scientist to travel to Snowmass 2022.
 - ⇒ Received funding from the LHC Physics Center (LPC) at Fermilab through the LPC Guest and Visitor program to cover travel and lodging expenses to Fermilab for 2017-2018.
 - ⇒ Awarded the American Physical Society travel grant for attending the APS April Meeting in Atlanta, Georgia.
 - ⇒ Full academic scholarship at Brown University (2007-2015) for Sc.M. and Ph.D. programs in Physics.
-

Leadership

✿ Convenership:

- ⇒ **January, 2024:** Selected to serve in the HEP Software Foundation representing CMS with a specific focus on event generators.
- ⇒ **September, 2023:** Selected to serve as the convener responsible for reviewing multiboson (SMP-VV) analyses in the Standard Model physics analysis group in CMS.
- ⇒ **Dec, 2022:** Selected to serve as the Effective Field Theory convener representing Standard Model analyses in the Effective Field Theory (EFT) forum in CMS.
- ⇒ **June, 2021-May, 2023:** Selected to serve as the Level 2 Convener in the Generator Studies Group in CMS.
- ⇒ **November, 2021:** Selected to serve as a convener for SM@LHC 2022 in the “Effective Field Theory” parallel session.
- ⇒ **January, 2021:** Selected to serve as a convener for LHCP 2021 in the “Upgrade and Future Projects” parallel session.

- ⇒ **March, 2020-March, 2022** Selected to serve as the Level 3 Convener in the Upgrade Performance Studies Group with regard to future Higgs, Standard Model and top related studies in CMS.
- ⇒ **July, 2020-July, 2022:** Served as liaison to the Snowmass Energy Frontier **Electroweak precision physics and constraining new physics** group (EF04) as part of the Snowmass Early Career group.
- ⇒ **May, 2017-December, 2019:** Selected to serve as the Level 3 Convener in the Generator studies group. This position entailed the validation and integration of CMS software releases with respect to event generators.
- ⇒ **January, 2016-August, 2017:** Selected to serve as the liaison between the New Physics (EXOTICA) analysis group and the simulation group within the CMS experiment. This involved the collation of various New Physics signal scenarios within the analysis group and working with the simulation group for a timely delivery of simulation samples.

✿ Editorial roles:

- ⇒ **July, 2023:** Serving as an editor for a comprehensive document highlighting usage of several different Monte Carlo event generators and theoretical models for the implementation of effective field theory scenarios.
- ⇒ **November, 2022:** Selected to serve as the chapter editor for the CMS Offline and Computing Conceptual Design Report (CDR) for the High Luminosity LHC
- ⇒ **November, 2021:** Selected to serve as the editor for the Snowmass 2022 Yellow Report responsible for the documentation of analysis pertaining to "Precision QCD" (EF05) topical group

✿ Professional service:

- ⇒ Organized the [Snowmass 2021 community planning meeting at Fermilab \(October 5th-8th, 2020\)](#) in association with the Fermilab Scientific Advisory Council.
- ⇒ Organized the [Physics Workshop At The LPC: Multibosons At The Energy Frontier](#)
- ⇒ **Elected chair of the Education and Outreach sub-committee in the Users Executive Committee at Fermilab.**

Professional Memberships

- ⇒ **Elected member of the American Physical Society's Division of Particles and Fields Executive Committee as an early career representative.**
 - ⇒ Chair of the Fermilab Users Executive Committee (2019-2020).
 - ⇒ Chair of the Education and Public Outreach subcommittee of the Fermilab Users Executive Committee (2018-2019).
 - ⇒ Member of the LHC Physics Center Physics Forum Committee at Fermilab (2019).
 - ⇒ Elected member of the Fermilab Users Executive Committee (2018-2020).
 - ⇒ Member of the American Physical Society.
-

Reviews

- ⇒ Member of the Analysis Review Committee for the measurement of the τ lepton $g-2$ in CMS.
- ⇒ Reviewer for the Department of Energy (DOE) Office of Science Graduate Student Research Program (SCGSR) geared toward supporting exceptional graduate students in physics.
- ⇒ Served as a reviewer for Physical Review D

Reviewer as convener in CMS

- ⇒ As the multiboson convener in CMS, reviewed several analyses including cross section measurements of WW (both at $\sqrt{s}=13$ TeV and 13.6 TeV), WZ (at $\sqrt{s}=13.6$ TeV), $Z\gamma$ (both leptonic and invisible decays of the Z-boson), combination of vector boson scattering analyses, combination of several effective field theory analyses.
- ⇒ As convener in the upgrade studies performance group:
 - Reviewed the analysis “Prospects for the measurement of the $t\bar{t}H$, $H \rightarrow b\bar{b}$ production in the opposite-sign di-leptonic channel at $\sqrt{s}=14$ TeV at the High-Luminosity LHC”
 - Reviewed the analysis “Prospects for the measurement of vector boson scattering production in leptonic $W^\pm W^\pm$ and WZ diboson events at $\sqrt{s}=14$ TeV at the High-Luminosity LHC”

Institutional reviews

- ⇒ June, 2021: Led the institutional review for the paper “Search for new particles in events with energetic jets and large missing transverse momentum in proton-proton collisions at $\sqrt{s}=13$ TeV” [JHEP 11 \(2021\) 153](#), [arXiv:2107.13021\[hep-ex\]](#)
- ⇒ July, 2020: Led the institutional review for the paper “Search for a low-mass dilepton resonance in Higgs boson decays to four-lepton final states at $\sqrt{s}=13$ TeV” [Eur. Phys. J. C 82 \(2022\) 290](#), [arXiv:2111.01299 \[hep-ex\]](#)
- ⇒ October, 2018: Led the institutional review for the paper “Search for an exotic decay of the Higgs boson to a pair of light pseudoscalars in the final state with two muons and two b jets at $\sqrt{s}=13$ TeV” [Phys. Lett. B 795 \(2019\) 398](#), [arXiv:1812.06359\[hep-ex\]](#)
- ⇒ May, 2018: Led the institutional review for the paper “Search for top+photon production in pp collisions at 13 TeV in the muon+jets channel” [Phys. Rev. Lett. 121, 221802 \(2018\)](#), [arXiv:1808.02913 \[hep-ex\]](#)
- ⇒ Fall 2015: Led the institutional review for the paper “Search for supersymmetry in pp collisions at $\sqrt{s}=8$ TeV in final states with boosted W bosons and b jets using razor variables”, [Phys. Rev. D 93, 092009 \(2016\)](#), [arXiv:1602.02917 \[hep-ex\]](#)
- ⇒ Summer 2012: Led the institutional review for the paper “Measurement of the $t\bar{t}$ production cross section in pp collisions at $\sqrt{s}=7$ TeV with lepton + jets final states”, [Phys. Lett. B 720 \(2013\) 83](#), [arXiv:1212.6682 \[hep-ex\]](#).

Research

- **June, 2023-present:** Received salary support from USCMS operations budget (\$25,000) to deploy GPU based event generator workflows on High Performance Computing facilities.
- **September, 2022-present:** I have begun working on a GNN based generative model that can simulate jets from $e^+e^- \rightarrow W^\pm W^\mp$ events. This analysis is at the nascent stage and the eventual goal is to launch an ML program that would replace the most computationally expensive part of LHC simulation

workflows.

→ **March, 2020-present:** Working on the Effective Field Theory (EFT) interpretation in triboson final states. Spearheading EFT interpretations in these novel final states, arising from the various decay products of the gauge boson, within the CMS Collaboration.

→ **September, 2020-present:** Performing global Standard Model EFT analyses using inputs from several existing Standard Model results, including diboson processes arising from both quark- antiquark annihilation and vector boson scattering.

→ **March, 2020-present:** Leading effort to compute position and timing regression to characterize the performance of the High Granularity Calorimeter using deep learning based techniques. I am using a network architecture that has proven to be performant for energy regression and extending the algorithm to regress other quantities of interest.

→ **May, 2019-May, 2020:** Performed a search for heavy triboson production in multileptonic final states with full Run 2 data. This analysis constitutes the first observation of the VVV process at the LHC. I focussed on final states with extreme leptonic multiplicities. In the five and six lepton final states, I devised analyses criteria sensitive to the WZZ and ZZZ processes. I constructed control regions, which was challenging given the extreme regions of phase space being probed. [Phys. Rev. Lett. 125 \(2020\) 151802](#), [arXiv:2006.11191 \[hep-ex\]](#)

→ **October, 2017-May, 2019:** Performed a search for WWW production using CMS data at $\sqrt{s}=13$ TeV and probed the existence of new physics that could manifest as higher dimensional contributions to the SM quartic couplings. The paper has published by Physics Review D [Phys. Rev. D 100 \(2019\) 012004](#), [arXiv:1905.04246 \[hep-ex\]](#).

→ **May, 2017-December, 2019:** Selected to serve as a convener in the Generator Studies group in CMS. My role includes the validation and integration of event generators in the official CMS software releases.

→ **March, 2016-present:** Playing a key role in the precision timing studies in CMS. These studies aim to characterize the timing capabilities of the planned upgrade to the CMS Calorimeter Endcaps, the High Granularity Calorimeter (HGCal) and have been included in the Technical Design Report for the detector.

→ **December, 2015-March, 2016:** Demonstrated the application of the Bayesian Blocks Algorithm to data analysis in High Energy Physics, specifically in looking for new physics in the tails of distributions.

→ **August, 2015-April, 2016:** Analyzed data collected by the CMS detector at $\sqrt{s} = 13$ TeV in a multi-jet final state. Searched for microscopic black holes and set limits on the production cross section. Computed model independent limits in this channel. The result of this analysis was presented at the [Physics Jamboree](#) at CERN on December 15th, 2015. Co-authored the paper published in Physics Letters B [Phys. Lett. B 774 \(2017\) 279](#), [arXiv:1705.01403 \[hep-ex\]](#).

→ **April, 2014-August, 2015:** Led the analysis on the search for Supersymmetry (SUSY) in oppositely charged di-lepton final states using Parked Data collected by the CMS detector at $\sqrt{s} = 8$ TeV. One of the potential hiding places of natural SUSY is in models with compressed spectra. Such signals are characterized by low transverse momentum (p_T) objects, low hadronic activity and missing energy. This analysis is sensitive to stop pair production in association with a photon. The analysis is enabled by the use of triggers that place no restrictions on the di-lepton p_T , instead relying on methods like Initial State Radiation (ISR) tagging by triggering on a high p_T photon, to reduce the trigger rate. The analysis is sensitive to stop masses between 90-100 GeV and model independent limits exclude new physics scenarios with cross sections greater than ~ 250 fb. This search constituted my dissertation.

→ **July, 2012-November, 2013:** Worked on a search for heavy top-like quarks with proton-proton ($p-p$) collision data collected at 8 TeV by the CMS detector. The hypothetical fermion is assumed to decay into a W -boson and a b -quark or into a Z -boson and a t -quark or the *newly discovered Higgs boson* and a t -quark. This leads to six different event topologies. I have specifically worked on the decay modes with multiple leptons in the final state. Performed the search during my stay at CERN from

July 2012-May 2013. This is one of the first searches that uses the Higgs boson as a probe for new physics. The analysis was published in [Phys. Lett. B, November 2013](#).

→ **June, 2013-November, 2013:** Contributed to the projection analysis for the above-mentioned search for collisions at 14, 33 and 100 TeV. This involved a sensitivity study for the LHC upgrade scenario. This work was documented as a Snowmass: Community Summer Study, 2013, white paper and as a proposal to the European Committee for Future Accelerators (ECFA) .

→ **January, 2012-March, 2014:** Participated in a search for heavy exotic quarks of charge $5/3$. The pair production of such quarks leads to multiple W bosons (produced through top partner and top decays) in the decay chain. Such processes lead to the presence of two leptons of the same charge in the final state. This analysis was done with collision data at 7 TeV and 8 TeV. This analysis was published in [Physical Review Letters, April 2014](#).

→ **January, 2010-December, 2011:** Played a key role in the b-tagging (identification of b-quark jets) effort at the LHC Physics Center at Fermilab. Identification of b-jets is of paramount importance in searches for new physics. Worked on data-driven techniques with minimal dependence on Monte Carlo simulations. Participated during the early LHC data-taking phase performing validation of b-tagging triggers and computing b-tagging efficiencies and scale factors using this method. This work led to publication in [JINST in April 2013](#).

→ **May, 2009-December, 2010:** Performed the Lorentz angle, the angle of deflection of charged particles in a magnetic field and electric field that are perpendicular to each other, calibration of the Silicon strips in the tracker of the CMS detector.

→ **May, 2008-April, 2010:** Participated in the LHC upgrade (S-LHC) studies for the silicon tracker. This involved testing the viability of using Magnetic Czochralski Silicon in the tracker. The results of this study were presented at the Vienna Conference on Instrumentation, 2009.

→ **August, 2010-August, 2011:** Worked on extending the phenomenology of vector-like quarks to the LHC and exploring their discovery potential. This work was done with Prof. Bogdan Dobrescu at Fermilab.

⇒ **Fall 2006 - Spring 2007, M. Sc. Thesis: "Wavelet transforms of Fractal Structures"**

→ I had worked on Wavelet Transforms applied to a fractal structure.

⇒ **Summer 2006, Internship**

→ **In Summer 2006**, as a summer intern at the [National Center for Radio Astrophysics in India](#), I mapped a radio galaxy (**J0155+299**) at frequencies between 1.2 to 8.4 GHz.

Publications with significant contribution

⇒ **Event generators:**

* **CMS Collaboration** Energy scaling behavior of intrinsic transverse momentum in Drell-Yan events, [GEN-22-001](#)

⇒ **Exploration of multiboson final states:**

> **S. Bhattacharya et al.**, LHC EFT WG Note: SMEFT predictions, event reweighting, and simulation, [arXiv:2406.14620](#)

☆ This paper provides a comprehensive review of the tools for Effective Field Theory analyses at the LHC.

> **R. Bellan, S. Bhattacharya et al.**, A sensitivity study of triboson production processes to

dimension-6 EFT operators at the LHC, [arXiv:2303.18215](#), *Journal of High Energy Physics* 2023, 158 (2023)

☆ The first comprehensive study of the sensitivity of higher order operators, particularly, dimension-6 operators in multiboson final states is carried out in this paper.

➤ **CMS Collaboration**, Observation of heavy triboson production in leptonic final states in proton-proton collisions at $\sqrt{s} = 13$ TeV, *Phys. Rev. Lett.* **125** (2020) 151802, [arXiv:2006.11191 \[hep-ex\]](#) **Citations: 48**

☆ This paper reports the first observation of the production of tribosons with a significance of 5.7σ and represents a major milestone in Standard Model physics. This paper has been featured in Physical Review Letters as Editor's Suggestion. Selected by the Physics Coordination in the CMS Collaboration to be interviewed by Phys.Org [for an article on the discovery of the VVV process](#). Interview by Symmetry magazine on the [discovery of heavy boson triplets](#).

➤ **CMS Collaboration**, Search for the production of $W^\pm W^\pm W^\mp$ events at $\sqrt{s} = 13$ TeV, *Phys. Rev. D* **100** (2019) 012004, [arXiv:1905.04246 \[hep-ex\]](#) **Citations: 34**

☆ This paper reports the first exploration of tribosons, specifically, $W^\pm W^\pm W^\mp$ and establishes analysis techniques that paved the way for future analyses of the VVV final state. An Effective Field Theory (EFT) interpretation in the $W^\pm W^\pm W^\mp$ final state is also presented in this paper. This is the first EFT interpretation in the $W^\pm W^\pm W^\mp$ final state at $\sqrt{s} = 13$ TeV. The limits on the Wilson Coefficients are comparable to those obtained from dedicated analyses.

⇒ Searches for physics beyond the standard model:

➤ **CMS Collaboration**, Search for black holes and sphalerons in high-multiplicity final states in proton-proton collisions at $\sqrt{s} = 13$ TeV, *JHEP* **11** (2018) 042, [arXiv:1805.06013 \[hep-ex\]](#) **Citations: 38**

➤ **CMS Collaboration**, Search for black holes and other new phenomena in high-multiplicity final states in proton-proton collisions at $\sqrt{s} = 13$ TeV, *Phys. Lett. B* **774** (2017) 279, [arXiv:1705.01403 \[hep-ex\]](#) **Citations: 40**

☆ The study of multijet phenomena at the LHC is a crucial test of the theory of quantum chromodynamics. While the study of microscopic black hole production at the LHC has been carried out at $\sqrt{s} = 8$ TeV, this analysis represents the first foray into primarily jet-based complex final states at a higher center-of-mass energy ($\sqrt{s} = 13$ TeV) with a distinct pile-up profile. The dominant source of background is from multijet processes and is estimated using a novel method. The computation of the multijet background is based on the near invariance of the shape of the S_T distribution, defined as the sum of the total energy in an event, as a function of the number of final state particles in an event or object multiplicity. Therefore, the multijet background can be determined in a region dominated by background processes (typically with low event multiplicities) and can be extrapolated to a signal-rich region without loss of generality.

➤ **CMS Collaboration**, Search for top-quark partners with charge $5/3$ in the same-sign dilepton final state. *Phys. Rev. Lett.* **112** (2014) 171801, [arXiv:1810.03188 \[hep-ex\]](#) **Citations: 41**

☆ Heavy partners of the top-quark appear in various models of beyond the Standard Model physics, making it a ubiquitous signature of new physics (featured in [Fermilab Today](#)). This analysis is one of the first investigations of such new physics scenarios.

➤ **CMS Collaboration**, Inclusive search for a vector-like T quark with charge $2/3$ in pp collisions at $\sqrt{s} = 8$ TeV. *Phys. Lett. B* **729** (2014) 149, [arXiv:1311.7667 \[hep-ex\]](#) **Citations: 221**

☆ This is the first analysis that used the Higgs boson as a probe for new physics based

on its coupling to a heavy partner of the top-quark (featured in [Fermilab Today](#)). These heavy partners, so-called vector-like fermions, appear in theoretically motivated minimal extensions of the Standard Model.

⇒ Studies of physics objects in CMS (*b*-tagging):

* **CMS Collaboration**, Identification of b-quark jets in the CMS experiment, [JINST 8 \(2013\) P04013](#), [arXiv:1211.4462 \[hep-ex\]](#) **Citations: 1134**

☆ The identification of b-quark jets is of crucial importance in CMS, enabling the discovery of certain Higgs decay modes, such as $H \rightarrow b\bar{b}$

⇒ Detector performance studies:

□ **S. Bhattacharya et al.**, GNN-based end-to-end reconstruction in the CMS Phase 2 High-Granularity Calorimeter, [arXiv:2203.01189 \[hep-ex\]](#) **Citations: 10**

□ **CMS Collaboration**, The Phase-2 Upgrade of the CMS Endcap Calorimeter, [CMS-TDR-019](#) **Citations: 298**

□ **CMS Collaboration**, The Phase-2 Upgrade of the CMS Beam Radiation Instrumentation and Luminosity Detectors (TDR-21-002), [CMS-TDR-023](#) **Citations: 7**.

□ **CMS Collaboration**, The Phase-2 Upgrade of the CMS Data Acquisition and High Level Trigger (TDR-21-001), [CMS-TDR-022](#) **Citations: 1**

⇒ Phenomenological Studies and Statistical analyses:

⇒ **Brian Pollack, Saptaparna Bhattacharya, Michael Schmitt**, Bayesian Blocks in High Energy Physics: Better Binning made easy!, [arXiv:1708.00810](#).

☆ This paper explores the idea of “perfect” binning of histograms, a data visualization tool widely used in high energy physics.

Physics analysis summaries

⇒ **CMS Collaboration**, Observation of heavy triboson production in leptonic final states in proton-proton collisions at $\sqrt{s} = 13$ TeV, [CMS PAS SMP_19_014 \(2020\)](#).

⇒ **CMS Collaboration**, Search for the production of $W^\pm W^\pm W^\mp$ events at $\sqrt{s} = 13$ TeV, [CMS PAS SMP_17_013 \(2019\)](#).

⇒ **CMS Collaboration**, Search for Black Holes with Early Run 2 Data, [CMS PAS EXO_15_007 \(2015\)](#).

⇒ **CMS Collaboration**, Sensitivity study for ECFA: heavy vector-like charge 2/3 quarks, [CMS PAS FTR_13_026 \(2013\)](#).

⇒ **CMS Collaboration**, Inclusive search for a vector-like T quark by CMS, [CMS PAS B2G_12_015 \(2013\)](#).

⇒ **CMS Collaboration**, Search for $T_{5/3}$ top partners in same-sign di-lepton final state, [CMS PAS B2G_12_012 \(2013\)](#).

⇒ **CMS Collaboration**, Search for a heavy partner of the top quark with charge 5/3, [CMS PAS B2G_12_003 \(2012\)](#).

⇒ **CMS Collaboration**, b-Jet Identification in the CMS Experiment, [CMS PAS BTV_11_004 \(2012\)](#).

⇒ **CMS Collaboration**, Performance of b-jet identification in CMS, [CMS PAS BTV_11_001 \(2011\)](#).

Conference proceedings

- ⇒ Proceedings of the LHCP 2023 conference accepted for publication: “Recent diboson and polarization measurements at CMS”.
- ⇒ Proceedings of the LHCP 2020 conference accepted for publication: [Multiboson measurements in CMS and ATLAS](#), Saptaparna Bhattacharya, on behalf of the CMS and ATLAS collaborations
- ⇒ Proceedings of the ALPS 2019 conference accepted for publication: [Electroweak physics with multi-bosons at the CMS experiment](#), Saptaparna Bhattacharya, on behalf of the CMS collaboration
- ⇒ [Search for new physics in dijet and multijet final states using data collected at \$\sqrt{s} = 13\$ TeV with the ATLAS and CMS detectors](#), Saptaparna Bhattacharya, on behalf of the CMS collaboration,
- ⇒ Search for Exotic Top Partners at $\sqrt{s} = 8$ TeV, Saptaparna Bhattacharya, for the CMS collaboration ([hep-ex:1310.2299](#)).
- ⇒ Efficiency measurement of b-tagging algorithms developed by the CMS experiment, Saptaparna Bhattacharya, for the CMS collaboration ([hep-ex:1110.4569](#)).

Whitepapers

- ⇒ Les Houches 2023: Physics at TeV Colliders: Standard Model Working Group Report, ([hep-ph:2406.00708](#))
- ⇒ Snowmass White Paper Contribution: Electroweak Precision Physics and Constraining New Physics [Snowmass report from EF04](#)
- ⇒ Snowmass White Paper Contribution: Physics with the Phase-2 ATLAS and CMS Detectors <http://cds.cern.ch/record/2805993>
- ⇒ Snowmass White Paper Contribution: Event Generators for High-Energy Physics Experiments ([hep-ph:2203.11110](#))
- ⇒ A standard convention for particle-level Monte Carlo event-variation weights ([hep-ph:2203.08230](#))
- ⇒ CMS Phase-2 Computing Model <https://cds.cern.ch/record/2815292>
- ⇒ Prospects for a Heavy Vector-Like Charge 2/3 Quark T search at the LHC with $\sqrt{s}=14$ TeV and 33 TeV. “A Snowmass 2013 Whitepaper”, Saptaparna Bhattacharya. et al ([hep-ex:1309.0026](#))
- ⇒ Snowmass Energy Frontier Simulations using the Open Science Grid (A Snowmass 2013 whitepaper), S. Bhattacharya et al. ([hep-ex:1308.0843](#))

Presentations (selected by the CMS Conference Committee)

⇒ Exploration of multiboson final states:

- “Multibosons at ATLAS and CMS”, Moriond Electroweak Interactions & Unified Theories, La Thuile Acosta valley, Italy
- “Vector Boson Scattering processes at the LHC”, SM@LHC, Jul 10th-13th, 2023, Fermilab.
- “Recent diboson and polarization measurements at CMS”, The Eleventh Annual Conference on Large Hadron Collider Physics (LHCP2023), May 22nd-26th, 2023, Belgrade, Serbia
- “Multiboson measurements at CMS”, Phenomenology Symposium 2022, May 9-11th, Pittsburgh.
- “Searches for New Physics in multi-boson events using anomalous coupling and effective field theory approaches”, Multi-boson Interactions (MBI), August 23-26th, 2021, Milan, Italy.

- “Multiboson Measurements in CMS and ATLAS”, The Eighth Annual Conference on Large Hadron Collider Physics (LHCP2020), May 25-30th 2020.
- “Usage of effective field theory and anomalous gauge coupling interpretation in ATLAS and CMS”, Physics Workshop At The LPC: Multibosons At The Energy Frontier, July 2019.
- “Electroweak physics with multibosons at the CMS experiment”, Plenary talk at ALPS, April 2019.
- “Search for WWW production with data collected by the CMS Detector at $\sqrt{s} = 13$ TeV”, APS April Meeting, 2019.
- “Recent results for charged diboson channels (including aTGCs)”, Multi-boson interactions (MBI), August 28-29th, 2018, Ann Arbor, Michigan.

⇒ Event generators:

- * “Minimum Bias and Underlying Event: review of measurements and MC tuning at CMS”, Multiple Parton Interactions at the LHC, October 11th-15th, 2021, Lisbon, Portugal.
- * “Event Generation: Negative Weights, CPU Performance and Multi Threading”, Offline and Computing Week, October 22nd, 2021, CERN.

⇒ Detector performance studies:

- “The HGCAL upgrade of the CMS detector for HL-LHC”, Meeting of the Division of Particles and Fields of the American Physical Society (DPF) 2021, August 12-14 July, 2021.
- “Exploring the timing capabilities of the High Granularity Calorimeter”, APS April Meeting, 2019.
- “The High Granularity Calorimeter for the HL-LHC”, US LHC Users Organization Meeting held at Fermi National Accelerator Laboratory (FNAL), November 2nd-3rd, 2017.

⇒ Searches for physics beyond the standard model:

- “Searches for new physics in dijet and multijet final states with CMS and ATLAS”, ICHEP 2016: The 38th International Conference on High Energy Physics, August 3-10, 2016, Chicago, IL.
- “Inclusive search for a vector-like T quark by CMS”, US LHC Users Organization Meeting held at the University of Wisconsin, Madison, November 6-8th, 2013.
- “T to lepton+jets and multileptons”, LHC Physics Center Workshop on Exotic Top Partners, September 26-27, 2013.
- “Search for Exotic Top Partners at $\sqrt{s} = 8$ TeV”, DPF 2013, held at the University of California, Santa Cruz, from August 8-13, 2013.
- “Search for a heavy exotic partner of the top quark with charge $5/3$ ”, APS April Meeting, 2012.
- “Higgs Production through Top-prime decays at the LHC”, DPF 2011, held at Brown University, Providence, RI from August 8-13, 2011.

⇒ Studies of physics objects in CMS (*b*-tagging):

- * “Efficiency measurement of *b*-tagging algorithms developed by the CMS experiment”, DPF 2011, held at Brown University, Providence, RI from August 8-13, 2011.
- * “Understanding of B-Tagging at CMS” presented at “Implications of First LHC Data”, a joint

Berkeley-MIT workshop, held at MIT from August 10-13, 2010.

Invited talks and colloquia

⇒ Exploration of multiboson final states and effective field theories:

- “The road to precision: Stress-testing the Standard Model of Particle Physics”, Physics Seminar, Texas Tech University, February 2024
- “The road to precision: Stress-testing the Standard Model of Particle Physics”, Physics Colloquium, University of Kansas, February 2024
- “The road to precision: Stress-testing the Standard Model of Particle Physics”, Physics Seminar, Southern Methodist University, January 2024
- “The road to precision: Stress-testing the Standard Model of Particle Physics”, Physics Seminar, Karlsruhe Institute of Technology, December 2023
- “The road to precision: Stress-testing the Standard Model of Particle Physics”, Physics Colloquium, University at Buffalo, State University of New York, November 2023
- “Looking for new physics in rare and novel processes at the Large Hadron Collider”, Physics Colloquium, Wayne State University, June 2023
- “Looking for new physics in rare and novel processes at the Large Hadron Collider”, Physics Seminar, Brookhaven National Laboratory, April 2023
- “Looking for new physics in rare and novel processes at the Large Hadron Collider”, Physics Seminar, University of Wisconsin-Madison, December 2022
- “An experimental overview of effective field theory exploration at the LHC”, Caltech, May 2022
- “Looking for new physics in rare and novel processes at the Large Hadron Collider”, Physics Colloquium, University of Alabama, April 2022
- “Looking for new physics in rare and novel processes at the Large Hadron Collider”, Physics Colloquium, University of Notre Dame, April 2022
- “Looking for new physics in rare and novel processes at the Large Hadron Collider”, Physics Colloquium, University of California, Davis, March 2022
- “Search for heavy gauge boson production at the Large Hadron Collider”, Physics Seminar, University of California, Davis, March 2022
- “Search for heavy gauge boson production at the Large Hadron Collider”, Columbia University, February 2022
- “An experimental overview of effective field theory exploration at the LHC”, University of Chicago, February 2022
- “An experimental overview of effective field theory exploration at the LHC”, Cornell University, February 2022
- “An experimental overview of effective field theory exploration at the LHC”, Northwestern University, January 2022
- “An experimental overview of effective field theory exploration at the LHC”, Physics Seminar, Brookhaven National Laboratory December 2021
- “Search for heavy gauge boson production at the Large Hadron Collider”, Physics Seminar, University of Notre Dame, December 2021

- “An experimental overview of effective field theory exploration at the LHC”, Physics Colloquium, University of Mississippi, November 2021
- “Search for heavy gauge boson production at the Large Hadron Collider”, Physics Seminar, Southern Illinois University, March 2021

⇒ Event generators:

- * “Monte Carlo simulation in CMS”, LHC Physics Center, Physics Forum, July 28th, 2022.
- * “Uncertainties in event generator predictions for LHC physics”, The Snowmass Energy Frontier Precision QCD group, July 17th, 2020

⇒ Snowmass projections:

- ◇ “The Higgs at the HL-LHC”, Snowmass Community Study, Seattle, July 2022
- ◇ “A Higgs aficionado’s exploration of the High Luminosity-LHC”, Energy Frontier Workshop, Brown University, March 2022

⇒ Searches for physics beyond the standard model:

- “Search for new physics in multi-particle final states with early Run 2 data collected with the CMS experiment at $\sqrt{s} = 13$ TeV”, Saha Institute of Nuclear Physics, Kolkata, March 8th, 2016.
- “Search for SuperSymmetry (SUSY) in low transverse momenta oppositely charged dilepton final states with parked data collected at $\sqrt{s} = 8$ TeV using the Compact Muon Solenoid (CMS) detector”, Talk given at Northwestern University, Evanston IL, July 29th, 2015.
- “Search for SuperSymmetry (SUSY) in low transverse momenta oppositely charged dilepton final states with parked data collected at $\sqrt{s} = 8$ TeV using the Compact Muon Solenoid (CMS) detector”, Talk given at the University of Virginia, Charlottesville VA, July 27th, 2015.

In the news

- ⇒ Selected by the Physics Coordination in the CMS Collaboration to be interviewed by Phys.Org [for an article on the discovery of the VVV process, December 2020](#)
- ⇒ Interview by Symmetry magazine on the [discovery of heavy boson triplets, December 2020](#)
- ⇒ CMS press release featuring the observation of triboson production: “Triple Treat! CMS Observes Production of Three Massive Vector Bosons”, [Press release, April 2020](#)
- ⇒ Was featured in Fermilab Today, [“Frontier Science Result: CMS”](#) for contributing to search for new physics in relatively “clean” same-signed di-leptonic final states, April 2014.
- ⇒ Was featured in Fermilab Today, [“Frontier Science Result: CMS”](#) for contributing to the first search that uses the Higgs boson as a probe for new physics, December, 2013.
- ⇒ Was featured in Fermilab Today, [“CMS Result of the week”](#) for contribution to the CMS b-quark identification effort, November, 2011.

Computer Skills

- ⇒ Languages: Proficient in C++, Python. Experience with Mathematica, Matlab, Feynrules.
 - ⇒ Monte Carlo event generators: Extensively used MadGraph4, MadGraph5 and Pythia 6 and 8.
 - ⇒ Markup Languages: HTML, Tex.
 - ⇒ Scripting Languages: bash, Python.
 - ⇒ LHC grid computing.
 - ⇒ Platforms: Linux, MacOS.
-

Mentorship

- ⇒ Invited to deliver a presentation on the “Academic Job Landscape” at the [APS Conference for Graduate Women and Gender Minorities in Physics 2024](#) in Washington DC in August 2024.
 - ⇒ January 2020-present: Mentoring Yulun Miao, a graduate student at Northwestern University on triboson production and effective field theory interpretation **in identically charged leptonic final states** and detector performance studies of the High Granularity Calorimeter. The process of mentorship involves daily interactions where analysis ideas are discussed, crystallized in the form of concrete to-do lists and tasks are assigned with an expected date of completion. These steps are an essential part of the training process of being a graduate student in particle physics.
 - ⇒ December 2020-present: Mentoring Qilong Guo, a graduate student at Peking University on triboson production and effective field theory interpretation **in a single leptonic final state**. Qilong is an advanced graduate student and I work with him regularly to discuss broad analysis strategies and the next steps with regard to his analysis channel.
 - ⇒ Summer 2018: Mentored Lacey Rainbolt, an undergraduate student at Northwestern University. Lacey and I have had extensive discussions on Monte Carlo generation of her signal model of interest. I introduced the CMS software package to her. She is currently a graduate student at the University of Chicago.
 - ⇒ Summer 2010: Mentored Jared Max Lafer, as an undergraduate student at Brown University who was assigned to compute trigger efficiency of primarily muon based triggers. He is currently a Lead AI Research Scientist at Imbellus, New York. I interacted with Jared regularly and worked with him to setup an analysis code and taught him to write code in [ROOT](#). I was a junior graduate student during this time and the process of discussing ideas and pragmatic approaches to problem solving helped me sharpen my skill set.
-

Teaching Experience

- ⇒ *Inaugural Sievert Prize Awardee*
Delivered a set of eight lectures at Northwestern University. I designed the arc and the content of these hour-long lectures.
- ⇒ *Hands On Tutorial, Fermilab*
July 2019, 2020 and September 2023: Served as the lead facilitator for the Generator Hands On Tutorial at the LHC Physics Center.
- ⇒ *Brown University, School of Professional Studies*

Summer 2015, Summer 2016, Summer 2023: **Designed and taught** a course on the **discovery of the Higgs boson and its legacy ten years later** for pre-college students for the School of Professional Studies at Brown. The course was rated highly by the students. Attendees included students from various countries with different academic backgrounds.

⇒ *Hands On Tutorial, Fermilab*

June 2018: Selected to serve as a facilitator for the Generator Hands On Tutorial at the LHC Physics Center.

⇒ *CMS Data Analysis School (DAS), Fermilab*

January 2018-2019, 2021: Served as the **lead facilitator** for the “Generators” exercise at CMS DAS. Also, served as a co-facilitator in the “Searches using boosted topologies” exercise designed for CMS DAS.

⇒ *Brown University*

Teaching Assistant, Fall 2007 - Spring 2008: Conducted laboratory classes for undergraduate students majoring in Physics.

Contribution to the Snowmass 2021-2022 process

⇒ Served as Level-3 convener in the upgrade studies performance group in CMS responsible for contributing to the Snowmass white paper which was submitted on behalf of the CMS Collaboration. I was specifically involved in the collation of analyses that posit the exploration of SM processes. I came up with a list of potential analyses and contributed to the letter of interest. I worked with analyses teams and conferred with them on analyses strategies, availability of samples, and assessment of person power needed to complete the analysis.

⇒ Served as liaison to “The Electroweak precision physics and constraining new physics” (EF04) group as part of the Snowmass Early Career (SEC) group. I was selected to present an overview of EF04 activities as part of the [SEC on Snowmass Day](#).

⇒ Selected to deliver talks on Higgs projections for the High Luminosity LHC at the Community Summer Study in Seattle and the Energy Frontier workshop at Brown University.

⇒ Organized the [Snowmass 2021 community planning meeting at Fermilab \(October 5th-8th, 2020\)](#) in association with the Fermilab Scientific Advisory Council.

Contribution to the Particle Physics Project Prioritization Process - P5

⇒ Delivered talk on “Stress-testing the Standard Model using the Effective Field Theory formalism”, P5 town hall at SLAC

⇒ Delivered talk on “Electroweak and Higgs Interplay at FCC-ee”, Virtual P5 town hall

Outreach Activities

⇒ Delivered a set of eight public lectures at Northwestern University as the inaugural Sievert Prize winner.

- ⇒ Spring 2017: Delivered a lecture on Particle Physics during the Saturday Morning Physics session at Fermilab.
 - ⇒ Fall 2011-Spring 2012: Involved in outreach activities at the Wheeler School in Providence, RI. and the Science Center at Brown University.
-



Papers and book chapters in preparation:

- ⇒ Search for higher order operators in triboson processes
 - ⇒ Constraining effective field theory operators of dimension-6 in multiboson final states using electroweak precision observables
 - ⇒ Annual Review of Particle Physics: Vector Boson Scattering processes, trilinear and quartic couplings - from LEP to LHC
-

Last updated: August 26, 2024