Keith A. Ulmer

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Education

Ph.D. Physics, University of Colorado, 2007

B.A. Physics and Mathematics, Amherst College, 2001 *Summa Cum Laude*

Academic Positions

Associate Professor, CMS experiment, University of Colorado Boulder	2021–
Assistant Professor, CMS experiment, University of Colorado Boulder	2017–2021
Assistant Professor, CMS experiment, Texas A&M University	2014–2017
Scientific Associate, CMS experiment CERN	2015
CMS Fellow, LHC Physics Center, Fermilab	2014
Research Associate, CMS experiment, University of Colorado Boulder	2007–2014
Research Assistant, *BABAR* experiment, University of Colorado Boulder	2002–2007

Research Experience

CMS (2007−present) CMS is a multi-purpose detector at the LHC collecting 13 TeV pp collisions designed primarily to search for the Higgs boson and physics beyond the standard model.

- **Searches for Lepton Flavor Violation (2022−present)** Leading new searches for charged lepton flavor violation in direct ($Z \to e^- \mu^+$) and indirect (Rare B meson decay ratio R_K) channels.
- **Forward Dark Matter Detector R&D (2022−present)** Leading R&D effort for development of a data triggering system and physics case for new CMS dark matter detector FACET (Forward Aperture CMS ExTension).
- **Manager of CMS Global Track Trigger project (2020−present)** Leading Global Track Trigger (GTT) project for the CMS Phase 2 upgrade of the Level 1 trigger system. Coordinating development and testing of hardware, firmware, and infrastructure for L1 track standalone object reconstruction.
- **Co-coordinator of US-CMS Trigger/DAQ project (2018−present)** Serve as one of two coordinators managing US contributions to CMS Phase 2 LHC upgrades to the level 1 trigger and data acquisition system. Responsible for budget $\sim$ \$18M to develop needed hardware, firmware, and software for next generation trigger system with contributions from 15 US institutions.
- **Research and Development toward Level 1 Correlator Trigger (2017−present)** Proposed Global Track Trigger (GTT) subsystem for L1 trigger upgrade, which was approved as

part of the baseline design in the Phase 2 Technical Design Report. Designed and demonstrated track standalone object reconstruction on prototype GTT boards.

- **Searches for electroweak production of supersymmetry (2016−present)** Updated electroweak Higgsino search in $4b$ plus missing energy final state with 2016 data published in PRD and combined with other decay channels in JHEP. Developing search merging boosted and resolved topologies for maximal reach with 2016-2018 data. Extending approach to other hadronic channels WZ, WW, and WH plus missing energy.
- **Searches for boosted supersymmetry with jet substructure (2016−2022)** Developed novel search for supersymmetry in strong production channels with boosted Higgs bosons utilizing merged jet tagging tools published in PRL. Extended approach to second publication submitted to JHEP in boosted Z boson final state.
- **Search for supersymmetry with multi-jets and missing energy (2015−2019)** CMS flagship supersymmetry search in the multi-jet and missing energy final state. Coordinating efforts of team of 35 collaborators. Successfully delivered the first CMS supersymmetry result with 2015 data published in PLB, and updated with 2016 data published in PRD, and 2016−2018 data published in JHEP.
- **Research and Development toward Level 1 Track Trigger (2014−present)** Developed track fit firmware for first demonstration of track reconstruction in hardware for L1 trigger application. Optimizing system for physics performance and track finding efficiency and latency for FPGA-only track trigger approach.
- **Co-convener of CMS Supersymmetry group (2014−2015)** Responsible for planning, coordinating, and directing SUSY searches in CMS from more than 300 participating CMS collaborators from over 40 institutions. Successfully delivered first physics results with 13 TeV data, including development of new trigger menu for Run 2. Coordinated CMS SUSY contribution to physics justification for Phase 2 detector upgrades. Total of 17 papers published from the group with over 1500 total citations under my leadership.
- **Co-convener of CMS Supersymmetry gluino group (2013)** Coordinated, planned, and directed searches for gluino decays for ten analysis teams comprised of more than 100 collaborators from over 20 institutions.
- **Search for supersymmetric Higgsino production (2013−2014)** Co-initiator of novel search for direct production of Higgsinos with Higgs to $b\bar{b}$ decays plus missing energy. First results published in PRD in 2014.
- **Search for supersymmetry with bottom quarks (2011−2013)** Pioneering author in CMS searches for SUSY with heavy flavor decays. Designed optimized signal selection for all hadronic channel with b-tags with 2011 CMS dataset published in PRD. Led updated result with 2012 data published in PLB based on new fitting technique of kinematic variable shapes.
- **Discovery of $B_s^0 \to \mu^+\mu^-$ (2012-2013)** Appointed by CMS management to task force to ensure the successful completion of the search. Measured B_s^0 production normalization decay channel. Wrote the PRL with first observation of $B_s^0 \to \mu^+\mu^-$.
- **Co-convener of exclusive B decays group (2011−2012)** Managed and guided 18 analyses with exclusive final state B decays in indirect searches for new physics and CP-violation studies. Oversaw the publication of seven papers, including four in PRL.
- **B physics analysis (2008−2012)** Led measurement of B^0 production with 2010 data and Λ_b baryon production with 2011 data. Was sole junior analyst for both results and wrote the papers published in PRL and PLB.
- **Silicon track reconstruction (2008−2010)** Optimized reconstruction of long-lived particles as early validation of tracker performance. Reconstructed first K_S^0, Λ, Ξ^-, and Ω^- particles in initial LHC collisions.

– **Tracker and tracking software commissioning (2007−2009)** Designed and wrote software to measure the hit efficiency for the strip tracker based on cosmic ray data. Designed technique to measure pixel and strip position resolutions used to improve tracking performance.

***BABAR* (2002−2007)** The *BABAR* experiment at SLAC collected e^+e^- collision data from 1999 to 2008. More than 500 fb^{-1} of data were collected at the $\Upsilon(4S)$ resonance to study B-meson decays.

– **Observation of *CP*-violation (2007)** Led first observation of mixing-induced *CP*-violation in charmless B decays. Measured *CP*-violation at the level of 5.5σ with the final state $\eta' K^0_S$ in the interference between $B^0-\bar{B}^0$ mixing and the B^0 decay.

– **Tracker data quality monitoring (2003−2005)** Responsible for data quality monitoring for drift chamber tracking system. Designed and implemented initial monitoring elements, including automated online monitoring.

– **Muon system hardware (2004)** Contributed to replacement of muon detectors including installation, cable design, and quality testing of limited streamer tubes.

Teaching Experience

University of Colorado (2018−present)

– **PHYS 2210** Taught sophomore-level physics course in Newtonian mechanics spring 2018, fall 2018, and fall 2022. Wrote and delivered class lectures, including emphasis on peer-to-peer interaction through real-time feedback questions with iClickers and in class discussion. Utilized flipped classroom model.

– **PHYS 4420** Taught undergraduate nuclear and particle physics class spring semesters in 2019 and 2020. Added course lecture material on the Higgs mechanism and Higgs boson. Developed computational data analysis exercises based on publicly available experimental data from the Large Hadron Collider.

– **PHYS 2150** Taught sophomore-level modern physics laboratory class fall 2019 and 2020, and spring 2021 and 2022. Revised laboratory manuals for twelve experiments based on commonly misunderstood issues in the procedures or data analysis. Adapted six experiments for online versions appropriate for remote teaching.

– **PHYS 2130** Taught modern physics class for non-majors fall 2021, spring 2023, and fall 2024. Focused on interactive teaching methods including in-class tutorials, online discussion boards, and peer-to-peer interactions with iClickers.

Texas A&M University (2015−2017)

– **PHYS 218** Taught calculus-based first-semester physics course in Newtonian mechanics to ∼150 students each semester in Fall 2015, Spring 2016, and Spring 2017 (two sections). Wrote and delivered class lectures, including emphasis on peer-to-peer interaction through real-time feedback questions with iClickers. Redesigned recitation sections around active engagement approach, including proposing and implementing the use of undergraduate learning assistants.

University of Colorado (2013)

– **PHYS 1110** Taught calculus-based first-semester physics course to 75 students in the summer session.

American School of Milan (2001−2002)

– Designed and taught introductory physics course for 10th grade students. Taught elective courses in robotics, computer hardware, digital art, and web page design to middle school students.

Awards

LHC Physics Center (LPC) Distinguished Researcher Award (2024) Awarded by Fermilab and the Department of Energy for outstanding contributions to the CMS experiment.

Marinus Smith Award (2023) Awarded by the University of Colorado Boulder for outstanding impact on students.

CU Physics Outstanding Teacher of the Year (2019−2020) Awarded by the University of Colorado Boulder department of physics for outstanding teaching.

Montague Center for Teaching Excellence Scholar (2016−2017) Awarded as the Texas A&M University College of Science scholar for teaching excellence.

CERN Scientific Associate (2015) Support from CERN to be resident at the laboratory to collaborate with the CMS experiment as the convener of the supersymmetry search group.

LHC Physics Center (LPC) Fellowship (2014) Fellowship from Fermilab to develop an independent program of research for supersymmetry physics analysis in connection with the LPC.

Walker Prize, Amherst College (1997) Top score in creative problem solving mathematics exam.

Mentoring

Graduate Students

- Emily (MacDonald) Fair (2016−2022), PhD 2022, now Software Engineer at Blue Origin
- Claire Savard (2018−2024), PhD 2024
- Noah Zipper (2019−)
- Maxwell Herrmann (2022−)
- Jared Fraticelli (2024−)
- Natalie Bruhwiler (2024−)

Postdocs

- Rishi Patel (2014−2020), now Data Scientist at NeuroFlow
- Marco De Mattia (2014−2017), now Data Scientist at KoBold Metals
- Alexx Perloff (2018−2022), now Research Scientist at Lawrence Livermore National Laboratory
- Filippo Marini (2021−2023), now Scientific Staff at INFN Padova
- Georgios Karathanasis (2021−2024), now Fellow at CERN
- Nick Manganelli (2023−2024), now postdoc at Northeastern
- Jannicke Pearkes (2023−)
- Stephanie Kwan (2025−)

Undergraduate Students

- Charles Dickerson (Texas A&M 2015−2016)
- Jacob Griffin (Texas A&M 2016)
- Musaab Al Bakhry (2018−2020), honors thesis *summa cum laude*, now in physics PhD program at UBC
- Jenna Kishanevsky (2018−2020), honors thesis *cum laude*, now in physics PhD program at Oregon
- Andrew Scheck (2020−2021), now in physics PhD program at Michigan
- Alex Koek (2020−2021), now in physics PhD program at U. of Alberta

- Guillermo Fidalgo Rodríguez (2021), CU Pathways to Physics student from Puerto Rico Mayagúez
- Olivia Courtney (2021−2023), now in applied math PhD program
- Arlee Shelby (2022), honors thesis *magna cum laude*, now in physics PhD program at NC State
- Reece Rupp (2023), CU REU program, now in physics PhD program at Colorado State
- Nattapat (Con) Muangkod (2023−) CU honors student
- Ada Collins (2024) USCMS PURSUE summer research program
- Ricardo Silvestre (2024) CU honors student

Peer Reviewed Publications

Since 2009, I have been an author on 1,260 CMS publications. From 2004 to 2010 I was an author on 265 *BABAR* publications. I was a primary author for the publications listed below. My full publication list may be found at `https://inspirehep.net/authors/1028311`.

A. Hayrapetyan *et al.* [CMS Collaboration], "Dark sector searches with the CMS experiment," Physics Reports, in press, (2024), [arXiv:2405.13778 [hep-ex]].

A. Hayrapetyan *et al.* [CMS Collaboration], "Enriching the physics program of the CMS experiment via data scouting and data parking," Physics Reports, in press, (2024), [arXiv:2403.16134 [hep-ex]].

A. Hayrapetyan *et al.* [CMS Collaboration], "Search for dark QCD with emerging jets in proton-proton collisions at $\sqrt{s} = 13$ TeV," JHEP **2024**, 142 (2024), [arXiv:2403.01556 [hep-ex]].

A. Hayrapetyan *et al.* [CMS Collaboration], "Combined search for electroweak production of winos, binos, higgsinos, and sleptons in proton-proton collisions at $\sqrt{s} = 13$ TeV," Phys. Rev. D bf 109, 112001 (2024), [arXiv:2402.01888 [hep-ex]].

A. Hayrapetyan *et al.* [CMS Collaboration], "Test of lepton flavor universality in $B^{\pm} \to K^{\pm}\mu^{+}\mu^{-}$ and $B^{\pm} \to K^{\pm}e^{+}e^{-}$ decays in proton-proton collisions at $\sqrt{s} = 13$ TeV," Reports on Progress in Physics bf 87 7 (2024), [arXiv:2401.07090 [hep-ex]].

CMS Collaboration, "2024 Data Collected with AXOL1TL Anomaly Detection at the CMS Level-1 Trigger," CMS Detector Performance Summary CERN-CMS-DP-2024-059 (2024), "https://cds.cern.ch/record/2904695"

C. Savard, N. Manganelli, B. Holzman, L. Gray, A. Perloff, K. Pedro, K. Stenson, and K. Ulmer, "Optimizing High-Throughput Inference on Graph Neural Networks at Shared Computing Facilities with the NVIDIA Triton Inference Server," Computing and Software for Big Science **8**, 14 (2024), [arXiv:2312.06838 [hep-ex]].

A. Hayrapetyan *et al.* [CMS Collaboration], "Development of the CMS detector for the CERN LHC Run 3," JINST **19**, no. 5, P05064 (2024), [arXiv:2309.05466 [physics.ins-det]].

A. Tumasyan *et al.* [CMS Collaboration], "Evidence for four-top quark production in proton-proton collisions at $\sqrt{s} = 13$ TeV," Phys. Lett. B **844**, 138076 (2023), [arXiv:2303.03864 [hep-ex]].

CMS Collaboration, "Anomaly Detection in the CMS Global Trigger Test Crate for Run 3," CMS Detector Performance Summary CERN-CMS-DP-2023-079 (2023), "https://cds.cern.ch/record/2876546"

A. Tumasyan *et al.* [CMS Collaboration], "Search for electroweak production of charginos and neutralinos at $\sqrt{s} = 13$ TeV in final states containing hadronic decays of WW, WZ, or WH and missing transverse momentum," Phys. Lett. B **842**, 137460 (2023), [arXiv:2205.09597 [hep-ex]].

S. Ajuha *et al.*, "Charged particle tracking in real-time using a full-mesh data delivery architecture and associative memory techniques," JINST **17**, no. 12, P12002 (2022) [arXiv:2210.02489 [physics.ins-det]].

CMS and ATLAS Collaborations, "Snowmass White Paper Contribution: Physics with the Phase-2 ATLAS and CMS Detectors," CERN Report, CMS-PAS-FTR-22-001, ATL-PHYS-PUB-2022-018 (2022).

A. Tumasyan *et al.* [CMS Collaboration], "Search for higgsinos decaying to two Higgs bosons and missing transverse momentum in proton-proton collisions at $\sqrt{s} = 13$ TeV," JHEP **2022**, 14 (2022), [arXiv:2201.04206 [hep-ex]].

A. M. Sirunyan *et al.* [CMS Collaboration], "Search for supersymmetry in proton-proton collisions at $\sqrt{s} = 13$ TeV in events with high-momentum Z bosons and missing transverse momentum," JHEP **2020**, 149 (2020), [arXiv:2008.04422 [hep-ex]].

CMS Collaboration, "The Phase-2 Upgrade of the CMS Level-1 Trigger," Technical Design Report, CERN-LHCC-2020-004, CMS-TDR-021 (2020).

E. Bartz *et al.*, "FPGA-based tracking for the CMS Level-1 trigger using the tracklet algorithm," JINST **15**, no. 06, P06024 (2020), [arXiv:1910.09970 [physics.ins-det]].

A. M. Sirunyan *et al.* [CMS Collaboration], "Combined search for supersymmetry with photons in proton-proton collisions at $\sqrt{s} = 13$ TeV," Phys. Lett. B **801**, 135183 (2020), [arXiv:1907.00857 [hep-ex]].

E. Hazen *et al.*, "The Apollo ATCA Platform," in proceedings of "Topical Workshop on Electronics for Particle Physics" PoS(TWEPP2019) **370**, 120 (2020). [arXiv:1911.06452 [physics.ins-det]].

R. Glein, A. Perloff and K. A. Ulmer, "Continuous Integration of FPGA Designs for CMS," in proceedings of "Topical Workshop on Electronics for Particle Physics" PoS(TWEPP2019) **370**, 028 (2020).

A. M. Sirunyan *et al.* [CMS Collaboration], "Search for supersymmetry in proton-proton collisions at 13 TeV in final states with jets and missing transverse momentum," JHEP **1910**, 244 (2019) [arXiv:1908.04722 [hep-ex]].

E. Clement *et al.* "A high-performance track fitter for use in ultra-fast electronics," Nucl. Instrum. Meth. A **935**, 95 (2019) [arXiv:1809.01467 [physics.ins-det]].

X. Cid Vidal *et al.*, "Beyond the Standard Model Physics at the HL-LHC and HE-LHC," CERN Yellow Rep. Monogr. **7**, 585 (2019) [arXiv:1812.07831 [hep-ph]].

M. Cepeda *et al.*, "Higgs Physics at the HL-LHC and HE-LHC," CERN Yellow Rep. Monogr. **7**, 221 (2019) [arXiv:1902.00134 [hep-ph]].

A. Cerri *et al.*, "Opportunities in Flavour Physics at the HL-LHC and HE-LHC," CERN Yellow Rep. Monogr. **7**, 867 (2019) [arXiv:1812.07638 [hep-ph]].

CMS Collaboration, "First Level Track Jet Trigger for Displaced Jets at High Luminosity LHC," CMS-PAS-FTR-18-018 (2018).

A. M. Sirunyan *et al.* [CMS Collaboration], "Combined search for electroweak production of charginos and neutralinos in proton-proton collisions at $\sqrt{s} = 13$ TeV," JHEP **03**, 160 (2018) [arXiv:1801.03957 [hep-ex]].

A. M. Sirunyan *et al.* [CMS Collaboration], "Search for physics beyond the standard model in events with high-momentum Higgs bosons and missing transverse momentum in proton-proton collisions at 13 TeV," Phys. Rev. Lett. **120**, 241801 (2018) [arXiv:1712.08501 [hep-ex]].

V. Khachatryan *et al.* [CMS Collaboration], "Search for higgsino pair production in pp collisions at $\sqrt{s} = 13$ TeV in final states with large missing transverse momentum and two Higgs bosons decaying via $H \to b\bar{b}$," Phys. Rev. D **97**, 032007 (2018) [arXiv:1709.04896 [hep-ex]].

A. M. Sirunyan *et al.* [CMS Collaboration], "Search for supersymmetry in multijet events with missing transverse momentum in proton-proton collisions at 13 TeV," Phys. Rev. D **96**, 032003 (2017) [arXiv:1704.07781 [hep-ex]].

V. Khachatryan *et al.* [CMS Collaboration], "Search for supersymmetry in the multijet and missing transverse momentum final state in pp collisions at 13 TeV," Phys. Lett. B **758**, 152 (2016) [arXiv:1602.06581 [hep-ex]].

V. Khachatryan *et al.* [CMS Collaboration], "Angular analysis of the decay $B^0 \to K^{*0}\mu^+\mu^-$ from pp collisions at $\sqrt{s} = 8$ TeV," Phys. Lett. B **753**, 424 (2016) [arXiv:1507.08126 [hep-ex]].

V. Khachatryan *et al.* [CMS and LHCb Collaborations], "Observation of the rare $B_s^0 \to \mu^+\mu^-$ decay from the combined analysis of CMS and LHCb data," Nature **522**, 68 (2015) [arXiv:1411.4413].

V. Khachatryan *et al.* [CMS Collaboration], "Searches for supersymmetry based on events with b jets and four W bosons in pp collisions at 8 TeV," Phys. Lett. B **745**, 5 (2015) [arXiv: 1412.4109 [hep-ex]].

V. Khachatryan *et al.* [CMS Collaboration], "Technical Proposal for the Phase-II Upgrade of the Compact Muon Solenoid," CERN-LHCC-2015-010 (2015), https://cds.cern.ch/record/2020886.

CMS Collaboration, "Supersymmetry discovery potential in future LHC and HL-LHC running with the CMS detector," CMS-SUS-14-012 (2014), http://cds.cern.ch/record/1981344.

V. Khachatryan *et al.* [CMS Collaboration], "Searches for electroweak neutralino and chargino production in channels with Higgs, Z, and W bosons in pp collisions at 8 TeV," Phys. Rev. D **90**, 092007 (2014) [arXiv:1409.3168].

S. Chatrchyan *et al.* [CMS Collaboration], "Description and performance of track and primary-vertex reconstruction with the CMS tracker," JINST **9**, no. 10, P10009 (2014) [arXiv:1405.6569 [physics.ins-det]].

S. Chatrchyan *et al.* [CMS Collaboration], "Measurement of the $B_s^0 \to \mu^+\mu^-$ branching fraction and search for $B^0 \to \mu^+\mu^-$ with the CMS Experiment," Phys. Rev. Lett. **111**, 101804 (2013) [arXiv:1307.5025 [hep-ex]].

S. Chatrchyan *et al.* [CMS Collaboration], "Angular analysis and branching fraction measurement of the decay $B^0 \to K^{*0}\mu^+\mu^-$," Phys. Lett. B **727**, 77 (2013) [arXiv:1308.3409 [hep-ex]].

S. Chatrchyan *et al.* [CMS Collaboration], "Search for gluino mediated bottom- and top-squark production in multijet final states in pp collisions at $\sqrt{s} = 8\,\text{TeV}$," Phys. Lett. B **725**, 243 (2013) [arXiv:1305.2390 [hep-ex]].

S. Chatrchyan *et al.* [CMS Collaboration], "Search for supersymmetry in events with b-quark jets and missing transverse energy in pp collisions at $\sqrt{s} = 7\,\text{TeV}$," Phys. Rev. D **86**, 072010 (2012) [arXiv:1208.4859 [hep-ex]].

S. Chatrchyan *et al.* [CMS Collaboration], "Measurement of the Λ_b cross section and the anti-Λ_b to Λ_b ratio with Λ_b to $J/\psi\ \Lambda$ decays in pp Collisions at $\sqrt{s} = 7\,\text{TeV}$," Phys. Lett. B **714**, 136 (2012) [arXiv:1205.0594 [hep-ex]].

S. Chatrchyan *et al.* [CMS Collaboration], "Measurement of the B^0 production cross section in pp Collisions at $\sqrt{s} = 7\,\text{TeV}$," Phys. Rev. Lett. **106**, 252001 (2011) [arXiv:1104.2892 [hep-ex]].

V. Khachatryan *et al.* [CMS Collaboration], "Strange Particle Production in pp Collisions at $\sqrt{s} = 0.9$ and $7\,\text{TeV}$," JHEP **1105**, 064 (2011) [arXiv:1102.4282 [hep-ex]].

V. Khachatryan *et al.* [CMS Collaboration], "CMS Tracking Performance Results from early LHC Operation," Eur. Phys. J. C **70**, 1165 (2010) [arXiv:1007.1988 [physics.ins-det]].

S. Chatrchyan *et al.* [CMS Collaboration], "Commissioning and Performance of the CMS Silicon Strip Tracker with Cosmic Ray Muons," JINST **5**, T03008 (2010) [arXiv:0911.4996 [physics.ins-det]].

S. Chatrchyan *et al.* [CMS Collaboration], "Commissioning and Performance of the CMS Pixel Tracker with Cosmic Ray Muons," JINST **5**, T03007 (2010) [arXiv:0911.5434 [physics.ins-det]].

W. Adam *et al.* [CMS Tracker Collaboration], "Stand-alone Cosmic Muon Reconstruction Before Installation of the CMS Silicon Strip Tracker," JINST **4**, P05004 (2009) [arXiv:0902.1860 [physics.ins-det]].

B. Aubert *et al.* [BABAR Collaboration], "Branching fraction and CP-violation charge asymmetry measurements for B-meson decays to $\eta K^\pm$, $\eta\pi^\pm$, $\eta' K$, $\eta'\pi^\pm$, ωK and $\omega\pi^\pm$," Phys. Rev. D **76**, 031103 (2007) [arXiv:0706.3893 [hep-ex]].

B. Aubert *et al.* [BABAR Collaboration], "Observation of CP violation in $B^0 \to \eta' K^0$ decays," Phys. Rev. Lett. **98**, 031801 (2007) [arXiv:hep-ex/0609052].

B. Aubert *et al.* [BABAR Collaboration], "Measurements of *CP*-violating asymmetries and branching fractions in B decays to ωK and $\omega\pi$," Phys. Rev. D **74**, 011106 (2006) [arXiv:hep-ex/0603040].

B. Aubert *et al.* [BABAR Collaboration], "B meson decays to $\eta^{(\prime)}K^*$, $\eta^{(\prime)}\rho$, $\eta^{(\prime)}\pi^0$, $\omega\pi^0$, and $\phi\pi^0$," Phys. Rev. D **70**, 032006 (2004) [arXiv:hep-ex/0403025].

L. R. Hunter, S. E. Maxwell, K. A. Ulmer, N. D. Charney, S. K. Peck, D. Krause, S. Ter-Avetisyan, and D. DeMille, "Detailed spectroscopy of the $a(1)[^3\Sigma^+]$ state of PbO," Phys. Rev. A **65**, 030501 (2002).

Invited Talks

"Searching for New Physics at the LHC" Physics Department Colloquium, Colorado State University, Ft. Collins, Colorado, USA, October 2024.

"The Higgs Boson as a Tool for Discovery at the LHC" Physics Department Colloquium, Idaho State University, Pocatello, Idaho, USA, March 2021.

"Searching for Supersymmetry at the Large Hadron Collider" Annual Meeting of the APS Four Corners Section, University of New Mexico, Albuquerque, New Mexico, USA, October 2020.

"The Higgs Boson as a Tool for Discovery at the LHC" Physics Department Colloquium, University of Colorado, Boulder, Colorado, USA, October 2020.

"Searching for Supersymmetry at the LHC" Physics Department Colloquium, Colorado State University, Fort Collins, Colorado, USA, December 2019.

"Supersymmetry experimental status and outlook" Aspen 2019 Winter Conference "In Pursuit of New Particles and Paradigms," Aspen, Colorado, USA, March 2019.

"Prospects for Physics Beyond the Standard Model at the HL-LHC and HE-LHC" International Linear Collider Workshop, University of Texas, Arlington, Texas, USA, October 2018.

"Experimental challenges for BSM physics" Workshop on the Physics of the HL-LHC, and Perspectives at HE-LHC, CERN, Switzerland, October 2017.

"Searches for supersymmetry in hadronic final states" Collider and Dark Matter Physics 2017, Mitchell Institute, Texas A& M University, College Station, Texas, May 2017.

"Searching for Supersymmetry at the LHC" Physics Colloquium, Baylor University, Waco, Texas, USA, March 2017.

"Searching for Supersymmetry at the LHC" Physics Colloquium, University of Colorado, Boulder, Colorado, USA, March 2017.

"Experience from Run 1 SUSY Searches at CMS" Experimental Challenges for the LHC Run 2 workshop, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, California, USA, April 2016.

"CMS Physics and Outlook" CMS Data Analysis School, Fermilab, Batavia, Illinois, January 2016.

"CMS Supersymmetry Group: Overview and Strategy" CMS SUSY Workshop, Fermilab, Batavia, Illinois, November 2014.

"Preparing for discovery: Supersymmetry searches at the LHC" High Energy Physics Seminar, Texas A&M University, College Station, Texas, USA, May 2014.

"Searching for Dark Matter at the LHC" Physics Colloquium, Texas A&M University, College Station, Texas, USA, April 2014.

"Preparing for discovery: Supersymmetry searches at the LHC" Research Progress Meeting Seminar, Lawrence Berkeley National Laboratory, Berkeley, California, USA, April 2014.

"Conclusions and strategy summary for CMS SUSY group in LHC Run 2" CMS SUSY Workshop, Lisbon, Portugal, March 2014.

"Preparing for discovery: Supersymmetry searches at the LHC" High Energy Seminar, University of Illinois, Urbana-Champaign, USA, February 2014.

"Measurement of the $B_s^0 \to \mu^+\mu^-$ branching fraction at CMS" Fermilab Joint Experimental-Theoretical (Wine & Cheese) Seminar, Fermilab, Batavia, Illinois, USA, August 2013.

"Overview of open topics in SUSY signatures with Higgs from strong production" SUSY with Higgs meeting, Fermilab LHC Physics Center, June 2013.

"SUSY searches with heavy flavor from CMS and ATLAS" CHICAGO 2012 Workshop on LHC Physics in the Higgs Era, University of Chicago, Chicago, Illinois, USA, November 2012.

"Searching for the Higgs: The origin of mass?" Physics Colloquium, University of Denver, Denver, Colorado, USA, November 2012.

"Recent heavy flavor results from CMS" Fermilab Joint Experimental-Theoretical (Wine & Cheese) Seminar, Fermilab, Batavia, Illinois, USA, June 2012.

"sbottom and stop production at CMS" Workshop on SUSY with 5 fb^{-1} at the LHC, Brookhaven National Laboratory, Upton, New York, USA, May 2012.

"3rd generation supersymmetry production at CMS" USCMS Collaboration Meeting, Boulder, Colorado, USA, May 2012.

"Searches for new physics in b hadron decays at CMS" Joint Theory-Experiment Workshop on Searches for New Physics Via Heavy Quark Physics in Hadron Colliders, University of Washington, Seattle, Washington, USA, May 2012.

Conference Talks

"Rare decays of electroweak bosons at CMS and ATLAS" 12th annual conference on Large Hadron Collider Physics (LHCP2024), Northeastern University, Boston, Massachusetts, USA, June 2024.

"Lepton Flavor Universality Studies at CMS and ATLAS" 11th annual conference on Large Hadron Collider Physics (LHCP2023), Belgrade, Serbia, May 2023.

"Status of FACET - a Forward-Aperture CMS ExTension for LLP Searches" Twelfth workshop of the LLP Community: Searching for long-lived particles at the LHC and beyond, CERN, Geneva, Switzerland, November 2022.

"Search for lepton and electroweak gauge boson partners with CMS," 27th International Conference on Supersymmetry and Unification of Fundamental Interactions (SUSY19), Corpus Christi, Texas, May 2019.

"Supersymmetry Searches at CMS" 25th International Conference on Supersymmetrty and Unification of Fundamental Interactions (SUSY17), Tata Institute of Fundamental Research, Mumbai, India, December 2017.

"Searching for Supersymmetry with Higgs Bosons at the LHC" Annual Meeting of the APS Four Corners Section, Colorado State University, Fort Collins, Colorado, USA, October 2017.

"Supersymmetry: Experimental Status" Large Hadron Collider Physics Conference (LHCP), St. Petersburg, Russia, September 2015. Proceedings: arXiv:1601.03774 [hep-ex].

"Future sensitivity studies for supersymmetry searches at $\sqrt{s} = 14$ TeV from CMS" American Physical Society Division of Particles and Fields 2013 Meeting, Santa Cruz, California, USA, August 2013. Proceedings: arXiv:1310.0781 [hep-ex].

"Search for supersymmetry in final states with multiple b-quarks" European Physical Society Conference on High Energy Physics, Stockholm, Sweden, July 2013. Proceedings: arXiv:1310.2588 [hep-ex].

"Studies of rare beauty and charm decays with the CMS experiment" 36th International Conference on High Energy Physics (ICHEP), Melbourne, Australia, July 2012. Proceedings: arXiv:1301.4690 [hep-ex].

"Studies of exotic charmonium and bottomonium states with the CMS experiment" 36th International Conference on High Energy Physics (ICHEP), Melbourne, Australia, July 2012. Proceedings: arXiv:1301.4686 [hep-ex].

"Search for $B_{s,d} \to \mu^+\mu^-$ with the CMS experiment" Supersymmetry 2011, Fermilab, Batavia, Illinois, USA, August 2011.

"Heavy flavor production at CMS" Rencontres de Moriond QCD and High Energy Interactions, La Thuile, Italy, March 2011. Proceedings: arXiv:1106.2528 [hep-ex].

"Hadron production at CMS in pp collisions at $\sqrt{s} = 0.9$, 2.4 and 7.0 TeV" 35th International Conference on High Energy Physics (ICHEP), Paris, France, July 2010. Proceedings: PoS **ICHEP2010**, 355 (2010).

"Tracking performance of the CMS detector in 2009 collision data" 2010 Lake Louise Winter Institute, Lake Louise, Alberta, Canada, February 2010. Proceedings: arXiv:1006.1123 [physics.ins-det].

"Heavy flavor physics at CMS" 8th International Conference on Hyperons, Charm, and Beauty Hadrons, University of South Carolina, June 2008. Proceedings: Nucl. Phys. Proc. Suppl. **187**, 57 (2009).

"Measurements of CKM angle β from *BABAR*" 2007 Lake Louise Winter Institute, Lake Louise, Alberta, Canada, February 2007. Proceedings: arXiv:0705.2998 [hep-ex].

"CP-violating asymmetries in $b \to s$ penguins" American Physical Society Division of Particles and Fields 2006 Meeting, Honolulu, HI, October 2006.

"Rare B Meson decays to ηK^*, $\eta' K^*$, $\eta\rho$, $\eta'\rho$, $\eta\pi^0$, $\eta'\pi^0$, $\omega\pi^0$ and $\phi\pi^0$" American Physical Society April Meeting 2004, Denver, CO, May 2004.

Professional Service

USCMS Advisory Board member (2024−)

LHC Physics Center at Fermilab Topic of the Week committee co-chair (2024−).

Organizing committee for Large Hadron Collider Physics 2024 conference, Northeastern University, Boston, Massachusetts, June 2024.

Chair of Poster Awards Committee, Large Hadron Collider Physics 2023 conference, Belgrade, Serbia, May 2023.

Advisory Board for the LHC Physics Center (LPC) at Fermilab (2021−2023).

Organizer for "2021 Annual Meeting of the American Physical Society Four Corners Section" University of Colorado, Boulder, Colorado, USA, October 2021.

Convener and chair for Supersymmetry sessions at SUSY2019 conference, Corpus Christi, Texas, May 2019.

Convener for "Beyond the Standard Model" working group at LPCC "Workshop on the physics of HL-LHC, and perspectives at HE-LHC," CERN 2017−2019.

Member CMS Conference Committee (2016−2020).

Convener for Supersymmetry sessions at "Experimental Challenges for the LHC Run II" workshop at the Kavli Institute for Theoretical Physics, University of California, Santa Barbara, May 2016.

Organizer and host for annual USCMS collaboration meeting, Texas A&M University, College Station, Texas, May 2016.

Convener and chair for Supersymmetry sessions at Large Hadron Collider Physics (LHCP) conference, St. Petersburg, Russia, Sept. 2015.

Organizer for CMS Supersymmetry workshops on Run 2 preparations, LIP, Lisbon, Portugal, March 2014, and Fermilab, Batavia, Illinois, November 2014.

Instructor for CMS Data Analysis School, Fermilab, Batavia, Illinois, January 2014.

Organizer for "Physics Beyond the Standard Model" sessions at the 2013 APS Division of Particles and Fields meeting, University of California at Santa Cruz, August 2013.

Organizer for "SUSY signatures with Higgs" workshop, Fermilab LHC Physics Center, June 2013.

Convener of "CHICAGO 2012 Workshop on LHC Physics in the Higgs Era" session on heavy flavor, University of Chicago, November 2012.

Peer reviewer for Journal of High Energy Physics, Physical Review D, Physics Letters B, European Physical Journal C, and International Journal of Modern Physics A.

Expert reviewer for US Department of Energy, Swiss National Science Foundation, and Hungarian HEP (OTKA) research proposals.

Member CMS publications board (2012, 2016−2020).