

# Norbert Neumeister

## Contact Information

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## Education

1996 Ph.D. in Physics (summa cum laude) University of Technology Vienna  
1992 M.S. in Physics (summa cum laude) University of Technology Vienna

## Professional Positions

2014 – present Professor, Department of Physics and Astronomy, Purdue University, USA  
2010 – 2014 Associate Professor, Department of Physics, Purdue University, USA  
2005 – 2010 Assistant Professor, Department of Physics, Purdue University, USA  
2002 – 2004 Scientific Associate, CERN, Geneva, Switzerland  
2002 – 2004 Scientific Staff, Institute for High Energy Physics Vienna, Austria  
1999 – 2001 Research Fellow, CERN, Geneva, Switzerland  
1996 – 1999 Postdoctoral Research Associate at the Inst. for High Energy Physics Vienna, Austria

## Awards and Honors

- Department of Energy (DoE) Outstanding Junior Investigator Award in High Energy Physics 2006
- Ruth & Joel Spira Award for Excellence in Undergraduate Education, Physics Department 2008
- Seed for Success Award, Purdue University 2006, 2007, 2009, 2010, 2011, 2012, 2013, 2019
- Purdue Research Foundation Research Grant 2005, 2006
- CERN research fellowship 1999 – 2001
- Co-recipient of the Particle Physics Prize of the European Physical Society 2013 (awarded to the CMS collaboration for the discovery of a Higgs boson)
- LHC Physics Center (LPC) Distinguished Researcher 2017, 2018

## Professional Memberships

- Member of the American Physical Society
- Member of the European Physical Society
- Member of the Austrian Physical Society
- Member of the CMS collaboration (1993 – present)
- Member of the DELPHI collaboration (1992 – 1999)
- Member of the UA1 collaboration (1991 – 1993)

## Teaching Experience

- Electricity and Magnetism (PHYS 271): Fall 2005
- Electricity and Magnetism for Physics Honors students (PHYS 272H): Spring 2006, Spring 2007, Spring 2008
- General Physics (PHYS 220): Fall 2006, Fall 2007, Fall 2008, Spring 2017, Fall 2019, Fall 2020, Fall 2021
- Mechanics, Heat and Wave Motion (PHYS 149): Fall 2008, Fall 2009, Fall 2010, Spring 2011
- Quantum Mechanics I for Physics Honors students (PHYS 460): Fall 2011, Fall 2012, Fall 2013
- Quantum Mechanics II for Physics Honors students (PHYS 461): Spring 2012, Spring 2013, Spring 2014
- Introduction to Elementary Particle Physics I (PHYS 564): Fall 2014, Fall 2015, Fall 2016
- Introduction to Elementary Particle Physics II (PHYS 565): Spring 2016
- Quantum Mechanics (PHYS 360): Spring 2019, Spring 2020, Spring 2021
- Invited lecturer at the CERN School of Computing 2003

## Professional Service

- Principal investigator of the US CMS Tier-2 analysis center at Purdue (2005 – present)
- Purdue Institutional Representative to the CMS Collaboration Board (2013 – present)
- Member of the CMS Thesis Award Committee (2018 – present)
- LPC Management Board (2019 – 2020)
- Co-convener of the LPC Run2 Discussion group on Leptons and Trigger (2017 – 2020)
- Co-convener of the CMS Muon Physics Object group (2007): ~80 people  
*Responsible for organizing and providing intellectual leadership for the development of muon reconstruction and identification strategies across all sub-detector systems (muon detectors, electromagnetic and hadronic calorimeter, silicon tracker) in preparation for physics with muons at the LHC.*
- Co-convener of the CMS Muon Physics Reconstruction and Selection group (2005 – 2006): ~100 people  
*Responsible for organizing the detector simulation, muon reconstruction, online trigger strategies, and offline analyses in preparation for physics with muons at the LHC. Editor of muon chapter of Volume I of the CMS Physics Technical Design Report.*
- Co-convener of the CMS reconstruction software project (2004 – 2005): ~150 people  
*Responsible for coordinating all reconstruction software development within CMS and organizing software releases.*
- Member and chair of various CMS Analysis Review Committees
- Chair of the Organization Committee for the US CMS Computing workshop at Purdue University (April 11–12, 2008)
- Chair of the Organization Committee for the CMS Endcap Muon workshop at Purdue University (October 6–7, 2006)
- Member of the CMS Physics Reconstruction and Selection editorial board (2004 – 2006)
- Worldwide LHC Computing Grid (WLCG) collaboration board member (2006 – 2011)
- Frequent reviewer of Nuclear Instruments and Methods in Physics Research
- Frequent reviewer of IEEE Transactions on Nuclear Science
- Frequent reviewer of Journal of Physics
- Reviewer of U.S. National Science Foundation proposals

- Reviewer of U.S. Department of Energy proposals
- Reviewer for the Portuguese Funding agency (FCT)
- Chair of the session on *New Phenomena Physics* at conference Moriond/QCD 2018
  
- Council of Department of Physics and Astronomy, Purdue University (2015 – present)
- Graduate admissions committee Department of Physics and Astronomy, Purdue University (2007 – present)
- Hubert James Lecture committee (2018 – present)
- Departmental promotion committee (2015 – 2018)
- Qualifying exam committee (2013 – 2020)
- Big Data search committee (2013 – 2015)
- Chair of the faculty search committee Experimental High Energy Physics (2019)
- Faculty search committee Theoretical High Energy Physics (2018)
- Faculty search committee Experimental High Energy Physics (2014)
- Faculty search committee Experimental High Energy Physics (2013)
- Head search committee Department of Physics and Astronomy (2013)
- Head search committee Department of Physics (2012)
- Faculty search committee Experimental High Energy Physics (2010)
- Faculty search committee Computer Science department (2006)
- Faculty search committee Nuclear Physics (2007)
- Faculty search committee Particle Astro Physics (2006)
- Departmental computing committee (2006 – 2013)
- Committee for the Lark-Horowitz, Akeley, Black, Fan and Tautfest awards (2008, 2011, 2012)
- Committee for the Raman and Ramdas awards (2019)
- Strategic Planning Department of Physics and Astronomy (2017, 2018)
  
- Purdue College of Science faculty council (2021 – present)
- Purdue University faculty senate (2015 – 2018)
- Purdue University Resources Policy Committee (2016 – 2018)
- College of Science Promotions Committee (2017 – 2019)
- High performance computing University committee (2006)
- Computational Sciences & Engineering Graduate Committee (2007 – present)
- Computing Research Institute (CRI) Steering Committee (2007, 2008)

## Grant Activity

My research is supported by grants from the U. S. Department of Energy (DoE) and the National Science Foundation (NSF). In 2006 I was awarded a DoE Outstanding Junior Investigator grant. Project funding from NSF supports my activities to build and operate the CMS Tier-2 center at Purdue.

Grants where I have been principle investigator:

Agency	Title (PIs)	Amount (total grant)	Dates
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: <u>N. Neumeister</u> , Co-PIs: J. Finley, M. Jones, A. Jung, D. Koltick, M. Kruczenski, N. Lashkari, M. Liu	\$3,125,000	04/1/21 – 03/31/24
NSF	<i>CC* Compute: Private Campus Cloud for Data Analytics and Machine Learning</i> PI: P. Smith, Co-PIs: <u>N. Neumeister</u> , Th. Hacker, E. Gough, J. Wisecaver	\$392,205	08/01/20 – 07/31/22
NSF	<i>High-Luminosity LHC U.S. CMS Detector Upgrade Project FPIX: Modules / Mechanics &amp; Assembly / Management</i> PI: <u>N. Neumeister</u> , Co-PIs: A. Jung, M. Jones	\$275,981	01/01/19 – 12/31/21
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: <u>N. Neumeister</u> , Co-PIs: J. Finley, M. Jones, A. Jung, D. Koltick, M. Kruczenski	\$2,618,000	04/1/18 – 03/31/21
NSF	<i>U.S. CMS Operations at LHC; Cooperative Agreement (Purdue subaward)</i> PI: <u>N. Neumeister</u> , Co-PIs: Th. Hacker	\$3,628,948	01/01/17 – 12/31/21
FNAL	<i>2020 Software and Computing HL-LHC R&amp;D Postdoc Program</i> PI: <u>N. Neumeister</u>	\$36,140	09/01/20 - 08/31/21
DoE	LPC DR fellowship for Jan-Frederick Schulte PI: <u>N. Neumeister</u>	\$43,049	01/01/20 – 12/31/20
FNAL	<i>Travel Grant</i> PI: <u>N. Neumeister</u>	\$28,000	01/01/20 - 12/31/20
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: <u>N. Neumeister</u> , Co-PIs: J. Finley, M. Jones, M. Kruczenski	\$595,000	04/1/17 – 03/31/18
DoE	LPC DR fellowship for Jan-Frederick Schulte PI: <u>N. Neumeister</u>	\$42,142	01/01/19 – 12/31/19
FNAL	<i>Travel Grant</i> PI: <u>N. Neumeister</u>	\$8,200	01/01/18 – 12/31/18
DoE	<i>LPC Distinguished Research Program</i> PI: <u>N. Neumeister</u>	\$53,884	01/01/18 – 12/31/18
DoE	<i>LPC Distinguished Research Program</i> PI: <u>N. Neumeister</u>	\$29,112	01/01/17 – 12/31/17

NSF	<i>U.S. CMS Operations at LHC; Cooperative Agreement (Purdue subaward)</i> PI: <u>N. Neumeister</u> , Co-PIs: Th. Hacker, A. Jung	\$623,607	01/01/16 – 12/31/16
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: <u>N. Neumeister</u> , Co-PIs: J. Finley, M. Jones, M. Kruczenski	\$595,000	04/1/16 – 03/31/17
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: J. Finley, Co-PIs: M. Jones, <u>N. Neumeister</u> , M. Kruczenski, W. Cui	\$720,000	04/1/15 – 03/31/16
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: J. Finley, Co-PIs: <u>N. Neumeister</u> , D. Bortoletto, I. Shipsey, S. Khlebnikov, M. Kruczenski, W. Cui	\$1,451,000	04/1/14 – 03/31/15
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: J. Finley, Co-PIs: <u>N. Neumeister</u> , D. Bortoletto, I. Shipsey, S. Khlebnikov, M. Kruczenski, W. Cui	\$1,744,000	04/1/13 – 03/31/14
DoE	<i>An Experimental and Theoretical High Energy Physics Program</i> PI: J. Finley, Co-PIs: <u>N. Neumeister</u> , D. Bortoletto, I. Shipsey, S. Khlebnikov, M. Kruczenski, W. Cui	\$1,669,000	05/01/12 – 04/30/13
NSF	<i>U.S. CMS Operations at LHC; Cooperative Agreement (Purdue subaward)</i> PI: <u>N. Neumeister</u> , Co-PIs: D. Bortoletto, Th. Hacker, I. Shipsey	\$5,683,406	11/01/11 – 10/31/16
DoE	<i>An Experimental High Energy Physics Project</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u> , J. Peterson	\$735,000	11/01/11 – 04/30/12
FNAL	LPC fellowship for Adam Everett PI: <u>N. Neumeister</u>	\$16,000	01/01/11 – 06/06/11
NSF	<i>Energizing Research through Cyberinfrastructure: Renovation of the Research Data Center</i> PI: J. Campbell, Co-PIs: J. Francisco, M. Lundstrom, J. Murthy, <u>N. Neumeister</u>	\$1,999,969	02/01/10 – 08/31/13
NSF	<i>A Proposal for a US CMS Tier-2 Center at Purdue University</i> PI: <u>N. Neumeister</u> , Co-PI: Th. Hacker	\$500,000	11/01/10 – 10/31/11
DoE	<i>An Experimental High Energy Physics Project</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u> , J. Peterson	\$1,069,000	11/01/10 – 10/31/11
NSF	<i>A Proposal for a US CMS Tier-2 Center at Purdue University</i> PI: <u>N. Neumeister</u> , Co-PI: Th. Hacker	\$523,000	11/01/09 – 10/31/10

DoE	<i>Recovery Act: Enhancing Capability in High Energy Physics at Purdue University</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, T. Clark, W. Cui, J. Finley, A. Garfinkel, M. Jones, S. Khlebnikov, L. Kruczenski, S. Love, D. Miller, <u>N. Neumeister</u> , J. Peterson	\$335,539	09/01/09 – 08/31/10
DoE	<i>An Experimental High Energy Physics Project</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u>	\$1,069,000	11/01/09 – 10/31/10
DoE	<i>An Experimental High Energy Physics Project</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u>	\$1,069,000	11/01/08 – 10/31/09
DoE	<i>An Experimental High Energy Physics Project Task A</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u>	\$1,035,000	11/01/07 – 10/31/08
DoE	<i>An Experimental High Energy Physics Project Task A</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u>	\$998,000	11/01/06 – 10/31/07
NSF	<i>A Proposal for a US CMS Tier-2 Center at Purdue University</i> PI: <u>N. Neumeister</u> , Co-PI: Th. Hacker	\$2,500,000	05/01/05 – 04/30/09
PRF	<i>Reconstruction and selection of muons for early physics discoveries at the LHC</i> PI: <u>N. Neumeister</u>	\$30,204	07/1/05 – 06/30/07
DoE	<i>OJI: Reconstruction and Selection of Muons for Early Physics Discoveries at the LHC</i> PI: <u>N. Neumeister</u>	\$240,000	11/01/05 – 10/31/09
DoE	<i>An Experimental High Energy Physics Project Task A</i> PI: I. Shipsey, Co-PIs: V. Barnes, D. Bortoletto, A. Garfinkel, M. Jones, D. Miller, <u>N. Neumeister</u>	\$1,020,000	11/01/05 – 10/31/06

## Students and Postdocs

### Post-doctoral associates:

- Arnab Purohit, 2020 – present
- Jan-Frederick Schulte, 2016 – present
- Bibhuprasad Mahakud, 2018 – 2019 (Indian Institute of Technology Bhubaneswar, India)
- Santiago Folgueras, 2016 – 2017 (University of Oviedo, Spain)
- Federica Primavera, 2014 – 2015 (University of Bologna, Italy)
- Benjamin Radburn-Smith, 2013 – 2016 (Seoul National University)
- Hwidong Yoo, 2008 – 2014 (Yonsei University, Korea)
- Suneel Dutt, 2012 – 2013 (National Institute of Technology Jalandhar, India)
- Adam Everett, 2006 – 2012 (US Army)

### Graduate students:

- Minxi Yang, 2018 – present

- Dmitry Kondratyev, 2017 – present
- Stylianos Gregoriou, 2019 – 2020 (Purdue University)
- Fan Zhang, 2018 – 2019 (Purdue University)
- Chang Liu, Ph.D. 2009 (Finance)
- Alexey Svyatkovskiy, Ph.D. 2014 (Microsoft Corporation)
- Amandeep Bakshi, M.S. 2018 (Purdue University)
- Cheng-Chieh Peng, 2013 – 2015 (Intel Corporation)
- Kurt Larson, 2014 – 2016 (Industry)
- Lingshan Xu, 2011– 2012 (Industry)
- Michael Meier, 2009 – 2010 (Industry)
- Edwin Antillon, 2007 – 2009 (Industry)

**Undergraduate students:**

- Jeff Verson (2005)
- Emily Grace (2007)
- Thomas Andrews (2008)
- Lenny Winterrowd (2008)
- Kyle Bemis (2008)
- Joshua Bone (2009)
- David Garand (2010)
- Alan Hicks (2011)
- Kate Schneider (2011)
- Jun Cheng (2012)
- Alice Zhang (2013)
- Greg Neeser (2013)
- Wolfe Greene (2014)
- Miranda Champion (2016)
- Jordan Alexander Young (2018)
- Brad Nethercutt (2018)
- Matthew Tao (2019)
- Akshat Anand Jha (2019)
- Yifeng Wang (2019)
- Robert Orlando (2020)

## Research Activities

### Proton-Proton Annihilation at the LHC (CMS):

- Precision electroweak measurements
- Measurement of the differential and double-differential Drell–Yan cross section
- Search for new heavy neutral vector bosons ( $Z' \rightarrow \mu\mu$ )
- Search for contact interactions, extra dimensions and dark matter using di-muon events
- Search for lepton flavor universality (LFU) violation
- Same-sign di-lepton search for Supersymmetric particles
- Search for exotic four-lepton resonances
- Measurement of the W and Z cross section
- Measurement of the Higgs boson properties (coupling to the second-generation fermions);  $H \rightarrow \mu^+ \mu^-$
- Measurement of the charge ratio of atmospheric muons
- Physics commissioning of the CMS detector with cosmic rays
- Design and implementation of novel muon reconstruction and identification algorithms
- Principal investigator of the US CMS Tier-2 analysis center at Purdue
- Large-scale distributed data analysis (Grid computing)
- Development of a Web portal for grid job submission
- Operations and maintenance of the Forward Pixel detector
- Online Event selection (High-Level Trigger)
- Level-1 muon trigger design and simulation
- $B$  physics studies (CP violation,  $b$ -Baryons)

### Electron-Positron Annihilation at LEP (DELPHI):

- Maintenance and operation of the forward tracking chamber
- Search for supersymmetric (SUSY) particles (three-body decays of scalar top quarks)
- Reconstruction of colour-suppressed  $B$  decays
- Inclusive  $J/\psi$  analysis

### Proton-Antiproton Annihilation at SPS (UA1):

- Intermittency studies
- Analysis of Bose-Einstein correlations

My area of research is in experimental Particle Physics where we use accelerators to search for new particles and study the properties of the elementary constituents of matter and their interactions at the most fundamental level. I am currently involved in the Compact Muon Solenoid (CMS) experiment and my research is focused on understanding the mechanism by which the symmetry between the electromagnetic and weak interaction is broken, the search for new physics beyond the established Standard Model, the understanding of the structure of the proton and large-scale distributed data analysis.

The CMS experiment is one of the two general-purpose experiments at the Large Hadron Collider (LHC) at CERN, designed to study the physics of proton-proton collisions. It involves more than 3000 scientists and engineers from more than 200 institutes and 50 countries. It is believed that the unprecedented energy range and sensitivity of the LHC, combined with the special capabilities of the CMS experiment will lead to a breakthrough in our understanding



of nature. Prior to joining Purdue, I worked on the CMS Level-1 trigger, the search for supersymmetric particles, as well as for rare  $B$ -meson decays within the DELPHI experiment at the Large Electron Positron (LEP) collider and on Bose-Einstein correlation studies within the UA1 experiment.

Understanding the elementary constituents of matter and the fundamental forces that control their behavior at the most basic level is the primary goal of particle physics. For the past 50 years, the current theory of particles and fields, known as the Standard Model, has been unexpectedly successful in describing with high precision the results of the great majority of particle physics experiments. The Standard Model mechanism of spontaneous electroweak symmetry breaking requires the existence of a neutral scalar particle, the Higgs boson. The Standard Model predicts the Higgs boson couplings to all other particles of known mass, but its mass remains unspecified. In the summer of 2012 the ATLAS and CMS collaborations discovered a new particle with a mass of 125 GeV via decays to photon,  $W$  and  $Z$  boson pairs with rates consistent with those of the Standard Model Higgs boson. It is the last piece in the Standard Model jigsaw-puzzle of the elementary building blocks of matter and their interactions via forces of nature.

Yet despite this success, the Standard Model leaves important questions (e.g. the origin of dark matter and dark energy) unanswered and its extrapolation to very high energies is unsatisfactory. Hence it is believed that the Standard Model is an effective ‘low energy’ approximation of a more complete ‘Grand Unified Theory’. However, at present only unverified theoretical concepts and vague experimental results point the way towards such a Grand Unified Theory. Therefore, the search for phenomena that are not explained by the Standard Model has top priority in experimental particle physics. The Higgs boson discovery is an important gateway to new physics processes that have been the subject of intense theoretical speculation. Is the new particle exactly the Higgs boson of the Standard Model, or could it be the herald of Supersymmetry, which predicts a shadow-world of new particles that mirrors our everyday atomic world? Only super-precise measurements of the couplings of the Higgs boson to fermions and vector bosons will allow us to discriminate between the Standard Model and theories such as Supersymmetry.

The LHC provides a crucial capability to answer these questions. It is currently the only operating collider to probe in detail the TeV energy scale relevant to electroweak symmetry breaking and to search for new physics phenomena not predicted by the Standard Model. It is a 17-mile long accelerator considered to be the largest scientific instrument on the planet and its physics program will continue for at least another 10 years. The LHC began its operation in 2010 with proton-proton collisions at 7 TeV. In 2012 the energy was increased to 8 TeV and in Summer 2012 the discovery of the Higgs particle was announced – a major scientific discovery. Then the machine was undergoing maintenance and consolidation work to increase its energy by a factor of 2, which in turn increased its capability to search for new particles. From 2015 to 2018 the LHC has provided proton-proton collisions at 13 TeV and delivered an unprecedented data set which opened novel possibilities for searches for new physics, precision measurements such as the properties of the Higgs boson, as well as detailed studies of the flavor sector. At the end of 2018, it entered a two-year shutdown period for further upgrades. The goal of the upgrades is to implement the High Luminosity Large Hadron Collider (HL-LHC) project, that will increase the luminosity by a factor of 10. The LHC is projected to restart in 2022 and will run until the end of 2024. The HL-LHC is scheduled to come into operation in 2028.

## Selected Publications

I am co-author of 1230 publications including 10 papers with over 1000 citations and 318 papers with over 100 citations. The complete list of publications can be found at:

[http://inspirehep.net/search?ln=en&p=find+author+neumeister%2C+n&of=hb&action\\_search=Search](http://inspirehep.net/search?ln=en&p=find+author+neumeister%2C+n&of=hb&action_search=Search)

The list below contains only selected papers that best represent my own work and where I, my students and postdocs played a major role.

1. A. Sirunyan et al. [CMS Collaboration], *Search for resonant and non-resonant new phenomena in high mass dilepton final states at  $\sqrt{s} = 13$  TeV*, J. High Energy Phys. **07** (2021) 208.
2. A. Sirunyan et al. [CMS Collaboration], *Evidence for Higgs boson decay to a pair of muons*, J. High Energy Phys. **01** (2021) 148.
3. A. Sirunyan et al. [CMS Collaboration], *Performance of the CMS muon trigger system in proton-proton collisions*

- at  $\sqrt{s} = 13 \text{ TeV}$ , *Journal of Instrumentation* **16** (2021) P07001.
4. A. Sirunyan et al. [CMS Collaboration], *Performance of the reconstruction and identification of high-momentum muons in proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *Journal of Instrumentation* **15** (2020) P02027.
  5. P.M. Smith, E. Gough, A. Younts, B. Werts, T.J. Hacker, N. Neumeister, J. Wisecaver, *The “Geddes” Composable Platform - An Evolution of Community Clusters for a Composable World*, 2020 IEEE/ACM International Workshop on Interoperability of Supercomputing and Cloud Technologies (SuperCompCloud), 2020, pp. 33-38. doi:10.1109/SuperCompCloud51944.2020.00011.
  6. A. Sirunyan et al. [CMS Collaboration], *Search for the Higgs Boson Decaying to Two Muons in Proton-Proton Collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *Phys. Rev. Lett.* **122** (2019) 021801.
  7. A. Sirunyan et al. [CMS Collaboration], *Search for contact interactions and large extra dimensions in the dilepton mass spectra from proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *J. High Energy Phys.* **04** (2019) 114.
  8. A. Sirunyan et al. [CMS Collaboration], *Search for high-mass resonances in dilepton final states in proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *J. High Energy Phys.* **06** (2018) 120.
  9. A. Sirunyan et al. [CMS Collaboration], *Performance of the CMS muon detector and muon reconstruction with proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *J. High Energy Phys.* **13** (2018) P06015.
  10. V. Khachatryan et al. [CMS Collaboration], *Search for narrow resonances in dilepton mass spectra in proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$  and combination with 8 TeV data*, *Phys. Lett. B* **768** (2017) 57–80.
  11. V. Khachatryan et al. [CMS Collaboration], *Search for leptophobic  $Z'$  bosons decaying into four-lepton final states in proton-proton collisions at  $\sqrt{s} = 8 \text{ TeV}$* , *Phys. Lett. B* **773** (2017) 563–584.
  12. V. Khachatryan et al. [CMS Collaboration], *Search for supersymmetry with multiple charged leptons in proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *Eur. Phys. J. C* **77** (2017) 635.
  13. V. Khachatryan et al. [CMS Collaboration], *Search for new physics in same-sign dilepton events in proton-proton collisions at  $\sqrt{s} = 13 \text{ TeV}$* , *Eur. Phys. J. C* **76** (2016) 439.
  14. V. Khachatryan et al. [CMS Collaboration], *Measurements of differential and double-differential Drell–Yan cross sections in proton-proton collisions at  $\sqrt{s} = 8 \text{ TeV}$* , *Eur. Phys. J. C* **75** (2015) 147.
  15. V. Khachatryan et al. [CMS Collaboration], *Constraints on the Higgs boson width from off-shell production and decay to Z-boson pairs*, *Phys. Lett. B* **736**, 64 (2014).
  16. S. Chatrchyan et al. [CMS Collaboration], *Evidence for the direct decay of the 125 GeV Higgs boson to fermions*, *Nature Phys.* **10** (2014).
  17. S. Chatrchyan et al. [CMS Collaboration], *Measurement of the properties of a Higgs boson in the four-lepton final state*, *Phys. Rev. D* **89**, 092007 (2014).
  18. S. Chatrchyan et al. [CMS Collaboration], *Measurement of the differential and double-differential Drell–Yan cross sections in proton-proton collisions at  $\sqrt{s} = 7 \text{ TeV}$* , *J. High Energy Phys.* **1312** (2013) 030.
  19. S. Chatrchyan et al. [CMS Collaboration], *Search for heavy narrow dilepton resonances in pp collisions at  $\sqrt{s} = 7 \text{ TeV}$  and  $\sqrt{s} = 8 \text{ TeV}$* , *Phys. Lett. B* **720**, 63 (2013).
  20. S. Chatrchyan et al. [CMS Collaboration], *Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC*, *Phys. Lett. B* **716**, 30 (2012).
  21. S. Chatrchyan et al. [CMS Collaboration], *A new boson with a mass of 125 GeV observed with the CMS experiment at the Large Hadron Collider*, *Science* **338**, 1569 (2012).
  22. S. Chatrchyan et al. [CMS Collaboration], *Search for the standard model Higgs boson decaying to  $W^+W^-$  in the fully leptonic final state in pp collisions at  $\sqrt{s} = 7 \text{ TeV}$* , *Phys. Lett. B* **710** (2012) 91-113.
  23. S. Chatrchyan et al. [CMS Collaboration], *Combined results of searches for the standard model Higgs boson in pp collisions at  $\sqrt{s} = 7 \text{ TeV}$* , *Phys. Lett. B* **710** (2012) 26.

24. S. Chatrchyan *et al.* [CMS Collaboration], *Search for large extra dimensions in dimuon and dielectron events in pp collisions at  $\sqrt{s} = 7$  TeV*, Phys. Lett. B **711** 15 (2012) 15.
25. S. Chatrchyan *et al.* [CMS Collaboration], *Performance of CMS muon reconstruction in pp collision events at  $\sqrt{s} = 7$  TeV*, JINST **7**, P10002 (2012).
26. S. Chatrchyan *et al.* [CMS Collaboration], *Search for narrow resonances in dilepton mass spectra in pp collisions at  $\sqrt{s} = 7$  TeV*, Phys. Lett. B **714** (2012) 158.
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### Invited Lectures

- *Searches for new heavy resonances in final states with leptons, photons, and jets at CMS*, PHENO 2019, Phenomenology 2019 Symposium, University of Pittsburgh, Pittsburgh, PA, 6–8 May 2019.
- *CMS searches for Leptoquarks,  $W'$  and  $Z'$* , DISCRETE 2018: 6th Symposium on Prospects in the Physics of Discrete Symmetries, Vienna, Austria, November 26–30, 2018.
- *Inclusive and differential W/Z W at ATLAS and CMS*, Rencontres de Moriond QCD: La Thuile, Italy, March 17–24, 2018.
- *Standard Model Measurements at CMS*, 6th International Conference on new Frontiers in Physics 2017 (ICNFP2017), Kolymvari, Greece, August 17–26, 2017.
- *Searches for new heavy resonances in final states with leptons, photons, and jets in CMS*, 2017 Meeting of the Division of Particles and Fields of the American Physical Society (DPF 2017), Fermilab, Batavia, IL, July 31 – August 4, 2017.
- *Exotic Physics Searches at the LHC*, PPC2017: XI International Conference on Interconnections between Particle Physics and Cosmology, Corpus Christi, TX, May 22 – 26, 2017.
- *W and Z inclusive and differential cross sections at CMS*, 38th International Conference on High Energy Physics (ICHEP 2016), Chicago IL, August 3 – 10, 2016.
- *Inclusive and differential W/Z at ATLAS and CMS*, 28th Rencontres de Blois: Particle Physics and Cosmology, Blois, France, May 29 – June 3, 2016.
- *W/Z + Jets Production*, SM@ LHC 2015: Standard Model at the LHC, Florence, Italy, April 21–24, 2015.
- *Dark Matter, Long-Lived Particles and R-Parity Violation*, LHCP: Large Hadron Collider Physics Conference 2014, Columbia University, New York NY, June 3–8, 2014.

- *Results on electroweak precision measurements from CMS*, Brookhaven Forum 2013: Exploring Fundamental Interactions in the Higgs Era, Brookhaven National Laboratory, Upton NY, May 1–3, 2013.
- *W/Z and Drell–Yan cross section measurements*, SM@ LHC 2013: Standard Model at the LHC, Freiburg, Germany, April 9–12, 2013.
- *Standard Model review of ATLAS and CMS*, ASPEN 2013: Higgs Quo Vadis, Aspen, CO, March 10–16, 2013.
- *Measurement of the Drell–Yan Cross Section with the CMS detector at the LHC*, PLHC2012: Physics at LHC – 2012, Vancouver, BC, June 4–9, 2012.
- *Measurement of the Drell–Yan differential cross section at 7 TeV*, DIS2011: XIX International Workshop on Deep-Inelastic Scattering and Related Subjects, Newport News, VA, April 11–15, 2011.
- *Search for Heavy Stable Charged Particles in CMS*, International Workshop on Discovery Physics at the LHC, Kruger 2010, Mpumalanga, South Africa, December 5–10, 2010.
- *CMS Grid Submission Portal*, Computing in High Energy and Nuclear Physics (CHEP) 2009, Prague, Czech Republic, March 21–27, 2009.
- *Prospects for Electroweak Physics at the LHC*, TIGER09: Winter Workshop on Physics in the LHC Era, Aspen, CO, February 8–14, 2009.
- *Data management at the Large Hadron Collider*, e-Science: CIC Center for Library Initiatives Conference, May 12–13, 2008.
- *Physics Beyond the Standard Model in CMS at the start of the LHC*, Les Rencontres de Physique de la Vallée d’Aoste (Results and Perspectives in Particle Physics), La Thuile, Italy, February 24 – March 1, 2008.
- *Data Analysis at the LHC – Cutting edge Physics with cutting edge computing*, International Conference on High Performance Computing, Networking, Storage and Analysis 2007 (SC07), Reno, NV, 10–17 November 2007.
- *Analyzing massive data from the LHC*, Northwest Indiana Grid Consortium (NWIGC) workshop, Purdue University, 8–9 March 2005.
- *The CMS Tier-2 center at Purdue University*, International Conference on Supercomputing 2005 (SC05), Seattle WA, 12–18 November 2005.
- *Muon Reconstruction Software in CMS*, Computing in High Energy and Nuclear Physics (CHEP) 2004, Interlaken, Switzerland, September 27 – October 1, 2004.
- *Muon Reconstruction in CMS*, Workshop on Muons at Hadron Colliders, Fermilab, USA, April 14–15, 2004.
- *The CMS Experiment – Status and Physics*, Conference on the Intersection of Particle and Nuclear Physics (CIPANP) 2003, New York City, USA, May 19–24, 2003.
- *Muon Reconstruction and Online Event Selection in CMS*, LHC Days in Split, Split, Croatia, October 8–12, 2002.
- *CMS: Electrons, Photons and Muons*, III International Symposium on LHC Physics and Detectors, Chia, Sardinia, October 25–27, 2001.
- *High Level Triggering in CMS*, 7th International Conference on B-physics at Hadron Machines – BEAUTY2000, Sea of Galilee, Israel, September 13–18, 2000.
- *The CMS Muon Trigger*, XXXth International Conference on High Energy Physics, Osaka, Japan, July 27 – August 2, 2000.
- *The CMS Experiment at the LHC - Status and Physics Potential*, International Workshop on Symmetry and Spin (SPIN99), Prague, Czech Republic, September 5–12, 1999.
- *Mixing of  $B_s$  mesons in hadronic production*, International Conference on Hyperons, Charm and Beauty Hadrons, Strasbourg, France, September 5–8, 1995.
- *CP Violation studies in ATLAS and CMS*, 1st International Four Seas Conference, SISSA Trieste, Italy, June 25 – July 1, 1995.

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- *Reconstruction of exclusive B decays in DELPHI*, Annual Conference of the Austrian Physical Society, Obergurgl, Austria, September 19–20, 1994.
  - *Measurement of  $\sin(2\beta)$  with the CMS Detector at LHC*, Workshop on B physics at hadron accelerators, Snowmass, Colorado, June 21 – July 2, 1993.
  - *Measurement of CP-Violation in B-Decays with the CMS Detector*, International Conference on B-physics at Hadron Machines – BEAUTY93, Liblice castle, Czechoslovakia, January 18–22, 1993.
  - *The Influence of Bose-Einstein Correlations on Intermittency in pp Collisions at  $\sqrt{s} = 630$  GeV*, Workshop on Intermittency, Lisboa, Portugal, September 1992.
  - *Higher Order Bose-Einstein Correlations at  $\sqrt{s} = 630$  GeV and 900 GeV*, 26th Recontres de Moriond, Les Arcs, Savoie, France, March 17–23, 1991.