Luca Pernié

Curriculum Vitae

Education

2011-2015 **Ph.D.**, *Université Libre de Bruxelles; Sapienza Università di Roma*.
Field: High Energy Physics
Advisers: Pascal Vanlaer: Chargé de cours at the Université Libre de Bruxelles.
Daniele Del Re: Assistant Professor at Sapienza Università di Roma.

2006-2011 **M.S.**, *Sapienza Università di Roma*, *Grade: 110/110*.
Field: Particle Physics
Adviser: Daniele Del Re: Assistant Professor at Sapienza Università di Roma.

Professional Experience

2015-present **Postdoctoral fellow**, *Texas A&M University*, Green Card Holder.
CMS experiment at the European Center of Nuclear Research (CERN).

Leadership and Service

Alignment, Calibration and Database Co-Manager: Directed all groups and activities (∼100 people) related to the data acquisition and data analysis aimed to estimate detector conditions for on-line data-taking, data reconstruction, and data simulation.

Data Analysis Coordinator: Coordinator (∼10 people) and developer of data analysis targeting the search for extremely rare processes hidden in PB of data through deep learning algorithms, and statistical analysis (search for Exotic Higgs, and resonant di-Higgs production).

Muon Alignment Project Coordinator Coordinator (∼10 people) and developer of a multidimensional regression framework to align the muon system, which increased the achieved precision by a factor of 2 from previous year (2017 Achievement Award).

Muon Detector Performance Group Office Representative: Promoted communication across all alignment teams as the Detector Performance Group Office's alignment representative.

Notable Accomplishments

Introduced a parametric deep learning algorithm (that supersede previous BDT algorithm) which adopt a novel parametrization approach that allow to tests several signal hypothesis simultaneously.

Increased, by a factor of three, the sensitivity to exotic particles by leading the developments of a new algorithm to identify and select displaced muons during the online data-taking.

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Doubled the sensitivity to rare events with multiple neutrinos in the final state by developing and implementing a likelihood-based algorithm to fully reconstruct the event kinematic.

Removed biases in the muon chamber position measurement by extending the multidimensional regression to all degrees of freedom.

Reduced user errors by guiding improvements of web-based services to ease and systematize the administration and display of calibration and alignment measurements.

Reduced manpower needs and ensured optimal performance in multiple alignment/calibration sub-groups by training and promoting team members, adopting novel technologies and tools to automatize workflows.

Academic Experience

2011-2015 **Graduate researcher**, *Université Libre de Bruxelles; Sapienza Università di Roma*.

Data Analysis

Main developer of the analysis of the whole 2011 and 2012 datasets which provided the most precise measurement available for the Z boson pair-production cross section in the $ll\nu\nu$ final state, and provided statistical upper limits on the existence of anomalous triple gauge couplings.

Developer of a data-driven estimation of Drell-Yann process for the Higgs boson search in the $H \to ZZ \to 2l2\nu$ decay channel with the 2012 dataset.

Algorithm Development

Developed a new framework to inter-calibrate lead tungstate crystals using neutral pions, integrating a random forest regression to decouple material effects from the detector response.

Data simulation and algorithm development aimed to assess the impact of precise timing for the phase-2 upgrade of the CMS experiment.

2006-2011 **Undergraduate researcher**, *Sapienza Università di Roma*.

Data Analysis

Data analysis aimed to search for a Higgs boson in the $H \to WW \to l\nu jj$ decay channel through the analysis of whole 2011 dataset. Improved the analysis sensitivity by using a kinematic fit to improve the jet energy resolution.

Awards

01/2018 CMS Achievement Awards: outstanding contribution to the MUON project. The annual CMS Achievement Awards honor individuals who have distinguished themselves by performing significant and lasting contributions to different components of the CMS experiment.

09/2016 Postdoctoral research symposium: distinguished postdoctoral flash talk, Texas A&M University.

01/2014-15 One year grant (50K CHF) as CERN-INFN associate (fellow position at CERN).

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Technical Proficiency

OS	Linux; Mac Os X.
Computing	Bash; C++; Python; SQL.
Libraries	Pyplot; NumPy; Pandas; Scipy; Keras; SciKit; TMVA.
Machine Learning	BDT; Random Forests; Naive Bayes; Regressions; Deep Neural Network.
Code Maintenance	GitHub; SVN.
Methodologies	Agile; (JIRA, Asana).
Software Applications	LaTeX; Microsoft Office (Excel, PowerPoint, and Word) for Macs.

Languages

Italian	Mother tongue
English	Advanced
Spanish	Advanced
French	Basic

Extra-curricular and outreach activities

11/2017 "*Machine Learning Techniques in Science*" (organizer), three seminars with the purpose of offering an opportunity for graduate students and postdocs to get a kick-start into being able to apply ML technique.

04/2017 "*A walk through the Large Hadron Collider*" (organizer), part of the Physics and Engineering Festival at Texas A&M University that gathers over 5000 visitors annually from across the United States.

2016-17 "*High Energy Physics Experiment Cosmology (HEPEC) seminar*" (organizer), a series of seminars attended by the members of both the experimental and theory communities, including faculty, postdocs, researchers, graduate and undergraduate students of Texas A&M University.

09/2014-17 "*Official guide*" of the CMS experiment, tours of the CMS experimental facility in English, Spanish, and Italian.

Selected presentations

Major international conferences

07/2018 (scheduled) CHEP2018, Sofia Bulgaria. Development and operational experience of the web based application to collect, manage, and release the alignment and calibration configurations for data processing at CMS (primary author, not speaker).

07/2018 (scheduled) CHEP2018, Sofia Bulgaria. Beyond the run boundaries: monitoring and calibrating the detector and the trigger validation of the CMS experiment across runs (primary author, not speaker).

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07/2018 (scheduled) CHEP2018, Sofia Bulgaria. Spy-Agency service for monitoring of automated real-time calibration workflows and steering the injection of prompt reconstruction workflows at the CMS experiment.

05/2018 Texas,The Mitchell Conference on Collider, Dark Matter, and Neutrino Physics 2018: Exotic Higgs decays at the CMS Experiment.

05/2018 Pittsburgh, Pheno2018: Probing the Electroweak Phase Transition at the High Luminosity LHC.

12/2017 Mumbai, India. SUSY17: 25th International Conference on Supersymmetry and the Unification of Fundamental Interactions. Title: Searches for long-lived particles and other non-conventional signatures.

06/2017 PASCOS17 PArticle physics, String theory and COSmology, Madrid. Title: Searches for extended Higgs sectors with the CMS experiment.

05/2016 Pittsburgh, Pheno2016: Phenomenology 2016 Symposium. Title: Extended Higgs searches at the CMS experiment.

09/2013 14th ICATPP Conference on Astroparticle, Particle, Space Physics and Detectors for Physics Applications; Evolution of the response of the CMS ECAL, and upgrade design options for electromagnetic calorimetry at the HL-LHC.

08/2013 16th Lomonosov Conference on Elementary Particle Physics, Moscow State University; ZZ cross section measurements and limits on anomalous coupling constants for neutral triple gauge boson.

Seminars, workshops, and national conferences

05/2017 Invited talk; Costing Review: motivation for the construction of each element of the alignment system for GE2/1 and ME0 detectors. Title: A summary of the current techniques/methods used in CMS for Muon Alignment.

05/2017 College Station, Texas. Mitchell Workshop on Collider and Dark Matter Physics. Title: Hidden sectors at colliders.

02/2017 Santa Fe Jets and Heavy Flavor 2017, Los Alamos National Laboratory. Title: CMS measurements of the Higgs, Higgs properties, and BSM searches.

02/2017 Seminar; College Station, Texas. Heavy Energy Physics Experiment and Cosmology Seminars. Title: Resonant Di-Higgs Production: Probing the Electroweak Phase Transition at the LHC.

10/2016 Seminar; University of Massachusetts Amherst. Title: Resonant Di-Higgs Production in the bbWW Channel: Probing the Electroweak Phase Transition at the LHC.

07/2016 Flash Presentation; College Station, Texas, TAMU Postdoctoral Research Simposium. Title: Extending The Higgs sector (winning talk).

05/2016 College Station, Texas, Mitchell Workshop on Collider and Dark Matter Physics. Title: Search for Beyond Standard Model Higgs with the CMS experiment.

04/2015 Seminar; College Station, Texas. Title: Measurement of the Z boson pair-production cross section in proton-proton collisions at 7 and 8 TeV, and ECAL timing studies for the phase-2 upgrade of the CMS experiment.

05/2013 Belgian physics Society (BPS). Title: ZZ cross section measurement at CMS experiment and aTGC limits.

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05/2013 Annual meeting of particles AND astrophysics (PANDA). Title: ZZ cross section measurement at CMS experiment and aTGC limits.

Posters

03/2015 Poster; LHCC poster session, CERN. Title: Simulation studies on precise timing information during High Luminosity LHC.

06/2014 Poster: Large Hadron Collider Physics (LHCP) Conference. Title: ZZ cross-section measurement and limits on anomalous neutral triple gauge couplings at the CMS detector.

09/2013 Poster; LHCC poster session, CERN. Title: ZZ cross-section measurement and limits on anomalous neutral triple gauge couplings.

Publications

Full list of publications (over 400 as a member of CMS Collaborations) is available upon request, or it can be accessed through this link.

Refereed journal publication (main author)

CMS Collaboration, "*A search for beyond the Standard Model light bosons decaying into muon pairs at CMS*", paper in preparation (CADI: HIG-18-003).

CMS Collaboration, "*Track-Based Alignment of the CMS Muon System.*", paper in preparation.

CMS Collaboration, "*A search for pair production of new light bosons decaying into muons*", Phys. Lett. B 752 (2016), DOI:10.1016/j.physletb.2015.10.067

Huang T., Pernié L. et al., "*Resonant Di-Higgs Production in the bbWW Channel: Probing the Electroweak Phase Transition at the LHC*", Phys. Rev. D 96 (2017), DOI:10.1103/PhysRevD.96.035007

CMS Collaboration, "*Measurements of the ZZ production cross sections in the 2l2ν channel in proton-proton collisions at $\sqrt{s}$ = 7 and 8 TeV and combined constraints on triple gauge couplings*", Eur. Phys. J. C 75 (2015), DOI:10.1140/epjc/s10052-015-3706-0

Brianza L., Pernié L. et al., "*Response of microchannel plates to single particles and to electromagnetic showers*, NIMA vol. 797 (2015), DOI:10.1016/j.nima.2015.06.057

Refereed journal publication (major contribution)

CMS Collaboration, "*Search for an exotic decay of the Higgs boson to a pair of light pseudoscalars in the final state of two muons and two τ leptons in proton-proton collisions at $\sqrt{s}$ = 13 TeV*", analysis review committee, CERN-EP-2018-078 (submitted to JHEP)

CMS Collaboration, "*Search for supersymmetry in events with at least three electrons or muons, jets, and missing transverse momentum in proton-proton collisions at $\sqrt{(s)} = 13$ TeV*", analysis review committee, J. High Energ. Phys. (2018) 2018: 67, DOI:10.1007/JHEP02(2018)067

ATLAS Collaboration, "*Search for dark matter produced in association with a Higgs boson decaying to bb using 36 fb^{-1} of pp collisions at $\sqrt{(s)} = 13$ TeV with the ATLAS detector*", External referee, Phys. Rev. Lett. 119, 181804, DOI:10.1103/PhysRevLett.119.181804

CMS Collaboration, "*Search for a Higgs boson in the mass range from 145 to 1000 GeV decaying to a pair of W or Z bosons*", J. High Energy Phys. 10 (2015), DOI:10.1007/JHEP10(2015)144

CMS Collaboration, "*Search for a standard-model-like Higgs boson with a mass in the range 145 to 1000 GeV at the LHC*", Eur. Phys. J. C 73 (2013), DOI:0.1140/epjc/s10052-013-2469-8

Public analysis, Conference Reports, and CMS internal notes

Pernié L., "*Performance of the Track-Based Muon alignment algorithm*", CMS DP 2017-046

Castaneda A., Pernié L. et al.,"*A Search for BSM Light Bosons Decaying into Muon Pairs*", CMS PAS HIG-16-035

Castaneda A., Pernié L. et al.,"*A Search for Beyond Standard Model Light Bosons Decaying into Muon Pairs*", CMS AN 2016-044

Pernié L.,"*Performance of Track-based Muon Alignment*", CMS DP 2016-053

Pernié L.,"*Simulation studies on precise timing information during High Luminosity LHC*", CMS CR 2015-101

Pernié L.,"*Measurement of the ZZ production cross section in the 2l2ν decay channel and limits on anomalous triple gauge couplings*", CMS CR 2014-181

Fast ECAL Timing Group,"*Performance of jets and missing transverse energy with fast ECAL timing*", CMS AN 2014-088

Meridiani P., Pernié L. Del Re D.,"*Studies on a precision timing electromagnetic calorimeter for the CMS upgrade*", CMS DN 2014-006

Pernié L.,"*ZZ cross section measurements and limits on anomalous coupling constants for neutral triple gauge boson*", CMS CR 013-453

Benedetti D. et al.,"*Bounding the Higgs width using Z to ll events with high missing transverse energy*", CMS AN 2013-411

Pernié L.,"*CMS ECAL calibration with π^0 and η in the LHC RUN1*", CMS AN 2013-344

Apyan A., Pernié L. et al.,"*Search for Z($\rightarrow$ ll) H($\rightarrow$ invisible) at $\sqrt{s}$ = 7 and 8 TeV*", CMS AN 2013-333

Pernié L.,"*Evolution of the response of the CMS ECAL, and upgrade design options for electromagnetic calorimetry at the HL-LHC*", CMS CR 2013-284

CMS Collaboration,"*Measurements of the ZZ production cross sections in the 2l2ν channel in proton-proton collisions at $\sqrt{s}$ = 7 and 8 TeV and combined constraints on triple gauge couplings*", CMS PAS SMP-12-016

Benedetti D., Pernié L. et al.,"*Search for a high-mass Higgs boson in the $H \rightarrow ZZ \rightarrow 2l2\nu$ decay channel in pp collisions with the CMS detector*", CMS AN 2012-371

Benedetti D., Pernié L. et al.,"*Measurement of ZZ production cross section at 7 and 8 TeV and anomalous gauge couplings limits in $2l2v$ decay channel*", CMS AN 2012-148

Barberis E., Pernié L. et al.,"*Search for the Higgs boson in the $H \rightarrow ZZ \rightarrow 2l2\nu$ decay channel in pp collisions with the CMS detector*", CMS AN 2012-138

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Barberis E., Pernié L. et al.,"*Search for Invisible Higgs Decays in the $ZH \to ll$ + MET channel*", CMS AN 2012-123

Pernié L., Del Re D., Organtini G.,"*Search for a Standard Model Higgs boson in the decay channel $H \to WW \to lvjj$*", CMS AN 2012-004

Andrews W., Pernié L. et al.,"*Search for Higgs Boson Decays to two W Bosons in the Fully Leptonic Final State with Full 2011 pp Dataset at $\sqrt{s} = 7$ TeV*", CMS AN 2011-432

Akchurin N., Pernié L. et al.,"*Search for a Standard Model Higgs boson produced via vector boson fusion, in the decay channel $H \to WW \to lvjj$*", CMS AN 2011-110

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