

Lorenzo Bianchini

Curriculum vitae

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Personal data

Full name Lorenzo Bianchini
Date of birth 19/02/1985
Place of birth Bagno a Ripoli (FI), Italy
Office Edificio C, Polo Fibonacci, Largo B. Pontecorvo, 3 - 56127 Pisa. Italy
Nationality Italian
Status Married, with one daughter

Scientific interests

CERN, LHC Particle physics at hadron colliders; the CMS experiment at the LHC.
The Higgs boson Physics of the Higgs boson and measurement of its properties; the $H \rightarrow \tau\tau$ and $H \rightarrow b\bar{b}$ final states; the VBF, VH, and $t\bar{t}H$ production channels.
Data analysis Matrix Element Method, Dynamical Likelihood Techniques. Data analysis on performing computing platforms.
 τ lepton Particle-flow techniques; reconstruction and identification of tau leptons.
Future colliders Particle physics at the future accelerator facilities; the Higgs physics program at the High-luminosity LHC and Future Circular Colliders.
SCADA Supervised control systems for the CMS calorimeter.

Professional history

04/09/2014 – present **Researcher**, *INFN, Sezione di Pisa.*, III-level researcher, CMS experiment.
01/12/2012 – 31/08/2017 **Postdoc**, *Institute for Particle Physics, ETH Zürich*, scientific researcher and teaching assistant, group of Prof. Dissertori.
24/09–30/10, 2012 **Postdoc**, *Laboratoires Leprince-Ringuet, École Polytechnique*, scientific researcher, group of Dr. Y. Sirois.

Scientific responsibilities

01/09/2015 – 31/08/2017 **Convener of the $H \rightarrow b\bar{b}$ group of the CMS experiment.**
2014–2017 **DCS operator for the CMS electromagnetic calorimeter.**
2009–present **Member of the CMS Collaboration.**

Education

- 18/09/2012 **PhD in Physics, École Polytechnique,**
“Search for the Standard Model Higgs boson decaying to tau leptons with the CMS experiment at LHC”, CERN-THESIS-2012-347, inspirehep.net/record/1231280,
Advisor: Prof. Yves Sirois (LLR-École Polytechnique).
Rapporteurs: G. Bernardi, A. Nisati. Referees: A. De Roeck, P. Fayet, L. Rolandi.
Mention: *très honorable*.
- 01/10/2009 **Diploma, Scuola Normale Superiore di Pisa,**
“Calibration of the magnetic field in the return yoke of CMS using cosmic muons”,
Advisor: Prof. Luigi Rolandi (CERN and SNS).
Grade: 70/70 *cum laude*.
- 22/07/2009 **M.Sc. in Physics, Università di Pisa,**
“Search for a Z' at the LHC and Magnetic Field Calibration in the CMS Barrel Yoke”, CERN-THESIS-2009-115, inspirehep.net/record/894104,
Advisor: Prof. Luigi Rolandi (CERN and SNS).
Grade: 110/110 *cum laude*.
- 26/09/2007 **B.Sc. in Physics, Università degli Studi di Firenze,**
“A mathematical model for solid tumor growth: the role of acid in the growth and invasion of tumors” ,
Advisor: Prof. Antonio Fasano (Università degli Studi di Firenze).
Grade: 110/110 *cum laude*.
- 2004 **Maturità Scientifica, Liceo Scientifico Statale “G. Castelnuovo”, Firenze,**
Grade: 100/100 *cum laude*.

Visits and schools

- 01/03/2014–
present **CERN**, participation to Run II data taking for the CMS experiment.
- 17/06-20/06,
2013 **CP3-Université Catholique de Louvain**, guest of F. Maltoni and P. Artoisenet.
- 01/01/2010–
30/11/2012 **CERN**, participation to CMS Run I data taking for the CMS experiment.
- 20/06-03/07,
2010 **European School of High-Energy Physics**, participant.
- 23/07-27/07,
2007 **Summer School of Scuola Normale Superiore**, participant.

Grants and awards

- 2014 **The CMS PhD Thesis Award** For outstanding research in the CMS experiment
- 2012 **Prix de Thèse de l'École Polytechnique** Best PhD thesis award
- 2009 **Allocation internationale de thèse Gaspard Monge** three-years grant for
doctoral studies
- 2007 **Admission to Scuola Normale Superiore di Pisa** Admitted by examination

Funding information

2012–2018 **SNF Sinergia grant n. CRSII2-141847**, “*Particle physics with high quality data from the CERN LHC*”, P.I.: Prof. G. Dissertori.

Teaching experience

2013–present **Supervision of students.**

- T. Bluntschli, “*Higgs boson mass reconstruction in the VH channel*”, M. Sc., 2016.
- J. Pata, “*Measurement of the associated $t\bar{t}H$ production*”, PhD, 2013–2017.
- M. Meinhard, “*Boosted-top tagging and matrix element methods for a precise determination of the top-quark Yukawa coupling at the LHC*”, M. Sc., 2014.
- S. Regnard, “*Search for the associated $t\bar{t}H$ production in pp collisions at $\sqrt{s} = 8$ TeV with the CMS experiment at the LHC*”, M. Sc., 2013.
- K. Ehatäht, CERN summer student, 2013.

2013–present **Teaching assistance at ETH Zürich.**

- *QCD: Theory and Experiment*
- *Introduction to Nuclear and Particle Physics*
- *Physics I*
- *Phenomenology of Particle Physics I*

11/02-13/02, 2015 **Introduzione alla fisica delle particelle**, lectures for high-school students, Liceo Statale Gioia, Piacenza (Italy).

23/01-27/01, 2012 **CMS Data Analysis School**, lecturer, Pisa (Italy).

Refereeing activities

Member of the Editorial Board of the peer-reviewed journal *Advances in High Energy Physics* (impact factor in 2016: 1.74).

Project reviewer for the *National Science Centre* (Poland), *Czech Science Foundation* (Czech Republic).

Internal referee of CMS analyses.

Track record of scientific achievements

See section “*Selected publications*” for the bibliography.

- During my master studies at the Scuola Normale Superiore di Pisa, I worked on the calibration of the external magnetic field of CMS, developing a method to measure the field intensity inside the iron yoke from the bending of cosmic muon tracks reconstructed by the inner tracker [23].
- As a PhD student at the École Polytechnique, I worked on the commissioning of the particle-flow (PF) technique with the first $\sqrt{s} = 900$ GeV data [22] by studying the performances of the particle-based isolation and of the electron reconstruction within the PF framework. I contributed to the offline reconstruction of τ leptons in CMS by developing and commissioning new τ identification algorithms [19]. My work on the object reconstruction had a direct impact on the first $Z \rightarrow \tau\tau$ cross section measurement [21], and on the first searches for Higgs bosons in di- τ final states [17,18,20].
- I worked out an optimisation of the $H \rightarrow \tau\tau$ analysis, which included an original mass reconstruction

algorithm (SVfit) [10], leading to a sizable improvement of the $H \rightarrow \tau\tau$ measurement, and yielding the most-sensitive $H \rightarrow \tau\tau$ analysis at that time. This work has been extensively documented in my PhD thesis, which has been awarded the best thesis prize by École Polytechnique and by the CMS Collaboration. My thesis work entered the *grand* combination that eventually brought to the July 4th discovery [13,14,16]. Still based on my optimisation, a subsequent top-up of data which I analysed during a short postdoc at École Polytechnique brought to the evidence of Higgs boson decays to fermions [11], and to τ leptons in particular [12].

- As a postdoc at ETH Zürich, I have been working on the measurement of the $t\bar{t}H$ cross section in $H \rightarrow b\bar{b}$ final states by developing a novel analysis based on an analytical matrix element method (MEM) [7,9], which greatly improved previous CMS analyses on the same data set based on non-analytical multivariate techniques. Thanks to the expertise gained on the MEM, I have been involved on a data analysis project aiming at deploying the MEM technique on accelerated computing platforms [8], and on a MEM extension of the SVfit algorithm [3].
- I have been involved in the characterisation study of a sampling calorimeter based on CeF_3 crystals as a viable option for the forward calorimetry of CMS [6].
- As a convener of the $H \rightarrow b\bar{b}$ group in the CMS Collaboration, I have been coordinating several analyses based on the Run 2 data. In particular, I have been a main author of the first $t\bar{t}H$, $H \rightarrow b\bar{b}$ analysis [2,4], and of the first search for resonances decaying to bottom quarks with mass below 1 TeV [1].

Selected publications

I am co-author of more than 500 scientific publications, in large part as member of the CMS Collaboration (2009–present). For the latter, I am describing below those for which I gave the most important contribution by authoring at least one related internal note.

A complete list of my publications can be found at inspirehep.net/author/L.Bianchini.1

- [1] L. Bianchini et al. [CMS Collaboration], “Evidence for the Higgs boson decay to a bottom quark-antiquark pair”, submitted to Phys. Lett. B, arXiv:1709.07497 [hep-ex], CMS-HIG-16-044, CERN-EP-2017-233 (2017).
- [2] L. Bianchini et al. [CMS Collaboration], “Search for a narrow heavy resonance decaying to bottom quark-antiquark pairs at $\sqrt{s} = 13$ TeV”, CMS Physics Analysis Summary, CMS-PAS-HIG-16-025 (2016), <https://cds.cern.ch/record/2204928>.
- [3] L. Bianchini, M. Pinamonti, “Higgs boson and quark top: measurements and searches at LHC”, *PoS(PP@LHC2016)013* (2016).
- [4] L. Bianchini, B. Calpas, J. Conway, A. Fowlie, L. Marzola, C. Veelken, “Reconstruction of the Higgs mass in events with Higgs bosons decaying into a pair of tau leptons using matrix element techniques”, Nucl. Instrum. Meth. A **862** 54-84 (2017), arXiv:1603.05910 [hep-ex].
- [5] L. Bianchini et al. [CMS Collaboration], “Search for $t\bar{t}H$ production in the $H \rightarrow b\bar{b}$ decay channel with $\sqrt{s} = 13$ TeV pp collisions in the CMS experiment”, CMS Physics Analysis Summary, CMS-PAS-HIG-16-004 (2016), <http://inspirehep.net/record/2139578>.

- [6] L. Bianchini, “*Higgs boson plus heavy flavour: searches and measurements from the LHC Run 1*”, to appear in *AIP Conference Proceedings*.
- [7] L. Bianchini et al., “*Performance of a tungsten-cerium fluoride sampling calorimeter in high-energy electron beam tests*”, *Nucl. Instrum. Meth. A* **804** (2015) 79-83, arXiv:1506.02604 [ins-det].
- [8] L. Bianchini et al. [CMS Collaboration], “*Search for a standard model Higgs boson produced in association with a top-quark pair and decaying to bottom quarks using a matrix element method*”, *Eur. Phys. J. C* **75** (2015) 251, arXiv:1502.02485 [hep-ex], CMS-HIG-14-010, CERN-PH-EP-2015-016.
- [9] G. Grasseau, D. Chamont, F. Beaudette, L. Bianchini, O. Davignon, L. Mastrolorenzo, C. Ochando, P. Paganini, T. Strebler, “*Matrix element method for high performance computing platforms*”, *J. Phys.: Conf. Ser.* **664** (2015) 092009.
- [10] L. Bianchini, “*Search for Higgs boson production in association with top quarks in the CMS detector*”, *Nuclear and Particle Physics Proceedings* (2016), pp. 884-889.
- [11] L. Bianchini, J. Conway, E. Friis, and C. Veelken, “*Reconstruction of the Higgs mass in H to tau tau events by Dynamical Likelihood techniques*”, *J. Phys.: Conf. Ser.* **513** (2014) 022035.
- [12] L. Bianchini et al. [CMS Collaboration], “*Evidence for the direct decay of the 125 GeV Higgs boson to fermions*”, *Nature Physics* **10** (2014) 557, arXiv:1401.5041 [hep-ex], CMS-HIG-13-033, CERN-PH-EP-2014-004.
- [13] L. Bianchini et al. [CMS Collaboration], “*Evidence for the 125 GeV Higgs boson decaying to a pair of tau leptons*”, *JHEP* **05** (2014) 104, arXiv:1401.5041 [hep-ex], CMS-HIG-13-004, CERN-PH-EP-2014-001.
- [14] L. Bianchini et al. [CMS Collaboration], “*Observation of a new boson with mass near 125 GeV in pp collisions at sqrt(s)=7 and 8 TeV*”, *JHEP* **06** (2013) 081, arXiv:1303.4571 [hep-ex], CMS-HIG-12-036, CERN-PH-EP-2013-035.
- [15] L. Bianchini 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** (2012) 30, arXiv:1207.7235 [hep-ex], CMS-HIG-12-028, CERN-PH-EP-2012-220.
- [16] L. Bianchini, “*Search for the SM Higgs boson in $b\bar{b}$, $\tau\tau$, WW, ZZ with 4.7/fb of CMS data*”, *SLAC eConf* C1206043.
- [17] L. Bianchini 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** (2012) 1569-1575.
- [18] L. Bianchini et al. [CMS Collaboration], “*Search for Neutral Higgs Bosons Decaying to Tau Pairs in pp Collisions at sqrt(s)=7 TeV*”, *Phys. Lett. B* **713** (2012) 68, arXiv:1202.4083 [hep-ex], CMS-HIG-11-029, CERN-PH-EP-2012-034.
- [19] L. Bianchini et al. [CMS Collaboration], “*Combined results of searches for the standard model Higgs boson in pp collisions at sqrt(s)=7 TeV*”, *Phys. Lett. B* **710** (2012) 26, arXiv:1202.1488 [hep-ex], CMS-HIG-11-032, CERN-PH-EP-2012-023.
- [20] L. Bianchini et al. [CMS Collaboration], “*Performance of tau-lepton reconstruction and identification in CMS*”, *JINST* **7** (2012) P01001, arXiv:1109.6034 [physics.ins-det].

- [21] L. Bianchini et al. [CMS Collaboration], “Search for Neutral MSSM Higgs Bosons Decaying to Tau Pairs in pp Collisions at $\sqrt{s}=7$ TeV”, *Phys.Rev.Lett.* **106** (2011) 231801, arXiv:1104.1619 [hep-ex], CMS-HIG-10-002, CERN-EP-PH-2011-027.
- [22] L. Bianchini et al. [CMS Collaboration], “Measurement of the Inclusive Z Cross Section via Decays to Tau Pairs in pp Collisions at $\sqrt{s}=7$ TeV”, *JHEP* **08** (2011) 117, arXiv:1104.1617 [hep-ex], CMS-EWK-10-013, CERN-EP-PH-2011-035.
- [23] L. Bianchini et al. [CMS Collaboration], “Commissioning of the Particle-flow Event Reconstruction with the first LHC collisions recorded in the CMS detector”, CMS Physics Analysis Summary, CMS-PAS-PFT-10-001 (2010), <http://inspirehep.net/record/925318>.
- [24] L. Bianchini et al. [CMS Collaboration], “Precise Mapping of the Magnetic Field in the CMS Barrel Yoke using Cosmic Rays”, *JINST* **5** (2010) T03021, arXiv:0910.5530 [physics.ins-det], CMS-CFT-09-015.
- [25] L. Bianchini, A. Fasano, “A model combining acid-mediated tumour invasion and nutrient dynamics”, *Nonlinear Analysis: Real World Appl.*, Vol. **10** (2009) 1955–1975.

Communications in international conferences and seminars

- 17/05/2016 **LHCpp2016: VII Workshop Italiano sulla fisica p-p a LHC**, “ $t\bar{t}H$ and tqH production at the LHC”, Pisa.
Invited speaker
- 10/11/2015 **Data Science @ LHC**, “The Matrix Element Method in High Energy Physics”, CERN.
Invited speaker
- 23/09/2015 **FCC-ee workshop on Higgs physics**, “Higgs Physics at the HL-LHC and complementarity to FCC-ee”, CERN.
Invited speaker
- 04/09/2015 **LHCP2015: The 3rd Conference on Large Hadron Collider Physics**, “Searches and measurements of Higgs bosons in association with Heavy Flavours and Higgs boson decays into Heavy Flavours”, St. Petersburg.
Selected speaker
- 29/05/2015 **Seminar in Particle Physics**, “Search for $t\bar{t}H$ events in the $H \rightarrow b\bar{b}$ final state using the Matrix Element Method”, Georg-August-Universität Göttingen.
Invited speaker
- 11/05/2015 **HL-LHC 2015: Physics at the High-Luminosity LHC**, “Challenging channels at the HL-LHC”, CERN.
Invited speaker
- 22/04/2015 **Seminar in Particle and Astro Physics**, “Associated top-Higgs production with the matrix element method”, University of Zürich.
Invited speaker

- 12/12/2014 **GDR@Terascale Workshop**, “Search for $t\bar{t}H$ events using the Matrix Element Method”, Heidelberg University.
Invited speaker
- 22/11/2014 **Seminar**, “Alla frontiera dell’energia: la scoperta della particella di Higgs”, Accademia Petrarca di Lettere Arte e Scienze, Arezzo.
Invited speaker
- 03/07/2014 **ICHEP2014: The 37th International Conference on High Energy Physics**, “Search for Higgs bosons produced in association with top quarks in the CMS detector”, Valencia.
Selected speaker
- 09/01/2014 **ZPW2014: Zürich Phenomenology Workshop**, “Search for $t\bar{t}H$ using the Matrix Element Method”, University of Zürich.
Invited speaker
- 25/07/2013 **HH2013: The Higgs Hunting Workshop**, “CMS Higgs to tau tau (SM and BSM)”, Orsay.
Selected speaker
- 08/06/2012 **PLHC2012: Physics at LHC**, “Search for the SM Higgs boson in $b\bar{b}$, $\tau\tau$, WW , ZZ ”, Vancouver.
Selected speaker
- 01/04/2011 **LHCC2011: The LHC students’ poster session**, “Tau reconstruction in CMS”, CERN.
Selected speaker
- 30/07/2010 **HH2010: The Higgs Hunting Workshop**, “Prospective for the search of a SM-like Higgs boson decaying to tau leptons in CMS and commissioning of the Particle-Flow event reconstruction with data”, Orsay.
Selected speaker

Spoken languages

Italian	Native speaker
English	Proficient user
French	Independent user

Technical skills

- Data analysis: ROOT, RooFit, TMVA.
- Programming languages: C, C++, Python
- Research softwares: Maple, Mathematica, Sherpa, Madgraph.
- Operative systems: Unix/Linux, Windows, Mac-OS.
- Supervised Control and Data Acquisition systems (WinCC-OA™)
- Driving licenses: A, B, nautical.

References

- Prof. Günther Dissertori (ETH Zürich): Guenther.Dissertori@cern.ch
- Prof. Florencia Canelli (University of Zürich): canelli@physik.uzh.ch

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