

Prof. Marco Zanetti

Department of Physics and Astronomy, University of Padua

e-mail: marco.zanetti@unipd.it

Address: Via Modigliani 42, 3502, Albignasego, Padova, IT

telephone: +39 3476812413; +41 7654115731

Academic positions

- 2014 - : Associate Professor, Department of Physics and Astronomy, University of Padua
- 2010 - 2014: Senior research associate at the Laboratory of Nuclear Science, MIT
- 2007 - 2009: Research fellow, CERN
- 2004 - 2006 : PhD associate, Department of Physics and Astronomy, University of Padua
- 2003 - 2003 : Scientific associate, INFN Padua

Scientific leadership

Management of projects with a budget

- 2017 - : Coordinator WP6.6, Accelerator Performance and Concepts, ARIES project, Grant Agreement number 730871, H2020
- 2017 - : Local responsible of the "R&D for Future Accelerators" group, INFN

Management roles in experimental collaborations

- 2016 - : Member of LEMMA Steering Committee
- 2016 - : LEMMA experimental tests coordinator
- 2012 - 2015: Member of CMS Physics Coordination Committee
- 2012 - 2015: Coordinator of CMS Luminosity Group
- 2011 - 2012: Coordinator of CMS Tier0 operations
- 2012 - 2014: Member of TLEP Steering Committee
- 2009 - 2010: LHC Point Owner, member of the LHC Commissioning Coordination
- 2009 - 2010: LHC Engineer in Charge
- 2007 - 2008: Coordinator of the CMS HLT operations
- 2007 - 2008: Coordinator of the CMS Trigger, Offline and Online Forum

Management roles at University of Padua

- 2015 - : Executive Board member, Department of Physics and Astronomy
- 2016 - : Chair of organising committee for Master Degree on "Physics of Data"

Overview of the research activity

Since my master degree, particle physics at colliders has been my field of research. I have been based at CERN in Geneva between 2004 and 2014 when I moved to Padua as tenured professor.

Machine Learning for any HEP. ML techniques can be exploited to solve technological issues and boost the sensitivity of the LHC data analysis. In particular I've been investigating how unsupervised learning algorithm could minimise the bias in the searches for new phenomena. My group is currently testing how such algorithm can classify particles tracks in a cloud chamber experiment.

New Physics searches at CMS. During the first LHC run (2011-16), my group analysed the CMS data to search for exotic new physics, in particular Dark Matter [1][2][3] and new resonant states decaying into weak bosons pairs [4][5][6][7]. Specifically for Dark Matter searches, the theoretical interpretation of the analysis results requires special care [8][9].

Higgs Boson Physics. I contributed directly at the discovery of the Higgs Boson at CMS, studying the decay into a pair of W bosons with the data collected in 2011 and 2012 [10][11][12]. I studied the compatibility of the measured properties of the Higgs Boson in terms of coupling strength with the other particles, comparing them with the predictions of the SM [13][14][15][16]. Furthermore I analysed the results of the measurements in the context of Supersymmetric theories [17]. The discovery of the Higgs Boson finalised the work I started during my PhD, when tools and analysis strategies have been developed [18][19][20][21].

LHC hardware commissioning. After the accident that caused the fatal damage of a km long LHC section in 2009, I joined the team responsible for the re-commissioning of the LHC superconducting circuits and magnets, bringing finally the accelerator to the first beam operation in 2010 [22] and its first high energy run in 2011 [23].

Luminosity measurement. I made use of the experience gathered working on the commissioning and initial operations of the LHC, by measuring the luminosity delivered to CMS [25], exploiting in particular a novel technique ("beam imaging" [24]). Those measurements have been pivotal for the determination of the W and Z production cross section [26] at 7 and 8 TeV.

Future accelerators for HEP. Since the discovery of the Higgs boson in 2012, I've been working on several options for the next large high energy accelerator, in particular HL-LHC [27], LEP3/TLEP [28][29][30][31][32], Sapphire [33] and more recently LEMMA (a novel idea for a high brilliance muon source).

High Level Trigger at CMS. As a CERN fellow (2007-2008), I developed and commissioned the CMS High Level Trigger, taking care also of the first operations prior to the LHC accident in September 2008 [34].

CMS Drift Tubes chambers. Between 2003 and 2007 I worked on the construction, test [35], integration [41], commissioning [37][36] and operations[39][40] of the Drift Tubes chambers (DT), the muon detector of the CMS barrel. Recently I'm leading the production a reduced size version of the DT to be employed at beam-tests.

Conferences and seminars

Seminars

- 2017, IIT, Genova, *Machine Learning and Data-based Physics*
- 2016, CERN, Geneva, *LEMMA, a Low Emittance Muon Accelerator*
- 2014, Scuola Normale Superiore, Pisa, *TLEP, a very large electron-positron circular Higgs factory*
- 2014, Institute for Advanced Studies, Princeton, *The Future Circular Collider project*
- 2014, Princeton University, Princeton, *The Higgs searches at CMS and perspective for HL-LHC*
- 2013, CPPM, Marseille, *The Higgs searches at CMS and future Higgs Factories*
- 2013, IPNL, Lyon, *The Higgs searches at CMS and future Higgs Factories*
- 2013, LNF, Frascati National Laboratory, *Sapphire, a cost effective photon collider*
- 2013, CERN, Geneva, *Recommendations for studying the Higgs properties*
- 2012, MIT, Boston, *Future Higgs Factories*

Contributions to international conferences

- 2013, Friburg, **Higgs Couplings**, *Projections for Higgs Physics at LHC and HLLHC*
- 2013, La Biodola, **European conference on Advance Accelerator Concepts**, *New Collider Concepts for Particle Physics*
- 2013, MIT, **Scenarios for future Higgs Physics (Snowmass)**, *Photon collider as a Higgs factory*
- 2012, Fermilab, **ICFA workshop on Higgs Factories**, *Beam-strahlung simulation for e+e- circular collider*
- 2012, CERN, **Joint Snowmass EuCARD/AccNet HiLumi LHC meeting**, *Parameters*
- 2012, Kyoto, **Hadron Collider Physics symposium**, *Higgs properties at CMS*
- 2011, CERN, **CERN PH seminar**, *Higgs searches with CMS*
- 2011, CERN, **LHC Luminosity workshop**, *Beams scan based Absolute Normalization of the CMS Luminosity Measurement*
- 2009, La Thuile, **Les Rencontres de Physique de la Vallée d'Aoste**, *First LHC beams in CMS*
- 2006, Coimbra, **TOP2006, Conference on Top quark physics**, *The Top background to the $H \rightarrow WW$ Higgs discovery channel for e+e- circular collider in a 80 km tunnel*
- 2006, Frascati National Laboratory, **Monte Carlo Workshop on LHC physics**, *The search for the Higgs Boson at the LHC*
- 2005, Les Houches, **Les Houches workshop, Physics at TeV Colliders**, *Background systematics to the $H \rightarrow WW$ Higgs discovery channel*

Organisation of international conferences

- 2017, Padua, **ARIES Photon Beams 2017**, organizer and chairman
- 2017, Venice, **European Physics Society Conference**, scientific secretary
- 2012/13, CERN, **Workshop series on TLEP3 machines**, organizer and chairman
- 2013, CERN, **SAPPHiRE day**, organizer and chairman
- 2011, Chamonix, **2011 Chamonix LHC workshop**, organizer and chairman

Teaching activities

- 2015 - , Electromagnetism and optics, bachelor's degree in Physics, University of Padua
- 2015 - , General Physics, bachelor's degree in Biotechnology, University of Padua
- 2018, Data Analysis and Machine Learning, Scuola Galileiana di Studi Superiori
- 2018, Advanced topics on Electrodynamics, Scuola Galileiana di Studi Superiori
- 2017, Physics at LHC and beyond, International Doctorate Network in Particle Physics, Astrophysics and Cosmology
- 2012 - 2013: Particle Physics, 8.811, MIT, TA

Students and postdocs supervision

Postdoc

- Jacopo Pazzini (2015-16): *Dark matter searches at CMS*
- Alberto Zucchetta (2015-16): *Dark matter searches at CMS*
- Paul Lujan (2016-): *Higgs boson physics at CMS and application of Machine Learning techniques on HEP topics*

PhD students

- Lisa Benato (2015-16): *Diboson resonance searches at CMS*
- Siew Yan Hoh (2017-): *Measurement of the top Yukawa coupling at CMS*
- Marco D'Andrea (2017-): *Crystal collimation at LHC*

Graduate students

- Federico Pobbe (2015-16): *An optimal limit setting procedure for heavy dark matter mediators*
- Marco D'andrea (2017): *Determination of BLM threshold to protect collimators at LHC*
- Francesco Forcher (2016-17): *An improved simulation routine for modelling coherent high-energy proton interactions with bent crystals*
- Gaia Grosso (2017): *Deep Learning techniques to search for New Physics at LHC*
- Altea Lorenzon (2017): *Beam test with positrons on target for the production of a low emittance muon beam*
- Gianmarco Pompeo (2017): *Study of the performance of the CMS Pixel Luminosity Telescope*

Publications

The complete list of publications is available on the internet at: <http://inspirebeta.net/author/M.Zanetti.1>

The total number is currently 737, of which 648 published on peer-reviewed journals, with $h_{HEP} = 124$. I'm co-author of 102 internal notes of the CMS experiments. In addition I published papers on HEP phenomenology (hep-ph) and accelerator physics (hep-ac). A list of selected publications can be found at the end of this document.

Education

- 2007: PhD in Physics, University of Padua, *The $H \rightarrow W^+W^- \rightarrow \mu^+\bar{\nu}\mu^-\nu$ Higgs discovery channel at CMS*
- 2003: Master degree in Physics, University of Padua, 110/110 cum laude
- 2001: CERN Summer Student

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- [3] CMS Collaboration [CMS Collaboration], "Search for Dark Matter produced in association with bottom quarks," CMS-PAS-B2G-15-007.
- [4] CMS Collaboration [CMS Collaboration], "Search for heavy resonances decaying into a vector boson and a Higgs boson in the (ll, lnu, nunu) bb final state," CMS-PAS-B2G-16-003.
- [5] CMS Collaboration [CMS Collaboration], "Combination of diboson resonance searches at 8 and 13 TeV," CMS-PAS-B2G-16-007.
- [6] CMS Collaboration [CMS Collaboration], "Search for heavy resonances decaying into a Z boson and a W boson in the $\ell^+\ell^-q\bar{q}$ final state," CMS-PAS-B2G-16-022.
- [7] CMS Collaboration [CMS Collaboration], "Search for heavy resonances decaying into a Z boson and a vector boson in the $\nu\nu q\bar{q}$ final state," CMS-PAS-B2G-17-005.
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- [9] D. Abercrombie *et al.*, "Dark Matter Benchmark Models for Early LHC Run-2 Searches: Report of the ATLAS/CMS Dark Matter Forum," arXiv:1507.00966 [hep-ex].
- [10] 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) [arXiv:1207.7235 [hep-ex]].

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- [12] S. Chatrchyan *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 **1306**, 081 (2013) [arXiv:1303.4571 [hep-ex]].
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Marco Zanetti