

ALLEGATO B

UNIVERSITÀ DEGLI STUDI DI MILANO

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Marianna Fontana

Curriculum Vitae

Personal Information

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Research profile

Main line of research is in high energy physics within LHCb (Large Hadron Collider beauty), an experiment at the Large Hadron Collider (CERN, Geneva). Its aim is the study of heavy flavors, through the measurements of CP violation and rare decays of beauty and charm mesons.

Publications 349
Total citations 2967
h-index 43

Present and past positions

- 07/2018 – **CERN, Geneva, Switzerland.**
present Research Fellow within the LHCb experiment.
- 06/2015 – **INFN, Cagliari, Italy.**
06/2018 Postdoctoral researcher within the LHCb experiment
- 7/2016 – **CERN Scientific Associate with INFN grant, Geneva, Switzerland.**
06/2018 The grant is assigned following an INFN internal application and selection procedure
- *Topic:* Rare decays of mesons with heavy quarks in leptonic channels
 - *Supervisor:* Monica Pepe-Altarelli

Responsibilities

- 02/2017 – **Convener of the Charm Rare decays Working Group of LHCb.**
03/2019 Responsible to coordinate the activities and internal review of physics measurements related to rare decays of charmed hadrons.
- 03/2018 – **Chair of the LHCb collaboration meeting.**
09/2018 Responsible to organise and chair the weekly plenary collaboration meetings, working in strict collaboration with the spokesperson.
- 09/2017 – **Member of the Upgrade Software planning group in LHCb.**
03/2018
- 01/2016 – **Member of the Physics planning group and of the Operation planning group in LHCb.**
03/2018
- 01/2016 – **Convener of the Global Particle Identification in LHCb.**
03/2018 Responsible to coordinate the activities of the global particle identification performance in LHCb, involving the Calo system (electromagnetic calorimeter, preshower detector, scintillating pad detector, hadronic calorimeter), two RICH detectors, and Muon system.
- 07/2015 – **Coordinator of the muon identification in LHCb.**
12/2016 Responsible of the muon identification software and of the coordination of all the activities concerning the performance during the Run II data taking as well as the effort in the development of new tools for the upgraded LHCb detector.
- 04/2012 – **"Data quality" expert at LHCb.**
12/2015 Responsible for off-line monitoring of the data collected by the LHCb detector

Education

- 04/2011 – **PhD student and Member of the Heidelberg Graduate School of Fundamental Physics, Max Planck Institute für Kernphysik, Heidelberg (Germany).**
12/2014 Research within the LHCb experiment under the supervision of Prof. Michael Schmelling:
- Thesis topic: *Search for the $B_{d,s}^0 \rightarrow K_S^0 K^{*0}$ decays in the LHCb experiment.*
 - **PhD defence day: 17/12/2014**

- 09/2008 – **Master degree in Physics**, *Università degli studi di Cagliari (Italy)*.
 11/2010 Thesis under the supervision of Prof. Biagio Saitta within the LHCb group of Cagliari (grade: 110/110 cum laude):
- Thesis topic: *D mesons production cross-section in pp collisions at LHCb*.
 - Assegno di merito Regione Sardegna (2008-2009 / 2009-2010)
- 10/2005 – **Bachelor degree in Physics**, *Università degli studi di Cagliari (Italy)*.
 09/2008 Thesis under the supervision of Prof. Biagio Saitta within the LHCb group of Cagliari (grade: 110/110 cum laude):
- Thesis topic: *New methods for the selection of the $B_d^0 \rightarrow K^* \mu \mu$ decay at LHCb*.
 - Assegno di merito Regione Sardegna (2007-2008)

Scholarship and membership

- 04/2011 – **International Max Planck Research School for Precision Tests of Fundamental Symmetries (IMPRS-PTFS)**, *Max Planck Institute für Kernphysik, Heidelberg (Germany)*.
 12/2014 Admission granted after international calls for application and a selection procedure based on performance and excellence.
- 06/2009 – **CERN Summer student programme**, *Geneva, Switzerland*.
 08/2009 Research project under the supervision of Silvia Borghi and Chris Parkes within the LHCb Velo group:
- Topic: *Development of a Graphical Interface for the LHCb Alignment Monitoring*.

Teaching and supervision

- 06/2015 – **Co-supervision of a PhD student**, *Università degli studi di Cagliari (Italy)*.
 02/2017 Title of the thesis: *Improvement of muon identification algorithms and perspectives on the $D^0 \rightarrow \mu^+ \mu^-$ search in LHCb*
- 06/2015 – **Co-supervision of a master student**, *Università degli studi di Cagliari (Italy)*.
 02/2016 Title of the thesis: *Search for the rare decay $D^0 \rightarrow \mu^+ \mu^-$*
- 09/2013 – **Tutor of Laser Spectroscopy laboratory for the Bachelor in Physics**, *Ruprecht-Karls-Universität, Heidelberg (Germany)*.
 07/2014
- 10/2008 – **Tutor of Mechanics and Thermodynamics for the Bachelor in Engineering**, *Università degli studi di Cagliari (Italy)*.
 02/2009

Conferences Talks and Posters

- 06/2018 **HL-LHC (High Luminosity-LHC Physics Workshop)**, *CERN, Geneva*.
 ○ Parallel talk: *LHCb physics : Charm and Kaons*
- 06/2018 **LHCP Conference 2018**, *Bologna, Italy*.
 ○ Parallel talk: *Charm physics at LHCb*
- 09/2017 **131th LHCC Meeting**, *CERN, Geneva*.
 ○ Plenary talk: *LHCb status report*
- 07/2017 **EPS 2017, EPS Conference on High Energy Physics**, *Venice, Italy*.
 ○ Parallel talk: *LHCb inputs to astroparticle physics*

- 09/2016 **CHARM 2016, VIII International Workshop on Charm Physics, Bologna, Italy.**
 - Plenary talk: *Rare charm decays at LHCb*
- 08/2016 **ICHEP 2016, 38th International Conference on High Energy Physics, Chicago, Illinois.**
 - Parallel talk: *Study on the performance of the Particle Identification Detectors at LHCb after the LHC First Long Shutdown (LS1)*
- 04/2016 **IFAE 2016, Incontri di fisica delle alte energie, Genova, Italy.**
 - Plenary talk: *Study of rare decays in LHCb* - awarded as best presentation of the "High Intensity frontier" session.
- 05/2015 **CIPANP 2015, 12th Conference on the Intersections of Particle and Nuclear Physics, Vail, Colorado.**
 - Parallel talk: *Charmless B decays*
- 08/2014 **International Max Planck Research School seminars, Heidelberg, Germany.**
 - Talk: *Search for the charmless decays $B_{d,s}^0 \rightarrow K^{*0} K_S^0$ at LHCb*
- 07/2014 **Beauty 2014, 15th International Conference on B-Physics at Frontier Machines, Edinburgh, UK.**
 - Plenary talk: *Charmless B decays: Dalitz*
- 04/2013 **IFAE 2013, Incontri di fisica delle alte energie, Genova, Italy.**
 - Poster: *Search for the charmless decays $B_{d,s}^0 \rightarrow K^{*0} K_S^0$ at LHCb.*
- 02/2013 **DPG (German Physics Society) Spring Meeting 2013, Dresden, Germany.**
 - Parallel talk: *Search for the charmless decays $B_{d,s}^0 \rightarrow K^{*0} K_S^0$ at LHCb.*
- 06/2012 **PLHC 2012, Vancouver, Canada.**
 - Parallel talk: *Measurements of particle productions and energy flow in pp collisions at $\sqrt{s} = 7$ TeV in LHCb.*

Selected Publications and documents

I am author of many publications as member of the LHCb collaboration, that can be found in [Inspire](#). In the following are reported those to which my contribution has been relevant:

- [1] LHCb collaboration, Aaij, Roel et al., *Study of $B_{(s)}^0 \rightarrow K_S^0 h^+ h'^-$ decays with first observation of $B_s^0 \rightarrow K_S^0 K^\pm \pi^\mp$ and $B_s^0 \rightarrow K_S^0 \pi^+ \pi^-$* , JHEP 10 (2013) 143 [arXiv:1307.7648]
- [2] LHCb collaboration, R. Aaij et al., *Observation of $B_s^0 \rightarrow K^{*\pm} K^\mp$ and evidence for $B_s^0 \rightarrow K^{*-} \pi^+$ decays*, New J. Phys. 16, no. 12, 123001 (2014) [arXiv:1407.7704]
- [3] LHCb collaboration, R. Aaij et al., *First observation of the decay $B_s^0 \rightarrow K_S^0 K^{*0}(892)^0$ at LHCb*, JHEP 01 (2016) 012 [arXiv:1506.08634]
- [4] LHCb collaboration, R. Aaij et al., *Observation of D^0 meson decays to $\pi^+ \pi^- \mu^+ \mu^-$ and $K^+ K^- \mu^+ \mu^-$ final states*, Phys. Rev. Lett. 119, 181805 (2017) [arXiv:1707.08377]
- [5] LHCb collaboration, R. Aaij et al., *Search for the rare decay $\Lambda_c^+ \rightarrow p \mu^+ \mu^-$* , Phys. Rev. D 97, 091101 (2018) [arXiv:1712.07938]

- [6] LHCb collaboration, R. Aaij et al., *Improved limit on the branching fraction of the rare decay $K_S^0 \rightarrow \mu^+ \mu^-$* , Eur. Phys. J. C77 (2017) 10, 678 [arXiv:1706.00758]
- [7] V. V. Gligorov et al., *Performance of the LHCb trigger and full real-time reconstruction in Run 2 of the LHC*, LHCb-DP-2019-001, JINST 14 (2019) P04013 [arXiv:1812.10790]
- [8] M. Fontana et al., *Selection and processing of calibration samples to measure the particle identification performance of the LHCb experiment in Run 2*, LHCb-DP-2018-001, EPJ Techniques and Instrumentation 2019 6:1 [arXiv:1803.00824]
- [9] LHCb collaboration, R. Aaij et al., *Measurement of the $B_s^0 \rightarrow \mu^+ \mu^-$ branching fraction and effective lifetime and search for $B^0 \rightarrow \mu^+ \mu^-$ decays*, Phys. Rev. Lett. 118 (2017) 191801 [arXiv:1703.05747]
- [10] LHCb collaboration, R. Aaij et al., *Test of lepton universality with $B^0 \rightarrow K^{*0} \ell^+ \ell^-$ decays*, JHEP 08 (2017) 055 [arXiv: 1705.05802]
- [11] LHCb collaboration, R. Aaij et al., *Search for lepton-universality violation in $B^+ \rightarrow K^+ \ell^+ \ell^-$ decays*, Phys. Rev. Lett. 122 (2019) 191801 [arXiv:1903.09252]
- [12] LHCb collaboration, R. Aaij et al., *Measurement of antiproton production in pHe collisions at $\sqrt{s_{NN}} = 110$ GeV*, Phys. Rev. Lett. 121 (2018) 222001 [arXiv:1707.02750]
- [13] LHCb collaboration, R. Aaij et al., *Measurement of the CKM angle γ using $B^\pm \rightarrow DK^\pm$ with $D \rightarrow K_S^0 \pi^+ \pi^-$, $K_S^0 K^+ K^-$ decays*, J. High Energ. Phys. (2018) 2018: 176 [arXiv:1806.01202]

Research activities

I joined the LHCb experiment in 2008 as a bachelor student and since then I worked on many aspects of heavy flavor physics. My research programmes have been completed successfully and have resulted in high impact journal publications. I have been invited to present my results at many of the most prestigious international particle physics conferences.

During my PhD at Max Planck Institute in Heidelberg my primary research was focused on the study of penguin-dominated non-leptonic $B_{d,s}^0 \rightarrow K_S^0 hh'$ ($h = \pi, K$) decays, that can reveal the presence of New Physics (NP) in decay amplitudes. Results on the branching fraction (BF) of the $B_{d,s}^0 \rightarrow K_S^0 hh'$ ($h = \pi, K$) decays have been obtained using the 2011 LHCb data sample [JHEP 1310, 143 (2013)] (Publication n. 1). I first collaborated to the first observation of the $B_s^0 \rightarrow K^{*\pm} K^\mp$ and the first evidence for $B_s^0 \rightarrow K^{*\pm} \pi^\mp$ [New J. Phys. 16, no. 12, 123001 (2014)] (Publication n. 2). Finally I studied the $B_s^0 \rightarrow K_S^0 K^{*0}$ decay and achieved its first observation and the BF measurement relative to the $B_d^0 \rightarrow K_S^0 \pi^+ \pi^-$ decay [JHEP 1601, 012 (2016)] (Publication n. 3). I had the opportunity to present these results at several international conferences, notably at the Beauty (2014) and CIPANP (2015) conferences.

During the first postdoctoral research position at INFN in Cagliari (with two years of CERN scientific association) I enlarged my interest for NP searches also to rare D^0 decays with muons in the final state. I am currently the leader of the group searching for the FCNC decay $D^0 \rightarrow \mu^+ \mu^-$ which is very sensitive to NP contributions, I developed a novel selection strategy giving an important improvement on the

expected limit. Following my contributions in the charm rare decays area, on January 2017 I have been appointed as convener of the Charm Rare Decays working group, for which I have been responsible to coordinate all the activities and support the analyses in this specific physics area. Under my coordination the first observation of the $D^0 \rightarrow hh\mu^+\mu^-$ ($h = K^\pm, \pi^\mp$) decay, the rarest charm decay so far, has been published [[Phys. Rev. Lett. 119, no. 18, 181805 \(2017\)](#)] (Publication n. 4). I gave a major contribution as reviewer and for the development of the muon identification strategy for muons with low transverse momentum. Moreover the study of processes involving $c \rightarrow u\ell^+\ell^-$ transitions have been carried out in the working group. I acted as reviewer for the search of the rare baryonic decay $\Lambda_c^+ \rightarrow p\mu^+\mu^-$ and in the determination of its upper limit [[Phys. Rev. D 97, no. 9, 091101 \(2018\)](#)] (Publication n. 5). Given my prominent role in the rare decays area I have been appointed as convener of the "Rare decay" session in the workshop on "Implications of LHCb measurements" (CERN, Geneva). Moreover I have been responsible for the "Rare charm decays" studies in the document "Physics case for an LHCb Upgrade II" [[arxiv:1808.08865](#)]

Within LHCb I covered several roles of responsibility. In July 2015 I have been appointed as coordinator of the muon identification, responsible of the software and I joined the effort for the upgrade of the Muon System. I coordinated the muon identification group in the development of a new tool. Thanks to the improved method, already introduced during the Run II data taking, an improved limit for the rare decay $K_S^0 \rightarrow \mu^+\mu^-$ has been set [[Eur. Phys. J. C 77, no. 10, 678 \(2017\)](#)] (Publication n. 6). The prospects for the use of this new algorithm under upgrade conditions have been reported in the biannual report for the upgrade trigger [[CERN-LHCb-PUB-2017-005](#)].

My expertise in the muon identification has been the proxy for my role as convener of the global Particle Identification (PID). For the Run II of LHC we established a new strategy to improve the purity and the kinematic coverage of the calibration samples and to keep the systematics effects under control. First the selections have been optimised to enhance the purity and the kinematic coverage of the samples. Secondly the samples are selected directly at the trigger level, as documented in the paper published in [[JINST 14 \(2019\) P04013](#)] (Publication n. 7). A centralised production of the calibration samples, developed with my fundamental contribution, ensures the best use of the available computing resources and a very fast accessibility to the samples. The novel strategy to select and produce the samples to determine the particle identification efficiency has been reported in an article published in the EPJ Techniques and Instrumentation [[EPJ Techniques and Instrumentation 2019 6:1](#)] (Publication n. 8). This important role of convenership gave me the chance to deeply train and develop my coordination skills. Under my mandate more than 100 papers have been published in LHCb. Among the high-profile publications are the first observation of the $B_s^0 \rightarrow \mu^+\mu^-$ [[Phys. Rev. Lett. 118, no. 19, 191801 \(2017\)](#)] (Publication n. 9), the measurements of $R(K^*)$ [[JHEP 1708, 055 \(2017\)](#)] (Publication n. 10) and $R(K)$ [[Phys. Rev. Lett. 122 \(2019\) 191801](#)] (Publication n. 11) as tests of lepton universality, the measurement of antiproton production in pHe collisions [[Phys. Rev. Lett. 121 \(2018\) 222001](#)] (Publication n. 12), presented also in international conferences such as LHCP.

The special attention devoted to the particle identification made the Collaboration to choose me as the internal reviewer for the very important measurement of the CKM angle γ using the $B^\pm \rightarrow DK^\pm$ decays, which represents the most precise determination from a single analysis [[J. High Energ. Phys. \(2018\) 2018: 176](#)] (Publication n. 13).

--- LHCb documentation

- LHCb collaboration, Aaij, Roel et al, *Upgrade trigger and reconstruction strategy: 2017 milestone*, CERN-LHCb-PUB-2018-005

- LHCb collaboration, Aaij, Roel et al, *Upgrade trigger: Biannual performance update*, CERN-LHCb-PUB-2017-005
- M. Fontana et al., *Working group productions for calibration samples*, LHCb-INT-2016-029
- M. Fontana et al., *The PIDCalib package*, CERN-LHCb-INT-2016-028
- M. Fontana et al., *New muon identification algorithms*, CERN-LHCb-INT-2016-006
- M. Fontana et al., *Development of a Graphical Interface for the LHCb Alignment Monitoring*, CERN-LHCb-INT-2009-027

Conference Proceedings

- Fontana M., *Charm Physics at LHCb*, PoS LHCP2018 (2018) 189
- Fontana M., *LHCb inputs to astroparticle physics*, PoS (EPS2017) 832
- Fontana M., *Rare decays at LHCb*, PoS (CHARM2016) 026
- Fontana M., *Study on the performance of the Particle Identification Detectors at LHCb after the LHC First Long Shutdown (LS1)*, PoS (ICHEP2016) 295
- Fontana M., *Charmless B decays: Dalitz*, PoS (Beauty 2014) 020
- Fontana M., *B meson decays into neutral kaons in the LHCb experiment*, Il nuovo Cimento C 37 (2014)
- Fontana M., *Measurements of particle production and energy flow in pp collisions at $\sqrt{s} = 7$ TeV in LHCb*, eConf (PLHC2012) C12-06-04.3

Organisation of conferences/workshops

- 05/2019 **Convener at the LHCP Conference 2019, Puebla, Mexico.**
Session: Performance and tools
- 11/2017 **Convener at the "Implications of LHCb measurements and future prospects", CERN, Geneva.**
Session: Semileptonic decays, rare decays, and tests of lepton flavour universality
- 04/2016 **Organizer of the LHCb Italian meeting, Cagliari, Italy.**

Physics Schools

- 05/2017 **INFN school of statistics, Ischia (Italy).**
- 08/2012 **CTEQ school, Lima, (Peru).**
- 04/2011 – **Biannual Physics Graduate Days, Heidelberg (Germany).**
12/2014 Lecture week on various physics topics
- 04/2011 – **Annual German B-physics workshop, Neckarzimmern (Germany).**
12/2014 Lectures about theoretical and experimental flavour physics
- 07/2011 **Trans-European School of High Energy Physics, Alushta, (Ukraine).**
Talk: *D mesons production cross-section in pp collisions at LHCb*

Outreach

- 02/2019 **Collaboration with the SpringerBlog.**
<http://blogs.springeropen.com/springeropen/2019/03/04/particle-identification-accuracy-lhcb/>
- 01/2019 – 09/2019 **Main organiser of the CERN Open Days for the LHCb experiment.**
- 06/2017 – present **Official LHCb guide, CERN, Geneva.**
- 02/2018 **LHCb Masterclass, CERN moderator, CERN, Geneva.**
- 02/2017-2018 **International day of women in Science, LHCb Masterclass - CERN moderator.**
- 02/2016 **LHCb Masterclass, local organiser at INFN Cagliari.**
- 09/2015 **Night of the European researchers, Cagliari (Italy).**
Series of outreach initiatives at Department of Physics
- 12/2010 **Organiser and moderator of the workshop: "Sardegna, energie e prospettive".**

Languages

Italian	Mothertongue
Sardinian	Mothertongue
English	Fluent
German	Basic
French	Basic

Computer skills

Operative Systems	Unix/Linux(Very Good), MacOS(Good), Windows(Good)
Programming languages	C/C++ (good), Python (good)
Scientific software	ROOT (very good), RooFit/RooStat (very good), TMVA (very good)

Data 03/08/2019 Luogo Ginevra