

Francesco Santanastasio

Work Address:

Department of Physics, Sapienza Università di Roma
Edificio Marconi, floor 2, room 202-b
Piazzale Aldo Moro, 2 00185 Rome
Italy

Office Phone: +39 06 4991 4388

e-mail:

francesco.santanastasio@cern.ch

francesco.santanastasio@roma1.infn.it

francesco.santanastasio@uniroma1.it

Born: 9 February 1980 — Rome, Italy

Website: <http://www.roma1.infn.it/santanastasio/index.php>

Current Position

Associate Professor

Department of Physics, Sapienza Università di Roma, Rome, Italy

Research Groups

2005 - today **Member of the CMS collaboration at the CERN Large Hadron Collider (LHC)**
CMS is one of the two general purpose particle physics detectors operated at LHC.

2014 - 2017 **Member of the i-MCP collaboration**
i-MCP is an R&D project within INFN CSN5 aimed at use of micro-channel plates for fast timing detection of single particles and electromagnetic showers at collider experiments.

Employment History

01/2018 - today **Associate Professor in Physics**
Sapienza Università di Roma, Rome, Italy

03/2014 - **Assistant Professor in Physics (RTDb)**
12/2017 *Sapienza Università di Roma*, Rome, Italy

09/2011 - **CERN Research Fellow in Experimental Particle Physics**
12/2013 *CERN*, Geneve, Switzerland
CONTACT: Dott. Maurizio Pierini (CERN)

12/2007 - **Post-Doctoral Research Assistant (Post-Doc) in Particle Physics**
08/2011 *University of Maryland*, College Park, MD, US
CONTACT: Prof. Sarah Eno (UMD)

11/2004 - **PhD in Physics**
01/2008 “Search for Supersymmetry with Gauge-Mediated Breaking using high energy photons at CMS experiment” [83]
ADVISORS: Prof. Shahram Rahatlou, Dott. Daniele del Re (Sapienza)
Sapienza Università di Roma, Rome, Italy

09/1998 - **Laurea in Physics** (highest honors)
05/2004

“Calibration of an electromagnetic calorimeter using the energy flow method” [84]

ADVISORS: Dott. Riccardo Paramatti (INFN), Prof. Egidio Longo (Sapienza)

Mark: 110/110 *“magna cum laude”*

Sapienza Università di Roma, Rome, Italy

Research Grants

08/2013 **Winner of Programma Per Giovani Ricercatori “Rita Levi Montalcini”**

[Risultati Bando 2010](#)

Three-year grant of about 220000 euros for research in experimental high-energy physics with the CMS detector at the CERN LHC, of which 44000 euros for research costs.

02/2019 **Winner of “Progetti di Ricerca Bando Ateneo Sapienza 2018 - Progetti Medi”**

Research project title: “Search for new resonances in unexplored trijet final states at LHC”. Three-year grant of 12500 euros for research costs.

12/2020 **Winner of “Progetti di Ricerca Bando Ateneo Sapienza 2020 - Progetti Medi”**

Research project title: “Investigation of LYSO crystal optical properties at very low temperature for the CMS Barrel Timing Layer at the High Luminosity phase of LHC”. Three-year grant of 13000 euros for research costs.

Invited Talks at Conferences

24-31/03/2024 **Moriond/EW 2024** - Rencontres de Moriond on “EW Interactions and Unified Theories”, La Thuile, Italy, *“Exotica Searches at CMS”* [47]

29/09/2019 - **SCINT2019** - 15th Conference on Scintillating Materials and their Applications, Sendai, Japan
04/10/2019 *“Precision Timing in the CMS MTD Barrel Timing Layer with Crystal Bars and SiPMs”* [48]

09-13/10/2017 **GGI2017** - Collider Physics and the Cosmos, Galileo Galilei Institute, Arcetri (FI), Italia
“Recent results and future perspectives on searches for dark matter mediators”

06-14/07/2016 **ICNFP2016** - International Conference on New Frontiers in Physics, Kolymbari, Crete,
“Search for new physics beyond the Standard Model in final states with jets and leptons+jets at CMS” [49]

02-09/07/2014 **ICHEP2014** - International Conference on High Energy Physics, Valencia, Spain, *“Search for heavy resonances decaying to bosons with the ATLAS and CMS detectors”* [50]

08-10/05/2013 **Workshop LHCpp 2013** - VI Workshop Italiano sulla Fisica p-p a LHC, Genova, Italy,
“Hadronic Resonances at ATLAS and CMS” [51]

12-15/09/2012 **PIC2012** - XXXII Physics in Collision 2012, Strbske Pleso, Slovakia, *“Exotic Phenomena Searches at Hadron Colliders”* [52]

13-20/03/2011 **Moriond/EW 2011** - Rencontres de Moriond on “EW Interactions and Unified Theories”, La Thuile, Italy, *“Exotica Searches at CMS”* [53]

19-23/04/2010 **DIS2010** - XVIII International Workshop on Deep-Inelastic Scattering and Related Subjects, Firenze, Italy, *“Searches With Early Data At CMS”* [54]

15-17/04/2009 **IFAE2009** - Incontri di Fisica delle Alte Energie, VIII Edizione, Bari, Italy, “*Prospects for Exotica Searches at ATLAS and CMS Experiments*” [55]

Review Committees

02/2019 - today Referee of *European Physical Journal C* [link to online journal](#) (2023 impact factor = 4.2)

06/2016 - today Referee of *New Journal of Physics* [link to online journal](#) (2023 impact factor = 2.8)

2011 - today Chair or member of the internal “*Analysis Review Committees*” for the scrutiny of public results of the CMS collaboration (a selection: [4, 24, 25, 42, 23])

Citation Report

Last updated on 24/07/2024

Total number of publications: 1285 [inspire link](#)
Total number of publications from 01/01/2019 (last 5 years): 483 [inspire link](#)
Total number of citations from 01/01/2014 (last 10 years): 102841 [inspire link](#)
Hirsch h index from 01/01/2014 (last 10 years): 153 [inspire link](#)

I’m author of more than 45 internal notes and 9 conference reports of the CMS experiment, and 9 articles on detector studies in small collaborations.

Teaching

09/2024 - today **Corso di Termodinamica e Laboratorio, Sapienza, Corso di Laurea in Fisica**
Professor of thermodynamics (with related laboratory activities) for physics majors at first year of University

03/2020 - today **Corso di Laboratorio di Meccanica, Sapienza, Corso di Laurea in Fisica**
Professor of laboratory of mechanics (including lessons of probability and statistics) for physics majors at first year of University

03/2015 - **Corso di Fisica I, Sapienza, Corso di Laurea in Chimica Industriale**
03/2020 *Professor of mechanics and thermodynamics for chemistry majors*

03/2018 - **Corso di Statistica, Sapienza, Corso di Laurea in Chimica**
03/2019 *Professor of error analysis and statistics for chemistry majors*

03/2017 - **Corso di Physics Laboratory II, Sapienza, Corso di Laurea in Fisica**
08/2018 *Teaching assistant of particle physics laboratory at physics majors*

10/2005 - **Corso di Fisica I, Sapienza, Corso di Laurea in Matematica**
02/2006 *Teaching assistant of mechanics at mathematics majors*

Academic Responsibilities

- 10/2021 - today **“Componente del collegio docenti del dottorato in fisica degli acceleratori” at Sapienza**
Member of the judging committee for the admission to the XXXVIII cycle of the Research Doctorate. Contribution to the evaluation of doctoral students.
- 09/2019 - 2024 **“Presidente della Commissione per i Prodotti della Ricerca del Dipartimento di Fisica” at Sapienza**
Organization of the activities related to research quality evaluation (VQR)
- 10/2014 - **“Referente di Con.Sienze per la Facoltà di SMFN” at Sapienza**
04/2018 *Organization of verification tests required for student registration at first year of University in science faculty*
- 09/2015 - **Member of “Commissione Didattica del CdL in Chimica Industriale” at Sapienza**
03/2020 *Coordination and rationalization of academic activities and teaching programs in undergraduate courses for chemistry majors*

Student Supervision

I have been the thesis supervisor or co-supervisor of the following students at Sapienza:

- 2024-2027 **Petra Akrap (PhD)**, Current activities on the CMS Mip Timing Detector. The thesis project will be defined by the end of 2024.
- 2021-2024 **Mattia Campana (PhD)**, “Search for leptoquarks coupling to muons in lepton-quark collisions at LHC”, [the thesis will be available at this link](#) [56]
- 2022-2023 **Agnese Foglietti (undergraduate)**, “Search for Leptoquarks in lepton-quark collisions with the CMS experiment at LHC” [link thesis](#)
- 2022-2023 **Petra Akrap (undergraduate, Erasmus+ program)**, “Study on the search for leptoquarks in lepton-quark collisions at the LHC using proton tagged events” [link thesis](#)
- 2019-2022 **Claudio Quaranta (PhD)**, “Search for high-mass resonances in final states with a boosted-dijet resonance in proton-proton collisions at $\sqrt{s} = 13$ TeV with the CMS detector”, [link thesis](#) [3, 59]
- 2018-2019 **Samuele Torelli (undergraduate)**, “Study of time resolution and characterization of LYSO crystals for the CMS MTD” [link thesis](#)
- 2016-2017 **Alfonso Tanga (undergraduate)**, “Ricerca di nuove risonanze in stati finali con tre jet a LHC” [link thesis](#)
- 2015-2017 **Simone Gelli (PhD)**, “Search for new particles decaying into $Z\gamma/W\gamma$ final states in proton-proton collisions at $\sqrt{s} = 13$ TeV” [link thesis](#)
- 2014-2015 **Giulia D’Imperio (PhD)**, “Search for narrow resonances in dijet final states at the LHC with $\sqrt{s} = 13$ TeV” [link thesis](#) [10]

During my convenerships of analysis groups and postdoc appointments in the CMS experiment, I supervised the research activity of the following students from different institutions:

- 2015-2017 **Federico Preiato (PhD)**, Sapienza University of Rome, Italy
"Search for heavy resonances in the dijet final state and jet energy calibration" [9, 61]
- 2012-2015 **Emine Gurpinar (PhD)**, Cukurova University, Turkey
"Searches for heavy resonances decaying to pair of jets at CMS" [12, 15]
- 2012-2014 **Shuai Liu (PhD)**, Peking University, China
"Searches for beyond Standard Model $WW \rightarrow \ell\nu qq$ resonances at CMS" [16]
- 2012-2014 **Edmund Berry (PhD)**, Princeton University, USA
"Searches for first-generation leptoquarks at CMS with $\sqrt{s} = 7$ and 8 TeV data" [26, 27]
- 2010-2011 **Dinko Ferencek (PhD)**, University of Maryland, USA
"Searches for First-Generation Leptoquarks at CMS with early $\sqrt{s} = 7$ TeV data" [28]
- 2008-2009 **Elizabeth Twedt Lockner (PhD)**, University of Maryland, USA
"Feasibility study of First-Generation Leptoquark searches at CMS" [46]

Scientific Coordination in the CMS experiment

- 01/2023 - **Coordination of the CMS team for the preparation of the Data Scouting and Data Parking review paper**
 07/2024 This analysis group was formed to write a long review paper (about 100 pages) on the topic of "data scouting and data parking" in CMS (more details below and in the highlights section). I led a group constituted by more than 15 physicists working in universities and research institutions from all the world. The review paper was submitted for publication in 2024 [2].
- 09/2016 - **Coordination of the CMS Exotica Jets+X Working Group**
 09/2018 This analysis group works on searches for new physics beyond the Standard Model in final states containing jets. The group, constituted by more than 50 physicists working in universities and research institutions from all the world, performs almost 20 physics analyses in this final state. During my convenership, the group produced 9 publications (including [5, 6, 7, 8]) and 3 preliminary results. The results of the remaining searches are expected to be published in 2018.
- 09/2014 - **Coordination of the Dijet Resonance Team of the CMS experiment**
 09/2016 This analysis team works on searches for new massive resonances at the TeV scale decaying into a pair of jets using the dijet mass spectrum. It is constituted by almost 20 physicists from several institutions from all the world. This group produced two high-impact papers using proton-proton collisions at $\sqrt{s} = 13$ TeV [9, 10], including the first published limits in the dijet final state on the mass of a mediator of the interaction between dark matter and standard model particles.
- 01/2013 - **Coordination of the CMS Exotica Leptons+Jets Working Group**
 01/2015 This analysis group works on searches for new physics beyond the Standard Model in final states containing leptons and jets. The group, constituted by more than 50 physicists working in universities and research institutions from all the world, performed about 15

physics analyses in this final state. During my convenership, the group produced 3 publications [21, 22, 16] and 7 preliminary results that were then published or submitted for publication in 2015 (including [19, 20, 26]).

- 03/2012 - **Coordination of the *Dataset Definition Team* of the CMS experiment**
- 03/2013 Definition of the trigger requirements forming the data streams used for physics analysis and detector calibration. This responsibility also consists in the design and implementation of a novel strategy for *data parking* and *data scouting* [43]. LHC searches for new particles with sub-TeV masses are hindered by the high thresholds required to limit trigger rates. The new technique of data scouting, based on online event reconstruction and small record sizes, allows to lower trigger thresholds and extend searches for new particles into hitherto unexplored regions.
- 09/2008 - **Coordination of the *Prompt Feedback Group* of the hadronic calorimeter of the CMS experiment (HCAL)**
- 09/2010 Monitoring and data analysis concerning problems in the detector during cosmic-ray data-taking. The group was formed by almost 10 students and postdocs working on HCAL detector studies in early data taking periods.

Highlights of Research Activities in the CMS experiment

- 01/2021 - today Proponent and author of novel searches for Leptoquarks (LQs). Due to quantum fluctuations, protons also contain charged leptons, making it possible to study lepton-induced processes in pp collisions the LHC. By picking a lepton from one proton beam and a quark from the other beam, it becomes possible to study the resonant single LQ production and the corresponding decay ($\ell + q \rightarrow LQ \rightarrow \ell + q$). This search is more sensitive than previous analyses for large LQ-lepton-quark coupling and for LQ masses above 1 TeV. I supervised the work of one PhD student and two master thesis students on this project using CMS pp collision data. Both muon [PhD thesis][56] and electron [master thesis] final states were studied, and we also considered the possibility that the proton emitting the lepton remains intact and is detected in the CT-PPS detector [master thesis].
- 09/2017 - today Responsible in the CMS Rome group for the laboratory activities on characterization of LYSO scintillating crystals for the Barrel Timing Layer (BTL) detector of the CMS experiment (Phase II upgrade) [41]. The precision time information of BTL (30-50 ps resolution) will reduce the effects of the high pile-up expected at the HL-LHC and bring new and unique capabilities to the CMS detector in identification of low energy charged particle and search for new long-lived particles predicted by theories beyond the standard model. The technology selected for the BTL consists of scintillating crystal of Lutetium Yttrium Orthosilicate doped with Cerium (LYSO:Ce) arranged in arrays of small elongated bars read out by Silicon PhotoMultipliers (SiPMs). The main goal of this activity is the definition and implementation of the procedures for the quality assurance and control tests of the crystals during the initial market survey phase in 2018-2023 [58, 57] and the final production phase in 2024 [40]. A comparative characterization of LYSO:Ce crystal products available on the market by mechanical, optical and scintillation measurements was published [1], aiming specifically to investigate key parameters of timing applications for high energy physics.
- 09/2018 - Leading author of a search for new resonances in unexplored trijet final states at LHC [3, 59].
- 07/2022 These particles are predicted in theories that foresee the existence of heavy partners of SM quarks or the existence of extra spatial dimensions. The signal benchmark model is the production of a new resonance (R1) which decays to a quark/gluon and a second resonance

(R2), which in turn decays to two quarks/gluons. I plan to explore the impact of modern data science technologies, such as deep learning, in jet substructure identification, in order to boost the sensitivity of this search to new physics signals.

- 03/2014 - Investigation of use of Micro Channel Plates (MCPs) detectors for precision timing measurements at future colliders. I have been involved in studies on the ionization-MCP (i-MCP) where the avalanche formation is triggered by secondary emission of electrons directly on the MCP surface, when this is hit by relativistic charged particles. The advantage consists in the elimination of the photo-cathode, improving the radiation tolerance of the device. The demonstration of the i-MCP concept has been achieved on both commercial devices and bare MCPs tested inside a custom vacuum chamber designed in Rome. In some configurations, detection efficiencies to single particles up to 90% are reached with time resolution between 20 ps and 30 ps [35, 36, 37, 38, 39]. For the BTL detector, the LYSO:SiPM solution was preferred over the novel i-MCP technology because of the time and cost constraints of the CMS upgrade project.
- 09/2011 - Leading author of searches for resonances at TeV mass scale decaying into a pair of jets (dijet) using the dijet mass spectrum in proton-proton collisions at $\sqrt{s}=7$ TeV [15, 70], 8 TeV [13, 69, 12, 68], and 13 TeV [9, 62, 10, 64, 63] with the CMS detector. The search for new dijet resonances is among the most important ones at LHC because any hypothetical new particle that might be produced originates from the colliding protons and therefore it must couple to quarks and/or gluons. This search is sensitive to the presence of a hypothetical, massive mediator of the interaction between dark matter and standard model quarks. These papers received in total more than 500 citations.
- 01/2015 - Study of jet energy calibration using γ +jet events [61] and study jet substructure observables using energetic W bosons in events with top quark pair production [60]. The detailed understanding of both the energy scale and resolution of the jets is of crucial importance for many physics analyses. Jet substructure observables are important in several searches for new physics to identify energetic W or Z bosons decaying to a pair of collimated quarks and reconstructed as single massive jets in the detector.
- 09/2011 - Proponent of a novel trigger, data acquisition, and analysis strategy to recover sensitivity to new dijet resonances at dijet masses below 1 TeV [43] (*data scouting*). Leading author of searches for dijet resonances using the data scouting technique at $\sqrt{s}=7$ TeV [44] and $\sqrt{s}=8$ TeV [11, 65]. Supervision of PhD student at Sapienza working on calibration of online reconstructed jets for the scouting analysis at $\sqrt{s}=13$ TeV [9, 62]. It is important to extend the dijet search in the mass region below 1 TeV in order to probe hypothetical hadronic resonances with small couplings to quarks and gluons that similar searches performed at previous colliders could not find yet.
- 12/2011 - Primary author of searches for heavy resonances decaying to WW / ZZ / WZ / qW / qZ in semi-leptonic $\ell\nu q\bar{q}'$ / $\ell\ell q\bar{q}$ [16, 66, 67] and fully hadronic [17, 71, 18, 72] final states at CMS using jet substructure techniques to identify the hadronic decays of boosted vector bosons. The investigation of the di-boson production at high center-of-mass energy is a necessary ingredient for the understanding of the origin of the electroweak symmetry breaking and to disentangle the nature of the Higgs boson.
- 12/2007 - Leading author of searches for pair production of first generation scalar Leptoquarks (LQ) in the decay channels $LQ\bar{L}\bar{Q} \rightarrow ee q\bar{q}$ [29, 46, 76, 77] and $LQ\bar{L}\bar{Q} \rightarrow e\nu q\bar{q}$ [28, 75] with the CMS detector using the first 36 pb⁻¹ of LHC collisions at $\sqrt{s}=7$ TeV. Primary author of the LQ analysis updates with full dataset at $\sqrt{s}=7$ TeV [27, 74] and author of the 8 TeV

analysis [26, 73]. These searches are sensitive to signals from Supersymmetry models with R-Parity violation that foresee $\text{stop} \rightarrow e q$ decays.

- 11/2009 - Commissioning of missing transverse energy (MET) reconstructed with the first proton-proton (pp) collisions at $\sqrt{s} = 0.9$ and 2.36 TeV collected by the CMS experiment [45, 78, 79].
09/2010
- 11/2009 - Development and implementation of algorithms for the identification of anomalous, beam-induced signals in the CMS hadronic forward calorimeter at $\sqrt{s} = 0.9, 2.36$ and 7 TeV [80, 31].
09/2010
- 06/2009 - Commissioning and calibration of the “*delay wire chambers*” used for beam position measurements during the test beam of the hadronic calorimeter (HCAL) of the CMS experiment in 2009 [30].
07/2009
- 01/2008 - Commissioning of the hadronic calorimeter of the CMS experiment: expert “on-call” for trigger and data acquisition operations during early cosmic-ray data-taking.
07/2008
- 12/2006 - Feasibility study of the search for Gauge Mediated Supersymmetry Breaking models in the prompt photon decay channel $pp \rightarrow \tilde{\chi}_1^0 \tilde{\chi}_1^0 + X \rightarrow \tilde{G} \tilde{G} \gamma \gamma + X$ [83], with simulation of the CMS detector.
12/2007
- 07/2006 - Monitoring of the high voltage system of the CMS electromagnetic calorimeter (ECAL) and data-taking shifts in the combined ECAL+HCAL test beam in 2006 [32].
11/2006
- 03/2006 - Analysis and test of stability of ECAL high voltage system [34].
11/2006
- 10/2005 - Feasibility study of the calibration of the CMS ECAL using $\pi^0 \rightarrow \gamma \gamma$ decays [33, 81, 82].
10/2006

References

PUBLICATIONS (QUOTED IN THIS DOCUMENT)

- [1] F.Santanastasio *et al.*, “Comparative characterization study of LYSO:Ce crystals for timing applications,” JINST 17, P08028 (2022), doi:10.1088/1748-0221/17/08/P08028, arXiv:2205.14890 [physics.ins-det].
I coordinated the Rome laboratory activities whose results are presented in this article.
- [2] [CMS Collaboration], “Enriching the Physics Program of the CMS Experiment via Data Scouting and Data Parking,” arXiv:2403.16134 [hep-ex].
I was the contact person for this long review paper (about 100 pages) of the CMS Collaboration.
- [3] [CMS Collaboration], “Search for high-mass resonances decaying to a jet and a Lorentz-boosted resonance in proton-proton collisions at $\sqrt{s}=13\text{TeV}$,” Phys. Lett. B 832, 137263 (2022), doi:10.1016/j.physletb.2022.137263, arXiv:2201.02140 [hep-ex].
I supervised the PhD thesis work of a student in this analysis.
- [4] [CMS Collaboration], “Search for dijet resonances using events with three jets in proton-proton collisions at $\sqrt{s} = 13 \text{ TeV}$,” Phys. Lett. B 805, 135448 (2020), arXiv:1911.03761 [hep-ex].
I was the chair of the Analysis Review Committee of this CMS publication.

- [5] [CMS Collaboration], “Search for narrow and broad dijet resonances in proton-proton collisions at $\sqrt{s} = 13$ TeV and constraints on dark matter mediators and other new particles,” JHEP 08, 130 (2018), arXiv:1806.00843 [hep-ex].
The analysis was reviewed within the “CMS Exotica jets+X working group” during the period of my convenership.
- [6] [CMS Collaboration], “Search for low mass vector resonances decaying into quark-antiquark pairs in proton-proton collisions at $\sqrt{s} = 13$ TeV,” JHEP 1801, 097 (2018), arXiv:1710.00159 [hep-ex].
The analysis was reviewed within the “CMS Exotica jets+X working group” during the period of my convenership.
- [7] [CMS Collaboration], “Search for a singly produced third-generation scalar leptoquark decaying to a τ lepton and a bottom quark in proton-proton collisions at $\sqrt{s} = 13$ TeV,” Submitted to JHEP, arXiv:1806.03472 [hep-ex].
The analysis was reviewed within the “CMS Exotica jets+X working group” during the period of my convenership.
- [8] [CMS Collaboration], “Search for a heavy right-handed W boson and a heavy neutrino in events with two same-flavor leptons and two jets at $\sqrt{s} = 13$ TeV,” JHEP 1805, 148 (2018), [arXiv:1803.11116 [hep-ex]].
The analysis was reviewed within the “CMS Exotica jets+X working group” during the period of my convenership.
- [9] [CMS Collaboration], “Search for dijet resonances in proton-proton collisions at $\sqrt{s} = 13$ TeV and constraints on dark matter and other models,” Phys. Lett. B 769, 520 (2017), Erratum: [Phys. Lett. B 772, 882 (2017)], arXiv:1611.03568 [hep-ex].
I’m co-coordinator of the analysis team that produced this CMS paper.
- [10] [CMS Collaboration]. “Search for narrow resonances decaying to dijets in proton-proton collisions at $\sqrt{s} = 13$ TeV” Phys. Rev. Lett. 116, 071801 (2016), arXiv:1512.01224 [hep-ex].
I’m co-coordinator of the analysis team that produced this CMS paper.
- [11] [CMS Collaboration], “Search for narrow resonances in dijet final states at $\sqrt{s} = 8$ TeV with the novel CMS technique of data scouting” Phys. Rev. Lett. 117, 031802 (2016), arXiv:1604.08907 [hep-ex].
I’m one of the two main authors and the editor of this CMS paper based on collision data.
- [12] [CMS Collaboration], “Search for resonances and quantum black holes using dijet mass spectra in proton-proton collisions at $\sqrt{s} = 8$ TeV” Phys. Rev. D 91, no. 5, 052009 (2015), arXiv:1501.04198 [hep-ex].
I’m the contact person and the main editor of this public CMS document. I supervised the main analyst working on this search (a PhD student from Cukurova University, Turkey).
- [13] [CMS Collaboration], “Search for narrow resonances using the dijet mass spectrum in pp collisions at $\sqrt{s} = 8$ TeV” Phys. Rev. D 87, no. 11, 114015 (2013), arXiv:1302.4794 [hep-ex].
I am the contact person of this CMS paper based on collision data. I supervised one of the two analysts working on this search (a PhD student from Cukurova University, Turkey).

- [14] [CMS Collaboration], “Search for $Z\gamma$ resonances using leptonic and hadronic final states in proton-proton collisions at $\sqrt{s} = 13$ TeV,” arXiv:1712.03143 [hep-ex].
I supervised Simone Gelli who contributed to this publication for his PhD thesis.
- [15] [CMS Collaboration], “Search for narrow resonances and quantum black holes in inclusive and b-tagged dijet mass spectra from pp collisions at $\sqrt{s} = 7$ TeV” JHEP 1301, 013 (2013) arXiv:1210.2387 [hep-ex].
I am one of two analysts of the inclusive dijet search reported in this CMS paper based on collision data.
- [16] [CMS Collaboration], “Search for massive resonances decaying into pairs of boosted bosons in semi-leptonic final states at $\sqrt{s} = 8$ TeV” JHEP 1408, 174 (2014), arXiv:1405.3447 [hep-ex].
I am one of the two contact people of this CMS analysis based on collision data, and co-editor of this CMS paper.
- [17] [CMS Collaboration], “Search for massive resonances in dijet systems containing jets tagged as W or Z boson decays in pp collisions at $\sqrt{s} = 8$ TeV” JHEP 1408, 173 (2014), arXiv:1405.1994 [hep-ex].
I’m part of the analysis group involved in this CMS search which is constituted by almost 10 people from CERN, John Hopkins University, and *L’Institut de Physique Nucleaire de Lyon* (IPNL).
- [18] [CMS Collaboration], “Search for heavy resonances in the W/Z-tagged dijet mass spectrum in pp collisions at 7 TeV” Phys. Lett. B 723, 280 (2013), arXiv:1212.1910 [hep-ex].
I’m part of the analysis group involved in this CMS search which is constituted by almost 10 people from CERN, John Hopkins University, and *L’Institut de Physique Nucleaire de Lyon* (IPNL).
- [19] [CMS Collaboration], “Search for massive WH resonances decaying into the $\ell\nu b\bar{b}$ final state at $\sqrt{s} = 8$ TeV” Eur. Phys. J. C 76, 237 (2016), arXiv:1601.06431 [hep-ex].
The analysis was reviewed within the “CMS Exotica leptons+jets working group” during the period of my convenership.
- [20] [CMS Collaboration], “Search for narrow high-mass resonances in proton-proton collisions at $\sqrt{s} = 8$ TeV decaying to a Z and a Higgs boson” Phys. Lett. B 748, 255 (2015), arXiv:1502.04994 [hep-ex].
The analysis was reviewed within the “CMS Exotica leptons+jets working group” during the period of my convenership.
- [21] [CMS Collaboration], “Search for pair production of third-generation scalar leptons and top squarks in proton-proton collisions at $\sqrt{s} = 8$ TeV” Phys. Lett. B 739, 229 (2014), arXiv:1408.0806 [hep-ex].
The analysis was reviewed within the “CMS Exotica leptons+jets working group” during the period of my convenership.
- [22] [CMS Collaboration], “Search for heavy neutrinos and W bosons with right-handed couplings in proton-proton collisions at $\sqrt{s} = 8$ TeV” Eur. Phys. J. C 74, no. 11, 3149 (2014), arXiv:1407.3683 [hep-ex].
The analysis was reviewed within the “CMS Exotica leptons+jets working group” during the period of my convenership.

- [23] [CMS Collaboration], “Search for a massive resonance decaying into a Higgs boson and a W or Z boson in hadronic final states in proton-proton collisions at $\sqrt{s} = 8$ TeV”
JHEP 1602, 145 (2016), arXiv:1506.01443 [hep-ex].
I was member of the “*Analysis Review Committee*” for the scrutiny of this analysis within the CMS collaboration.
- [24] [CMS Collaboration], “Search for exotic resonances decaying into WZ/ZZ in pp collisions at $\sqrt{s} = 7$ TeV”
JHEP 1302, 036 (2013), arXiv:1211.5779 [hep-ex].
I was member of the “*Analysis Review Committee*” for the scrutiny of the ZZ search in jet plus missing transverse energy final state within the CMS collaboration.
- [25] [CMS Collaboration], “Measurement of the $t\bar{t}$ production cross section in the all-jet final state in pp collisions at $\sqrt{s} = 7$ TeV”
JHEP 1305, 065 (2013), arXiv:1302.0508 [hep-ex].
I was member of the “*Analysis Review Committee*” for the scrutiny of this analysis within the CMS collaboration.
- [26] [CMS Collaboration], “Search for pair production of first and second generation leptons in proton-proton collisions at $\sqrt{s} = 8$ TeV”
Phys. Rev. D 93, 032004 (2016), arXiv:1509.03744 [hep-ex].
I supervised the main analyst (a PhD student from Princeton University) of the first-generation search included in this CMS paper based on collision data.
- [27] [CMS Collaboration], “Search for pair production of first- and second-generation scalar leptons in pp collisions at $\sqrt{s} = 7$ TeV”
Phys. Rev. D 86, 052013 (2012), arXiv:1207.5406 [hep-ex].
I supervised the main analyst (a PhD student from Princeton University) of the first-generation search included in this CMS paper based on collision data.
- [28] [CMS Collaboration], “Search for First Generation Scalar Leptoquarks in the $e\nu jj$ channel in pp collisions at $\sqrt{s} = 7$ TeV”
Phys. Lett. B 703, 246 (2011), arXiv:1105.5237 [hep-ex].
I am the contact person and one of the two analysts (from University of Maryland group) of this CMS paper based on collision data.
- [29] [CMS Collaboration], “Search for Pair Production of First-Generation Scalar Leptoquarks in pp Collisions at $\sqrt{s} = 7$ TeV”
Phys. Rev. Lett. 106, 201802 (2011), arXiv:1012.4031 [hep-ex].
I am one of the four analysts (from University of Maryland group) of this CMS paper based on collision data.
- [30] [CMS HCAL Collaboration], “Study of various photomultiplier tubes with muon beams and Cherenkov light produced in electron showers”
JINST 5, P06002 (2010).
The data used in this study were collected during the HCAL Test Beam 2009. I contributed to commissioning and calibration of the “*delay wire chambers*” installed along the H2 beam line (CERN, Preveessin site) for beam position measurements.
- [31] [CMS Collaboration], “Identification and Filtering of Uncharacteristic Noise in the CMS Hadron Calorimeter”
JINST 5, T03014 (2010), arXiv:0911.4881 [physics.ins-det].
I supervised a PhD student at University of Maryland working at the the development

and implementation of algorithms for the identification of anomalous, beam-induced signals in the CMS hadronic forward calorimeter at $\sqrt{s}=0.9, 2.36$ and 7 TeV.

- [32] [USCMS Collaboration and ECAL/HCAL Collaboration], “The CMS Barrel Calorimeter Response To Particle Beams From 2-Gev/C To 350-Gev/C”
Eur. Phys. J. C 60, 359 (2009), [Erratum-ibid. C 61, 353 (2009)].
I monitored the high voltage system of the CMS electromagnetic calorimeter (ECAL) and performed data-taking shifts in the combined ECAL+HCAL test beam in 2006.
- [33] [CMS Electromagnetic Calorimeter Group], “Intercalibration of the barrel electromagnetic calorimeter of the CMS experiment at start-up”
JINST 3, P10007 (2008).
I performed a feasibility study of using $\pi^0 \rightarrow \gamma\gamma$ decays for the calibration of the ECAL crystals, with full detector simulation.
- [34] [F. Santanastasio *et al.*], “High voltage system for the CMS electromagnetic calorimeter”
Nucl. Instrum. Meth. A 582, 462 (2007).
I performed part of the stability tests on the high voltage boards at CERN laboratory and most of the data analysis.
- [35] [F. Santanastasio *et al.*], “Response of microchannel plates to single particles and to electromagnetic showers,”
Nucl. Instrum. Meth. A 797, 216 (2015).
I contributed to the preparation of the experimental setup for the test-beam studies and to the data analysis.
- [36] [F. Santanastasio *et al.*], “Response of microchannel plates in ionization mode to single particles and electromagnetic showers,” Nucl. Instrum. Meth. A 879, 6 (2018)
I contributed to the data analysis.
- [37] [F. Santanastasio *et al.*], “Beam test results on the detection of single particles and electromagnetic showers with microchannel plates,” Nucl. Instrum. Meth. A 845, 471-474 (2017) I contributed to the internal article review.
- [38] [F. Santanastasio *et al.*], “A fast timing calorimetric layer using micro-channel plates in ionisation mode,” JINST 12, no.03, C03019 (2017) I contributed to the internal article review.
- [39] [F. Santanastasio *et al.*], “Micro-channel plates in ionization mode as a fast timing device for future hadron colliders,” JINST 12, no.08, C08014 (2017) I contributed to the internal article review.

PRELIMINARY RESULTS OF THE CMS COLLABORATION (QUOTED IN THIS DOCUMENT)

- [40] [CMS Collaboration], “Barrel Timing Layer crystals quality control plots”
CMS DN-24-077 (2024), [link to pdf](#)
I am the coordinator of this activity in the Rome laboratory.
- [41] [CMS Collaboration], “A MIP Timing Detector for the CMS Phase-2 Upgrade”
CMS-TDR-020 (2019) <https://cds.cern.ch/record/2667167>.
Technical design report of the MIP Timing Detector for the CMS experiment.

- [42] [CMS Collaboration], “Search for low-mass pair-produced dijet resonances using jet substructure techniques in proton-proton collisions at a center-of-mass energy of $\sqrt{s} = 13$ TeV”
CMS-PAS-EXO-16-029 (2016) [link to pdf](#).
I was chair of the “*Analysis Review Committee*” for the scrutiny of this analysis within the CMS collaboration.
- [43] [CMS Collaboration] “Data Parking and Data Scouting at the CMS Experiment” CMS DP-2012/022 (2012) [link to pdf](#).
I’m the editor of this public CMS document.
- [44] [CMS Collaboration], “Search for Narrow Resonances using the Dijet Mass Spectrum in pp Collisions at $\sqrt{s}=7$ TeV”
CMS PAS EXO-11-094 (2012) [link to pdf](#).
I am the main developer of the novel trigger, data acquisition, and analysis strategy employed in this search to recover sensitivity to new physics at dijet masses below 1 TeV.
- [45] [CMS Collaboration], “Performance of Missing Transverse Energy Reconstruction in $\sqrt{s}=900$ and 2360 GeV pp Collision Data”
CMS PAS JME-10-002 (2010) [link to pdf](#).
I worked on the section related to calorimeter MET cleaning algorithms and performances.
- [46] [CMS Collaboration], “Search for Pair Production of First Generation Scalar Leptoquarks at the CMS Experiment”
CMS PAS EXO-08-010 (2009) [link to pdf](#).
I am co-author and one of the four analysts (from University of Maryland group) of this public CMS Physics Analysis Summary based on MC simulation.

CONFERENCE PROCEEDINGS

- [47] “Exotica searches at the CMS experiment”
F.Santanastasio
Proceedings of the conference in preparation
Prepared for LVIIIth Rencontres de Moriond 2024 Electroweak Interactions and Unified Theories, La Thuile, Aosta Valley, Italy, 24-31 March 2024
- [48] “Precision Timing in the CMS MTD Barrel Timing Layer with Crystal Bars and SiPMs”
F. Santanastasio
IEEE Transactions on Nuclear Science TNS (2020), doi:10.1109/TNS.2020.3009251.
Prepared for the 15th Conference on Scintillating Materials and their Applications, Sendai, Japan, 29 September - 04 October 2019
- [49] “Search for new physics beyond the Standard Model in final states with jets and leptons+jets at CMS”
F. Santanastasio
EPJ Web Conf. 164, 07039 (2017).
Prepared for the 5th International Conference on New Frontiers in Physics, Kolymbari, Crete, 6-14 July 2016

- [50] “Search for heavy resonances decaying to bosons with the ATLAS and CMS detectors”
F.Santanastasio
Nucl. Part. Phys. Proc. 273-275, 649 (2016).
Prepared for the XXXVII International Conference on High Energy Physics, Valencia, Spain, 2-9 July 2014
- [51] “Searches for Heavy Hadronic Resonances with the ATLAS and CMS detectors at the LHC”
F. Santanastasio and C. Doglioni
PoS LHCPP2013, 015 (2013).
Prepared for the Workshop LHCpp 2013 - VI Workshop Italiano sulla Fisica p-p a LHC, INFN - Sezione di Genova, Genova, Italy, 8-10 May 2013
- [52] “Exotic Phenomena Searches at Hadron Colliders”
F.Santanastasio
arXiv:1301.2521 [hep-ex] (2013).
Prepared for the XXXII Physics in Collision 2012 conference (PIC2012), Strbske Pleso, Slovakia, 12-15 September 2012
- [53] “Exotica searches at the CMS experiment”
F.Santanastasio
Proceedings of the XLVIth Rencontres de Moriond 2011 Electroweak Interactions and Unified Theories, 125-132 (2011), edited by Etienne Aude, Jacques Dumarchez, and Jean Tran Thanh Van © The Gioi Publishers.
Prepared for XLVIth Rencontres de Moriond 2011 Electroweak Interactions and Unified Theories, La Thuile, Aosta Valley, Italy, 13-20 March 2011
- [54] “Searches With Early Data At CMS”
F.Santanastasio
PoS DIS2010, 206 (2010).
Prepared for 18th International Workshop on Deep Inelastic Scattering and Related Subjects (DIS 2010), Florence, Italy, 19-23 Apr 2010
- [55] “Prospects for Exotica Searches at ATLAS and CMS Experiments”
F.Santanastasio
Il Nuovo Cimento Vol.32 C, N.3-4 ncc9484 (2009).
Prepared for Incontri di Fisica delle Alte Energie (IFAE 2009), Bari, Italy, Apr 2009

INTERNAL NOTES OF THE CMS COLLABORATION (QUOTED IN THIS DOCUMENT)

- [56] “Search for leptoquarks with couplings to muons and produced in lepton-quark collisions using Run2 data ”
F. Santanastasio *et al.*
CMS AN-23-093 (2023)
I am one of the few authors of this internal note based on analysis of collision data. I supervised Mattia Campana (PhD student in Sapienza University of Rome) who is the main analyst.
- [57] “BTL LYSO crystal characterization for the CERN Market Survey”
F. Santanastasio *et al.*
CMS DN-2021/014 (2021)
I am the main author of the part related to the LYSO:SiPM prototype detector.

- [58] “LYSO crystal characterization activities performed in 2019”
F. Santanastasio *et al.*
CMS DN-2020/10 (2020)
I am the main author of the part related to the LYSO:SiPM prototype detector.
- [59] “Search for trijet resonances in the boosted dijet final state”
F. Santanastasio *et al.*
CMS AN-19-273 (2019)
I am one of the three authors of this internal note based on analysis of collision data.
I supervised Claudio Quaranta (PhD student in Sapienza University of Rome) who is the main analyst.
- [60] “Measurement of W-tagging data/MC scale factors using ttbar semi-leptonic events using full 2016 dataset”
F. Santanastasio *et al.*
CMS AN-2017/051 (2017)
I am one of the three authors of this internal note based on analysis of collision data.
I supervised Simone Gelli (PhD student in Sapienza University of Rome) who is the main analyst.
- [61] “Absolute residual jet energy corrections with γ +jet events at 13 TeV”
F. Santanastasio *et al.*
CMS AN-2016/344 (2016)
I am one of the three authors of this internal note based on analysis of collision data.
I supervised Federico Preiato (PhD student in Sapienza University of Rome) who is the main analyst.
- [62] “Search for narrow resonances decaying to dijets in pp collisions at $\sqrt{s} = 13$ TeV using 12.9 fb^{-1} ”
F. Santanastasio *et al.*
CMS AN-2016/202 (2016)
I am the editor of this internal note. I supervised Federico Preiato (PhD student in Sapienza University of Rome) working on the calibration of online reconstructed jets employed in the scouting analysis.
- [63] “Search for narrow resonances using the dijet mass spectrum with 2.45 fb^{-1} of proton-proton collisions at $\sqrt{s} = 13$ TeV”
F. Santanastasio *et al.*
CMS AN-2015/175 (2015)
I am the editor of this internal note presenting results on analysis of collision data.
I supervised Giulia D’Imperio (PhD student in Sapienza University of Rome) who is the main analyst.
- [64] “Search for narrow resonances using the dijet mass spectrum in proton-proton collisions at $\sqrt{s}=13$ TeV (Phys14 MC analysis)”
F. Santanastasio *et al.*
CMS AN-2015/063 (2015)
I am the editor of this internal note concerning a feasibility study of the dijet search.
I supervised Giulia D’Imperio (PhD student in Sapienza University of Rome) who is the main analyst.
- [65] “Search for dijet resonances at $\sqrt{s} = 8$ TeV with data scouting”
F. Santanastasio *et al.*
CMS AN-2014/104 (2014)

I am co-editor of this CMS analysis note based on collision data and one of the two main analysts.

- [66] “Search for a BSM resonance decaying to W vector bosons in the semileptonic final state”
F. Santanastasio *et al.*
CMS AN-2013/045 (2013)
I am the contact person of this CMS analysis based on collision data and one of the four main analysts. I supervised one of the two main analysts working on this search (a PhD student from Peking University, China). The analysis is has been published in 2014 in combination with a complementary search for ZZ resonances (EXO-12-022).
- [67] “Search for a BSM resonance decaying to Z vector bosons in the semileptonic final state”
F. Santanastasio *et al.*
CMS AN-2013/040 (2013)
I’m part of the analysis group involved in this CMS search which is constituted by about 10 people from CERN, KIT, Peking University, SPRACE, and University of Perugia. The analysis has been published in 2014 in combination with a complementary search for WW resonances (EXO-12-021).
- [68] “Search for Narrow Resonances using the Dijet Mass Spectrum in pp Collisions at $\sqrt{s}=8$ TeV with full 2012 dataset”
F. Santanastasio *et al.*
CMS AN-2012/455 (2012)
I am the contact person of this CMS analysis based on collision data. I supervised the main analyst working on this search (a PhD student from Cukurova University, Turkey). A public preliminary result has been released by the CMS collaboration on February 2013 in view of the Moriond/EW conference. The analysis is aiming for publication in 2015 in combination with a search for high mass resonances decaying to pairs of b-quarks.
- [69] “Search for Narrow Resonances using the Dijet Mass Spectrum in pp Collisions at $\sqrt{s}=8$ TeV”
F. Santanastasio *et al.*
CMS AN-2012/229 (2012)
I am the contact person of this CMS analysis based on collision data. I supervised one of the two analysts working on this search (a PhD student from Cukurova University, Turkey). This analysis has been published in 2013.
- [70] “Search for Dijet Resonances in the Dijet Mass Spectrum in pp Collisions at $\sqrt{s}=7$ TeV”
F. Santanastasio *et al.*
CMS AN-2012/012 (2012)
I am one of the two analysts (from a group of about 10 people from various institutions including CERN) of this CMS analysis based on 4.7 fb^{-1} of pp collision data collected in 2011. I am the main developer of the novel trigger, data acquisition, and analysis strategy employed in this search to recover sensitivity to new physics at dijet masses below 1 TeV. This analysis has been published in 2012 in combination with a complementary search for heavy resonances decaying in pairs of b-quarks.
- [71] “Search for heavy resonances in the W/Z-tagged dijet mass spectrum in pp collisions at 8 TeV”

- F. Santanastasio *et al.*
 CMS AN-2012/393 (2013)
 I'm part of the analysis group involved in this CMS search which is constituted by almost 10 people from CERN, John Hopkins University, and *L'Institut de Physique Nucleaire de Lyon* (IPNL). This analysis has been published in 2014.
- [72] "Search for $qW/qZ/WW/WZ/ZZ$ Resonances in the W/Z-tagged Dijet Mass Spectrum from 7 TeV pp Collisions at CMS"
 F. Santanastasio *et al.*
 CMS AN-2011/524 (2011)
 I'm part of the analysis group involved in this CMS search which is constituted by almost 10 people from CERN, John Hopkins University, and *L'Institut de Physique Nucleaire de Lyon* (IPNL). This analysis has been published in 2013.
- [73] "Search for Pair-production of First Generation Scalar Leptoquarks in pp Collisions at $\sqrt{s}=8$ TeV"
 F. Santanastasio *et al.*
 CMS AN-2013/109 (2013)
- [74] "Search for First-Generation Scalar Leptoquarks in pp Collisions at $\sqrt{s}=7$ TeV using the CMS Detector"
 F. Santanastasio *et al.*
 CMS AN-2011/492 (2011)
 I am one of the two analysts (supervising a PhD student from Princeton University) of this CMS analysis based on 4.7 fb^{-1} of pp collision data collected in 2011. This analysis has been published in 2012 in combination with a complementary second-generation leptoquark search.
- [75] "Search for Pair Production of First-Generation Scalar Leptoquarks Using Events Produced in pp Collisions at $\sqrt{s}=7$ TeV Containing One Electron, Two Jets and Large Missing Transverse Energy"
 F. Santanastasio *et al.*
 CMS AN-2010/361 (2010)
- [76] "Search for Pair Production of First Generation Leptoquarks Using Events Containing Two Electrons and Two Jets Produced in pp Collisions at $\sqrt{s}=7$ TeV"
 F. Santanastasio *et al.*
 CMS AN-2010/230 (2010)
- [77] "Search for Pair Production of First Generation Scalar Leptoquarks at the CMS Experiment"
 F. Santanastasio *et al.*
 CMS AN-2008/070 (2009)
- [78] "Results of a visual scan of high MET events in 7 TeV pp collision data"
 F. Santanastasio *et al.*
 CMS AN-2010/219 (2010)
- [79] "Commissioning of Uncorrected Missing Transverse Energy in Zero Bias and Minimum Bias Events at $\sqrt{s}=900$ GeV and 2360 GeV"
 F. Santanastasio *et al.*
 CMS AN-2010/029 (2010)

- [80] “Optimization and Performance of HF PMT Hit Cleaning Algorithms Developed Using pp Collision Data at $\sqrt{s}=0.9, 2.36$ and 7 TeV”
F. Santanastasio *et al.*
CMS DN-2010/008 (2010)
- [81] “InterCalibration of the CMS Barrel Electromagnetic Calorimeter Using Neutral Pion Decays”
F. Santanastasio *et al.*
CMS DN-2007/013 (2007)
- [82] “Study of ECAL calibration with $\pi^0 \rightarrow \gamma\gamma$ decays”
F. Santanastasio *et al.*
CMS IN-2006/050 (2006)

THESES (*LAUREA* AND *PHD*)

- [83] “Search for Supersymmetry with Gauge-Mediated Breaking using high energy photons at CMS experiment”
F. Santanastasio
PhD thesis at *Sapienza Università di Roma* (2007)
[link thesis](#)
- [84] “Calibrazione di un calorimetro elettromagnetico tramite il flusso totale di energia”
F. Santanastasio
Laurea thesis at *Sapienza Università di Roma* (2004)
[link thesis](#)