

Curriculum vitæ of Daniele del Re

General Information and summary

<i>Citizenship</i>	Italian
<i>email</i>	daniele.delre@uniroma1.it, daniele.delre@roma1.infn.it, daniele.del.re@cern.ch
<i>Spoken Languages</i>	Italian, English

Most important scientific and coordination roles in the last ten years

2019 – now	Coordinator of the INFN National Scientific Committee 1 at INFN Sezione di Roma
2018 – now	Director of the INFN/Sapienza national PhD school in accelerator physics
2020 – 2022	President of the panel for postdoc positions (assegni di ricerca) at INFN Sezione di Roma
2018 – 2022	Italy manager of the CMS MIP timing detector (~50 people)
2016 – 2019	Group leader of the CMS Rome group (~20 people)
2016 – 2019	President of the panel for postdoc positions (assegni di ricerca) at Laboratori Nazionali del Gran Sasso (LNGS)
2017 – 2018	Member of “Commissione Ricerca d’Ateneo”, Sapienza
2014 – 2016	Convener of the CMS Exotica analysis working group (hundreds of people)
2016	Member of FY 2017 DOE/HEP Energy Frontier panel
2013 – 2014	Convener of the CMS Long-Lived Exotica analysis working subgroup (~50 people)
2010 – 2012	Convener of the CMS JetMET object working group (~100 people)

Detailed information

Education

- 2000 – 2002 **Ph. D. in Physics**, Università Sapienza (Roma), with a dissertation in Particle Physics: “Measurement of $|V_{ub}|$ studying inclusive semileptonic decays on the recoil of fully reconstructed B’s with the BaBar experiment” [p9,o2].
- 1994 – 1999 **Laurea in Fisica** Università Sapienza (Roma), 110/110 cum laude, with a thesis in Particle Physics: “La Camera a Deriva di BaBar: analisi in linea dei parametri di funzionamento” [o1].

Appointments

- 03/2022–now **Professore Ordinario**, Università Sapienza di Roma;
- 10/2015–02/2022 **Professore Associato**, Università Sapienza di Roma;
- 07/2015–08/2016 **Scientific Associate at Cern**;
- 03/2006–09/2015 **Ricercatore universitario**, Università Sapienza di Roma; confermato since 03/2009;
- 07/2011–12/2011
08/2008–01/2009 **Cern - INFN fellowship**;
- 12/2005–03/2006 **Ricercatore INFN**, Sezione di Napoli;
- 02/2003–12/2005 **PostGraduate Researcher**, step VI, Physics Department, **San Diego**, California;

Abilitazioni

- 04/2017 **Abilitazione scientifica Nazionale tornata 2016, settore 02/A1 ordinario**
- 11/2014 **Abilitazione scientifica Nazionale tornata 2013, settore 02/A1 associato**
- 01/2014 **Abilitazione scientifica Nazionale tornata 2012, settore 02/A1 associato**

Society and Scientific Memberships, Awards, and Honors

- 2020 **Riconoscimento eccellente insegnamento universitario**. I have been one of the three most voted teachers in the Physics Department (<5%)
- 2018 **Riconoscimento eccellente insegnamento universitario**. I have been one of the three most voted teachers in the whole Faculty of Science (out of ~500 teachers, <1%)
- 2005 - now **CERN** (European Laboratory for Particle Physics) user/associate
- 1998 - 2008 **SLAC** (Stanford Linear Accelerator Center) user/associate
- 1996 **“Enrico Persico” Grant, Accademia dei Lincei**

Funding Information (last 10 years)

06/2019-now	coordinator of the INFN National Scientific Committee 1 in Roma, INFN specific grant to support the needs of the different research groups: ~130K euro/year (excluding salaries)
10/2020	progetto di ricerca d'Ateneo, "Study and monitoring of the Covid-19 epidemics using mortality data and calls to the 118 emergency medical services", <u>Principal investigator</u>, Università "Sapienza" Rome: 13K euro
10/2018	progetto di ricerca d'Ateneo, "Precision timing for the upgrade of the CMS experiment", <u>Principal investigator</u>, Università "Sapienza" Rome: 15K euro
09/2018-05/2022	Italy manager of the MIP timing detector, INFN funding for 2018-2024: 3.6M euro
11/2016-07/2019	group leader of the CMS Rome group, INFN specific grant to support the research needs: ~200K euro/year (excluding salaries)
10/2016	progetto di ricerca d'Ateneo, "Precision timing in high energy physics", <u>Principal investigator</u>, Università "Sapienza" Rome: 15K euro
10/2014	progetto di ricerca d'Ateneo, "Precision timing in high energy physics", <u>Principal investigator</u>, Università "Sapienza" Rome: 50K euro
2014 - 2016	CMS Exotica WG coordination, INFN specific grant to support my role of coordinator: 28K euro
2013 - 2014	CMS Long-Lived Exotica sub-WG coordination, INFN specific grant to support my role of coordinator: 14K euro
2010 - 2012	CMS Jet/MET WG coordination, INFN specific grant to support my role of coordinator: 42K euro

Scientific and Academic Activities

Summary and timeline

CMS

- 2014 – now study of **fast-timing detectors for the upgrade of the CMS detector** for the so-called Phase2, which corresponds to the LHC luminosity increase foreseen in 2028 [c26, pr6]. I have obtained university grants (Fondi d'Ateneo), corresponding to a total of 80K euro, to develop prototypes of fast timing detectors. This activity produced a few publications, e.g. [p37, p38]. The CMS Collaboration approved the construction of a new detector to provide MIP time-tagging [o15, o20] and I have been nominated as the Italy manager of the CMS of this new MIP timing detector (MTD). The project is now in a very advanced state: the final sensor/ASIC layout is being tested at beam tests [p44] and the procurement of the sensors is now starting. I have presented these results at conferences [c31, pr9]. I have also performed studies on the possible use of this detector to identify new physics with displaced photon signatures at HL-LHC [o16].
- 2018 – now search for new physics in **signatures with boosted jets**. This analysis

identifies **resonances decaying to three jets**, predicted by several theories beyond the Standard Model. The jets are reconstructed in a boosted scenario, where two jets are merged in a single object and substructure variables are used [cms29]. This analysis has been recently published [p45].

- 2006 – 2016 search for new physics in final states with **photons in two topologies: photon and MET** in the **Gauge-mediated Supersymmetry Breaking** scenario [c20, c21, c25] and [p26, p42] and **diphotons** [cms22, p34].
- 2010 – 2014 analysis for the search of the **Higgs boson** decaying in **two photons and ZZ/WW** (two leptons, two jets) final states [cs13, cs14, c22, c23, c24]. These studies produced several papers [p21, p22, p23, p23bis, p32] and contributed to the discovery of a new boson at 125 GeV [p24, p26bis]. I have also collaborated with theorists for the interpretation of the Higgs results [p25].
- 2006 – 2014 **ECAL energy and time calibration** using reconstructed π^0 mesons and energetic photons [cms1, cms3, cms6, cms21, p14bis].
- 2010 – 2012 **studies of jet properties and composition** for the discrimination between quark and gluon jets and for the rejection of pile-up jet events [p21, cms15].
- 2007 – 2012 **jet energy calibration** using γ +jet events and studies on alternative jet reconstruction methods [c19], summarized in a paper [p19].
- 2006 – now installation, quality control, and maintenance of the **high voltage system of CMS ECAL** [p13, p14bis].
- 2008 – 2009 evaluation of the performance of the **time measurement of the ECAL** using beam-splash and cosmic events collected by CMS. This analysis produced a JINST paper [p17].
- 2006 – 2007 CMS ECAL **H2 and H4 testbeams** (CERN) and study of the energy calibration using high energy electrons and π^0 from **charge-exchange** ($\pi p \rightarrow \pi^0 n$) events. The results are reported in two publications [p12, p14].

BaBar

- 2001 – 2006 measurement of the **CKM parameter V_{ub}** using charmless semileptonic decays of the B meson [c16, c17]. The results of inclusive and exclusive studies have been published on two PRL journal papers, representing the first publications at the B factories with these techniques [p9, p10].
- 2005 – 2006 study of the **$B \rightarrow D^{(*)}D_s(J)$** decays and measurement of the absolute branching ratios of the $D_s J(2460)$ and D_s^+ mesons [c18]. This analysis produced a PRD paper [p11].
- 2003 development of the so-called Computing Model 2, the new and optimized tool to analyze the data of the BaBar experiment.
- 2003 feasibility studies on semileptonic decays to evaluate the potential of an asymmetric B factory at high luminosity [pr0].
- 2001 – 2002 author of the so-called **semi-exclusive reconstruction** to create samples of hadronic B decays reconstructed with high efficiency. This technique has been used by several BaBar analyses, which produced more than 15 journal publications.
- 2000 – 2001 high precision measurement of the **mixing parameter Δm_d** of the neutral B mesons using dilepton events, published on PRL [p5].

- 2000 – 2001 work on K mesons particle identification [p4].
- 1998 – 2002 implementation and contact person of the **online fast-monitoring of the drift chamber** of the BaBar experiment. The result of these activities is reported in a NIM paper [p1].
- 2002 quality control and installation of the new RPC detectors and repair of the Front End electronics for the muon detector (IFR) [p2,p3].

COVID-19 related studies

- 2020 – now study and monitoring of the **Covid-19 epidemics using mortality data and calls to the 118 emergency medical services**. This activity has been funded with a university grant (Fondi d'Ateneo) corresponding to 13K euro. A research collaboration agreement with AREU (Azienda Regionale Emergenza Urgenza of Lombardy) has been signed on May 2021 [o17]. Preliminary results are available on medRxiv [o18] and two publications are in preparation.

Coordination

- 06/2019-now **coordinator of the INFN National Scientific Committee 1 in Roma**. The INFN research activities are divided into 5 different committees (CSN). The CSN 1 studies fundamental interactions of matter in experiments using particle accelerators. Thanks to my broad experience on this topic, I have been elected by the community as the coordinator of all CNS1 activities in Rome, involving 10 different experiments, about 100 people, and a total budget of about 4M euro.
- 09/2018-05/2022 **Italy manager of the CMS MIP timing detector (MTD)**. The construction of this new detector has been approved by the CMS collaboration and Italy will fund it with 3.6M euro. Six INFN institutes are contributing (Genova, Milano, Padova, Roma, Trieste, and Torino). I have been serving as the coordinator of the different Italian activities, regarding the design of the mechanics, geometry, and electronics of the detector and the characterization of the sensors.
- 11/2016-07/2019 **group leader of the CMS Rome group**. The Rome group is active in CMS since more than 20 years. It has been the main actor in the construction of the electromagnetic calorimeter and is constantly involved in its maintenance and operation. The members of the group are expert in photon, electron, and jet reconstruction and leaders in CMS as coordinators of several physics and detector groups. The group counts 13 members with a permanent position in Università Sapienza of Rome and INFN Rome and, in average, about 2 postdocs, 3 PhD students and 3 undergraduate students. The total budget of the group is about 200K euro per year (excluding all salaries: faculty, postdocs, and PhD students). During my coordination the group continued, along with other things, its involvement in Higgs analysis [p41] and initiated important new activities, e.g. the design and R&D for high precision timing measurements for the phase2 CMS detector (both for the em calorimeter and the MTD), the analyses related to the measurement of the W mass [p43], and the analysis of the B meson decays using parked samples.

- 10/2016-now **member of the EXO/B2G Pub Com Board** of CMS. This group plays a crucial role in maintaining the high standard of CMS publications related to search for new physics. I have participated to the final editing of about 30 papers.
- 09/2014 –
08/2016 **convener of the CMS Exotica** analysis working group. This is the largest physics group in the CMS experiment and counts hundreds of members. The topics covered by this group include all possible non-SUSY new physics searches done in the experiment. I have coordinated more than 70 analyses. This group has produced more than 170 papers up to now in total and about 30 papers and almost 50 preliminary results during my convenership (e.g. [p35, p36, p37bis], full list in [o13]). Thanks to my experience I have been invited to convene the Exotics session at the LHCP conference in 2015 [o12] and to give several talks on the status of these searches: at the LHC at the Società Italiana di Fisica (SIF) meeting [c27], to the Moriond QCD conference [c28], to the ICHEP conference with a plenary talk [c29], and to the International Conference on High Energy Physics [c30]. I have also organized two CMS exotica workshops [o8, o11], attended by about 80 people.
- 01/2013 –
10/2014 **convener of the CMS** analysis working group that studies **Long-Lived Exotic Particles**. This group has about 50 members and during my convenership produced 4 papers [p29, p30, p31, p33].
- 05/2012 –
05/2014 **convener of the “Jets” subgroup** of the LHC Higgs Cross Section Working Group [o7, p27].
- 02/2010 –
12/2012 **convener of the CMS JetMET working group** that is responsible for the reconstruction and commissioning of Jets and missing transverse energy (MET). These physics objects are used by almost all CMS analyses. This group had about 100 members and produced two published papers [p18, p19] and several CMS public notes. The calibration and the commissioning of jets and MET have been crucial for the earliest CMS searches for new physics, e.g. [p18bis, p20bis, p22bis].
- 10/2008 –
12/2010 **member of the Editorial Board** of the **CMS electromagnetic calorimeter (ECAL)**, the committee which examines the ECAL papers.
- 08/2004 –
12/2005 **convener of the BaBar** analysis working group that studies the **exclusive hadronic B meson decays in final states with charm** ($B \rightarrow DX$). The group had about 70 physicists. During my convenership, it produced about 20 journal publications, e.g. [p10bis].
- 10/2003 –
10/2005 **coordinator of the Recoil Analysis Forum of the BaBar experiment**. The goal of this forum was the discussion and the coordination of strategies and tool implementations that are in common among the analyses performed on the recoil of reconstructed B mesons.

Organization of international conferences and workshops

- 12/2021 **organizer of the Bruno Touschek Memorial Symposium** [o19].
- 07/2015 **chair and organizer of the EXOTICS sessions at the LHCP international conference**, held in Saint Petersburg [o12]. This is one of the most important Summer conferences in HEP. The sessions had in total 16 contributions and about 50 people attended it.
- 11/2015 organizer of the 2015 “**CMS Exotica workshop**”, Venezia [o11].
- 11/2014 organizer of the 2014 “**CMS Exotica workshop**”, Madrid [o8].

- 03/2005 member of the international organizing committee of “**CKM Workshop 2005**” held in San Diego, California [o6].
- 12/2003 organizer of the “**Vxb workshop**” held at Slac in December 2003 [o3].

Commissions of trust

- 2021 – now referee for ERC program (starting and synergy grants)
- 2021 – now INFN referee for the experiment SND
- 2020 – now referee for the INFN activity on R&D for circular colliders (RD_FCC) and muon colliders (RD_MUCOL)
- 2020 – 2022 president of panel for postdoc positions (assegni di ricerca) at Roma1
- 2019 – 2020 referee for the INFN activity on R&D for future accelerators (RD_FA)
- 2016 – 2019 president of panel for postdoc positions (assegni di ricerca) at LNGS
- 2017 – 2018 member of “Commissione Ricerca d’Ateneo, Sapienza”
- 2016 member of FY 2017 DOE/HEP Energy Frontier panel
- 2016 – now referee for Research Grants Council (RCG) of Hong Kong: both for General Research Fund and Areas of Excellence
- 2016 – now referee for Swiss National Science Foundation Grants
- 2016 referee for programma Vinci, Università Italo-Francese

Reviewing activities

- 2014 – now referee of Journal of High Energy Physics
- 2010 – 2013 referee of Physics Letters B
- 2009 – now chair/member of several internal review committees of CMS analyses on very different topics. Some examples are [p16, p28, p39, p40].
- 2004 – 2006 chair of the internal review committees of two BaBar analyses [p6, p7, p8].

Academic Activities

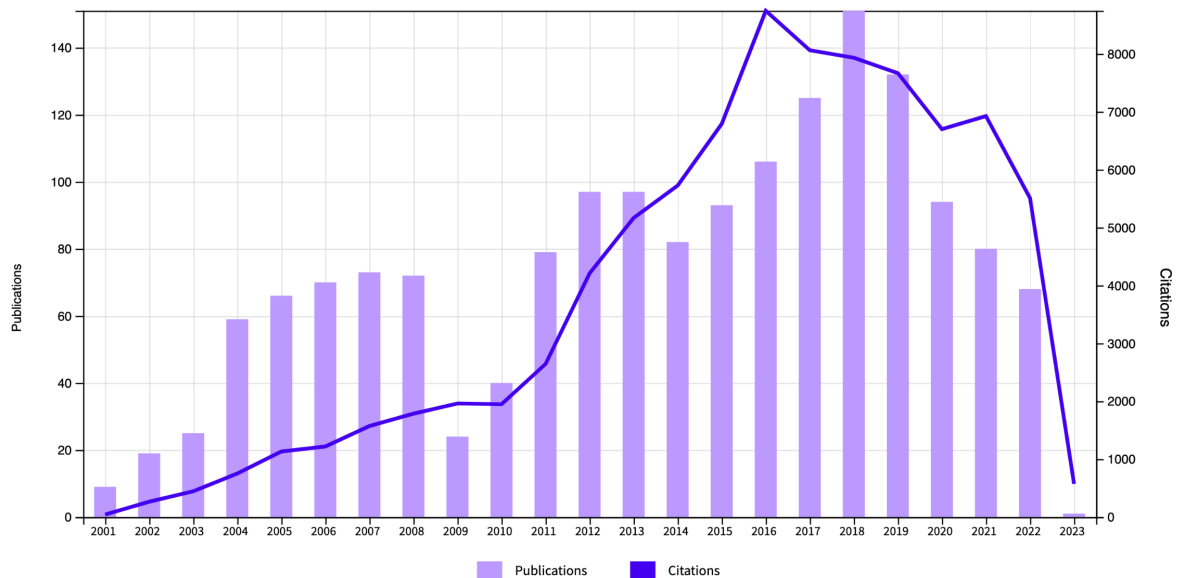
- 2023-now president of the “commissione manutenzione” of physics department, Sapienza
- 2018-now director of the national PhD school in accelerator physics
- 2018-2022 member of the “commissione placement - Mondo del lavoro” of physics department, Sapienza
- 2020-2021 member of the “commissione per le chiamate dirette” of physics department, Sapienza
- 2018-2020 member of the “commissione per la qualità della ricerca e terza missione” of physics department, Sapienza
- 06/2011–04/2013 member of “Giunta di Facoltà, SMFN”
- 01/2010–03/2011 editor of the Scientific Report of Physics Department, Sapienza, years 2007-2009 [o9]
- 2007 – 2010 responsible for the Physics Department web page with national and international academic job offers [o10]

Summary of Scientific Achievements (last update 13/04/2023)

The most up-to-date full list of papers [can be found at Inspire: https://inspirehep.net/authors/1023425?ui-citation-summary=true](https://inspirehep.net/authors/1023425?ui-citation-summary=true)

<i>year of first publication</i>	2001 (*)
<i>year of PhD</i>	2003
<i>total number of publications on international peer-reviewed journals</i>	1662
<i>total number of citations</i>	87747
<i>h factor</i>	135

(*) all numbers are extracted from ISI database



Invited talks

- c31 *Aug 21* PANIC2021 22nd Particles and Nuclei Interaction Conference, Lisboa, Parallel talk, "Precision Timing with the CMS MTD Barrel Timing Layer for HL-LHC"
- c30 *Jun 19* XLVII International Meeting on Fundamental Physics, Aranjuez, Madrid, Plenary talk, "CMS+ATLAS: *experimental BSM review*"
- c29 *Jul 18* 39th International Conference on High Energy Physics (ICHEP 2018), Seoul Corea, Plenary talk, "*Exotics at the LHC*"
- c28 *Mar 17* LIIth Rencontres de Moriond, QCD and High Energy Interactions. "*Exotica in CMS*"
- c27 *Sep 16* 102° Congresso Nazionale, Società Italiana di Fisica (SIF), Padova, relazione su invito "*Ricerche di fisica oltre il Modello Standard al LHC.*"
- c26 *May 14* 16th International conference on calorimetry in high energy physics (CALOR), Giessen, "*Timing Performance of the CMS Electromagnetic Calorimeter and Prospects for the Future*"

- c25 May 13 Sixth Italian workshop on p-p Physics at LHC, Genova *"Particelle esotiche a vita media lunga"*
- c24 Feb 13 Lake Louise Winter Institute, 60 minutes invited talk on *"Higgs results from CMS"*
- c23 Jul 11 EPS-HEP 2011, International Europhysics Conference on High Energy Physics. Invited talk: *"A Search For The Higgs Boson In The Channel $H \rightarrow \gamma\gamma$ With The CMS Detector"*
- c22 Sep 11 5th International Workshop "From Parity Violation to Hadronic Structure and more...", held in Rome. Invited talk *"News from the LHC"*.
- c21 Mar 08 XLIIIth Rencontres de Moriond, QCD and High Energy Interactions. *"Searches for GMSB and for high ET Dilepton pair events at the LHC"*
- c20 Feb 08 Fifth Italian workshop on p-p Physics at LHC, Perugia *"Beyond the Standard Model and Exotics"*
- c19 Feb 08 Workshop on Montecarlo, physics and simulation at the LHC, Frascati *"Jet energy corrections and calibration at CMS"*
- c18 Aug 06 33rd International Conference on High Energy Physics (ICHEP 2006), Moscow, Russia *"Study of recently observed mesonic charm states with the BaBar experiment and possible observation of new states"*
- c17 Aug 04 32nd International Conference on High Energy Physics (ICHEP 2004), Beijing, China *"Vub Measurements with the BaBar Detector"*
- c16 Mar 03 XXXVIIIth Rencontres de Moriond, ElectroWeak Interactions and Unified Theories. *"Vub, Vcb and mixing from Babar"*

Books

- b1 Oct 18 D. del Re, M. Diemoz, *"Fisica delle particelle"*, series *"Lezioni di Fisica"* of *"Corriere della Sera"* [o21]

Lectures at schools, educational seminars and outreach

- 110 Apr 23 Seminario a collegio universitario "Villa Nazareth", *"Dalla fisica nucleare all'atomo come fonte di energia"*
- 19 Nov 19 Progetto Lauree Scientifiche, seminario ai licei matematici, *"Risonanze in fisica classica e in fisica delle particelle"*
- 18 Set 16 Notte Europea dei ricercatori *"Introduzione alla Fisica delle particelle"*
- 17 Feb 16 Progetto Lab2go, *"La fisica tra simulazione e sperimentazione"*
- 16 Oct 15 Incontri di Fisica, Frascati, *"Searches for New Heavy Resonances at the LHC"*
- 15 Apr 15 Asimmetrie INFN #18: *Cercasi Susy disperatamente: Lhc alla ricerca della supersimmetria* [o14]
- 14 Feb 15 Scuola Normale di Pisa, Lecture for PhD students, *"Searches for New Heavy Resonances at the LHC"*

- 13 Feb 15 International Masterclass on Particle Physics, “*Measuring particles at LHC*”
- 12 Feb 14 International Masterclass on Particle Physics, “*Measuring particles at LHC*”
- 11 Jun 07 “Seminars on Software for Nuclear, Subnuclear and Applied Physics”, Alghero “*Software and data analysis in High Energy Physics experiments*”

Student Supervision and tutoring

PhD	Student	Title	Now
2003-2006	A. D’Orazio (tutoring)	“ <i>Measurement of the CKM matrix element V_{ub} studying Exclusive Semileptonic Decays on the Recoil of Fully Reconstructed B’s with the BaBar detector</i> ”	Head of INFN National Head of EU/International Projects Development Sector
2004-2007	F. Santanastasio (co-supervisor)	“ <i>Search for Supersymmetry Gauge-Mediated Breaking using high energy photons at CMS experiment</i> ”	Associate Prof. Physics Sapienza
2007-2010	D. Franci (co-supervisor)	“ <i>Search for SUSY events with off-time photons</i> ”	ARPA Lazio
2008-2011	F. Pandolfi (supervisor)	“ <i>Search for a Standard Model Higgs Boson in the $H \rightarrow ZZ \rightarrow 4lq$ Channel at CMS</i> ”	INFN Researcher
2009-2012	M. Grassi (co-supervisor)	“ <i>Measurement of the Standard Model Higgs Boson Couplings by Means of an Exclusive Analysis of its Diphoton Decay Channel</i> ”	RTD-b Padova
2012-2014	L. Soffi (co-supervisor)	“ <i>Search for new physics in the final states with two photons</i> ”	INFN Researcher
2012-2015	L. Perniè (supervisor)	“ <i>Measurement of the Z boson pair-production cross section in proton-proton collisions at 7 and 8 TeV, and ECAL timing studies for the phase-2 upgrade of the CMS experiment</i> ”	Lead data scientist at FICO
2014-2017	S. Gelli (co-supervisor)	“ <i>Search for new particles decaying into $Z\gamma/W\gamma$ final states in proton-proton collisions at $\sqrt{s} = 13$ TeV</i> ”	Senior data scientist Achilles Information
2018-2022	C. Quaranta (co-supervisor)	“ <i>Search for trijet resonances in final states with a boosted-dijet resonance in proton-proton collisions at $\sqrt{s} = 13$ TeV</i> ”	Assegno di ricerca, INFN Roma1
Undergrad (Laurea Specialistica)			
2007	D. Franci (co-supervisor)	“ <i>Algoritmi di identificazione di fotoni e pioni neutri con il calorimetro elettromagnetico di CMS</i> ”	
2011	C. Fanelli (co-	“ <i>Exclusive search for a Fermiophobic Higgs at CMS</i> ”	

	supervisor)	
2011	L. Soffi (co-supervisor)	<i>“Ricerca di supersimmetria in eventi con grande energia mancante e fotoni energetici ad LHC”</i>
2011	L. Perniè (supervisor)	<i>“Ricerca del bosone di Higgs nel canale $H \rightarrow WW \rightarrow l\nu_{ll}$ all'esperimento CMS”</i>
2012	C. Pistone (supervisor)	<i>“Study of the timing reconstruction with the CMS Electromagnetic Calorimeter”</i>
2013	F. Gizzarelli (supervisor)	<i>“Ricerca di nuove risonanze a vita media lunga che decadono in Jet ad LHC”</i>
2017	C. Quaranta (co-supervisor)	<i>“Studio della risoluzione temporale dei cristalli di tungstato di piombo del calorimetro elettromagnetico di CMS.”</i>
2020	M. Carillo (co-supervisor)	<i>“Analisi e simulazione di un fotoiniettore ibrido in banda C criogenica”</i>
2020	A. Luketina (co-supervisor)	<i>“Study of the associated production of a W boson and heavy flavour quarks from gluon splitting in proton-proton collisions at $\sqrt{s} = 13$ TeV”</i>

I have been member of juries for the discussion of PhD in physics: ULB in Brussels (2015 and 2016), Milano Bicocca (2015) and CEA Paris-Saclay (2018), Milano (2023)

I have also supervised about 20 Lauree triennali.

Teaching Experience

AA 22-23 && 21-22	<p>a) Course in “Fisica Nucleare e Subnucleare” III anno, “Sapienza” Physics Department (6 CFU). 80-100 students</p> <p>b) Course in “Meccanica” I anno, “Sapienza” Physics Department (12 CFU). 100-120 students</p>
AA 20-21 && 19-20 && 18-19 && 17-18 && 16-17	<p>a) Course in “Meccanica” I anno, “Sapienza” Physics Department (12 CFU). 80-100 students</p> <p>b) Lessons to high school students for the preparation to the Physics Olympics</p>
AA 15-16	<i>Sabbatical leave due to research activity and CMS convenership at CERN</i>
AA 14-15 && 13-14 && 12-13	<p>a) Course in “Laboratorio di Meccanica” I anno, “Sapienza” Physics Department (12 CFU). 60-70 students</p> <p>b) Teaching assistant for a course in Particle Physics Lab (Prof. F. Ferroni, Dott. S. Veneziano), “Sapienza” Physics Department.</p> <p>c) Lessons to high school students for the preparation to the Physics Olympics</p>
AA 11-12	<p>a) Course in “Fisica” I anno, “Sapienza”, Natural Science Department (6 CFU). ~50 students</p> <p>b) Teaching assistant for a course in Particle Physics Lab (Prof. F. Ferroni), “Sapienza” Physics Department.</p>
AA 10-11 && 09-10	<p>a) Course in “Fisica” I anno, “Sapienza”, Natural Science Department (6 CFU). ~50 students</p> <p>b) Teaching assistant for a course in “Meccanica” (Prof. A. Pelissetto), “Sapienza” Physics Department.</p> <p>c) Teaching assistant for a course in Particle Physics Lab (Prof. F. Ferroni), “Sapienza” Physics Department.</p>
AA 08-09	<p>a) Course in “Fisica” I anno, “Sapienza”, Natural Science Department (6 CFU). ~50 students</p>

b) Course in “Fisica Applicata” I anno, ”Sapienza”, Scienze della Sicurezza e Protezione (5 CFU). 5 students

c) Teaching assistant for a course in “Meccanica” (Prof. A. Pelissetto), “Sapienza” Physics Department.

AA 07-08 Teaching assistant for a course in “Meccanica” (Prof. A. Pelissetto), “Sapienza” Physics Department.

AA 05-06 Teaching assistant for a course in “Elettromagnetismo” (Prof. Lacava, Mariani, Trevese), “Sapienza” Physics Department.

AA 01-02 Teaching assistant for a course in “Fisica” (Prof. C. Luci), “Sapienza” Pharmacy Department.

Evaluation of the teaching by students (OPIS, last 9 years)

Name	Year	Question & answer												
		Il docente stimola / motiva l'interesse verso la disciplina?				Il docente espone gli argomenti in modo chiaro?				Sono complessivamente soddisfatto di come è svolto questo insegnamento?				
		Decisamente sì	Più sì che no	Più no che sì	Decisamente no	Decisamente sì	Più sì che no	Più no che sì	Decisamente no	Decisamente sì	Più sì che no	Più no che sì	Decisamente no	
Meccanica (112 answers)	21-22	D. del Re	82.1%	17.0%	0.9%	0.0%	83.9%	17.0%	0%	0%	76.8%	23.2%	0%	0%
		media CdS	41.8%	42.8%	11.9%	3.5%	40.0%	43.9%	12.7%	3.3%	36.3%	48.4%	11.9%	3.4%
FNSN (69 answers)	21-22	D. del Re	56.5%	34.8%	8.7%	0.0%	60.9%	33.3%	5.8%	0%	43.5%	50.7%	5.8%	0%
		media CdS	41.8%	42.8%	11.9%	3.5%	40.0%	43.9%	12.7%	3.3%	36.3%	48.4%	11.9%	3.4%
Meccanica (96 answers)	20-21	D. del Re	70.5%	26.3%	2.1%	1.0%	70.5%	28.4%	1.0%	0%	60.0%	40.0%	0%	0%
		media CdS	40.5%	41.9%	13.2%	4.4%	35.5%	43.5%	15.8%	5.1%	33.5%	47.3%	14.4%	4.8%
Meccanica (88 answers)	19-20	D. del Re	84.3%	13.5%	2.2%	0%	88.8%	11.2%	0%	0%	80.9%	16.9%	2.2%	0%
		media CdS	42.2%	37.2%	15.1%	5.5%	37.1%	38.1%	17.9%	6.9%	35.6%	43.0%	15.6%	5.7%
Meccanica (78 answers)	18-19	D. del Re	90.3%	9.7%	0%	0%	90.3%	9.7%	0%	0%	86.1%	13.9%	0%	0%
		media CdS	40.8%	40.5%	13.1%	5.5%	34.0%	42.6%	16.7%	6.8%	33.5%	46.2%	14.5%	5.8%
Meccanica (70 answers)	17-18	D. del Re	92.4%	7.6%	0%	0%	93.9%	6.1%	0%	0%	83.3%	16.7%	0%	0%
		media CdS	40.9%	39.3%	14.0%	5.8%	35.5%	41.4%	16.6%	6.5%	33.8%	45.4%	14.9%	6.0%
Meccanica (88 answers)	16-17	D. del Re	84.3%	13.5%	2.2%	0%	88.8%	11.2%	0%	0%	80.9%	16.9%	2.2%	0%
		media CdS	42.2%	37.2%	15.1%	5.5%	37.1%	38.1%	17.9%	6.9%	35.6%	43.0%	15.6%	5.7%
Laboratorio di Meccanica (59 answers)	14-15	D. del Re	67.8%	32.2%	0%	0%	66.1%	36.9%	0%	0%	71.2%	28.8%	0%	0%
		media CdS	39.4%	38.9%	16.0%	5.7%	36.1%	39.3%	17.0%	7.6%	34.1%	44.6%	15.0%	6.4%
Laboratorio di Meccanica (46 answers)	13-14	D. del Re	56.5%	39.1%	4.3%	0%	52.2%	39.1%	8.7%	0%	50.0%	41.3%	8.7%	0%
		media CdS	38.1%	40.1%	15.8%	5.9%	36.2%	39.0%	17.2%	7.6%	33.1%	46.6%	14.5%	5.9%
Laboratorio di Meccanica (37 answers)	12-13	D. del Re	64.9%	35.1%	0%	0%	70.3%	29.7%	0%	0%	Domanda non presente			
		media CdS	37.4%	40.3%	-	-	37.9%	37.1%	-	-				

Additional information

Details of research activity

I am an experimental high energy physicist. Since 2006 I am a member of CMS, one of the four experiments running at the LHC. I work on detector calibration and on physics analysis, searching for physics beyond the Standard Model and studying [the](#) Higgs boson. From 1998 to 2007 I have been a member of BaBar, the experiment at the B-factory PEP-II at [SLAC \(Stanford, USA\)](#). My activity concentrated on the measurement of the Standard Model parameters and on the study of the B decays.

My **work in CMS** has been mainly devoted to five topics:

Studies for fast-timing detector for the CMS upgrade

Future high-energy colliders will provide instantaneous luminosities exceeding $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ and the high rate of interactions and the large number of simultaneous collisions in each interaction will be a major challenge. During the high-luminosity operation of the LHC, about 140 concurrent interactions per-bunch collision are expected. While one collision contains the rare signatures of interest for discoveries or precision measurements, the contribution of the remaining interactions must be reduced. About one third of the particle flux originating from high energy hadron collisions is detected as photons. I have worked on the development of a detector element based on micro-channel plates (MCP) to sample the ionizing component of electromagnetic showers. The high resolution of MCPs exceeds by far the performance of all previously used detector elements for calorimetry measurements, which could improve significantly in the event reconstruction of events at high luminosity. I have also worked on simulation studies, describing how timing information with a precision of a few tens of picoseconds can improve the reconstruction of the physics events under challenging conditions. I have demonstrated that such a detector can significantly reduce the impact of simultaneous interactions in reconstruction and identification of photons, jets, and missing transverse energy [c26, cms23]. To perform these studies, I obtained three university grants (Fondi d'Ateneo) corresponding to 50K, 15K and 15K euro. This activity produced several publications e.g. [p37,p38].

The CMS Collaboration is now pursuing two technologies to also provide MIP time-tagging for the HL-LHC detector upgrade: small scintillating crystals read out by silicon photomultipliers for lower radiation areas and silicon low gain avalanche detectors for higher radiation areas. A hermetic detector design, suitable for integration in the CMS barrel on the outer tracker support tube, and in the CMS endcaps in front of the high granularity calorimeter is proposed. The Technical Proposal and the Technical Design Report of this new detector (MTD), which describe in detail the design and the expected improvements in particle reconstruction, are here [o15, o20]. The R&D on this new detector is almost finished and we are now in a phase where prototypes of the detector in a close-to-final design are being tested [p44]. The procurement of the sensors for the barrel sector of the detector is also starting. Thanks to my activity in this area of research [cms25,cms26,cms27], I have been nominated as the Italy manager of this new MIP timing detector. I have recently presented these results at conferences [c31, pr9]. I have also performed studies on the possible use of this detector to identify new physics with displaced photon signatures at HL-LHC [o16].

Analysis of beyond the Standard Model physics signatures in photons and jets

I have been working on search of new physics in the Gauge-mediated Supersymmetry Breaking scenario, where the lightest supersymmetric particle is the gravitino, which is a good candidate for Dark Matter. I studied the case where the second lightest supersymmetric

particle is the neutralino, which decays into a gravitino and a photon. The signature is represented by a high momentum photon and large missing transverse energy [cms4, cms10, cms28]. The presence of these particles is determined by using the timing measured by the electromagnetic calorimeter of CMS. This is because the photon from the neutralino is not produced at the beamspot and, in average, hits the calorimeter with $O(1 \text{ ns})$ delay. A paper describing the result of these studies is public [p26]. Because of my experience in this kind of signatures in January 2013 I have been appointed as the convener of the CMS Exotica Long-Lived Particles analysis subgroup. Later on, in September 2014, I have been appointed as the convener of the CMS Exotica analysis group. This is the largest physics group in CMS, with hundreds of members. The topics covered by this group include all possible non-SUSY new physics searches done in the experiment. Just to give a few examples, all high mass ($>1\text{TeV}$) resonance searches in dijets, diphotons, dileptons and all dark matter mono-object searches (monojet, monophoton) are performed in this group. This group produced more than 110 papers in total and about 30 papers and almost 50 preliminary results during my convenership (e.g. [p35, p36, p37bis], full list in [o13]). Thanks to my experience I have been invited to convene the Exotics session at the LHCP conference in 2015 [o12], to give a talk on the status of these searches at the LHC at the Società Italiana di Fisica (SIF) meeting [c27], to the Moriond QCD conference [c28], to the ICHEP conference with a plenary talk [c29], and to the International Conference on High Energy Physics [c30]. I have also organized two CMS Exotica workshops [o8, o11], attended by about 80 people. Recently, I am also working on searches for new physics in signatures with boosted jets. This analysis identifies resonances decaying to three jets, predicted by several theories beyond the Standard Model. The three jets are reconstructed in a boosted scenario, where two jets are merged in a single object and substructure variables are used to discriminate from the large QCD background [cms29]. The analysis has been recently published [p45].

Analysis of the Higgs boson

I have been working on the search of the Higgs boson in several decay channels. The study of the diphoton decay mode of the Higgs has represented a very important contribution for the discovery of the new boson at 125 GeV [p24, p26bis], since it gave the largest significance (4 sigmas). I was deeply involved in both the inclusive and exclusive analyses [p23, p32]. In the latter, the requirements of two forward jets allows to both identify a specific Higgs production mode (vector boson fusion) and isolate events with a better signal over background ratio. The addition of this channel increases the sensitivity of the search and it is very important for the determination of the Higgs couplings to fermions and vector bosons. It also allowed to put stronger constraints on the existence of a fermiophobic Higgs [p22]. Thanks to my experience in Higgs analysis with jets I have been appointed as the convener of the “Jets” subgroup of the LHC Higgs Cross Section Working Group [o7]. The activity of this group is summarized in the CERN Yellow Report on Higgs [p27]. I also worked on the addition of another exclusive channel where the signature is represented by two photons and missing transverse energy. The goal is to select Higgs decays produced via the associated production mode, where the final state includes a W or a Z decaying in neutrinos [cms19, cms20]. These studies have been included in the Higgs to diphoton run1 legacy publication [p32]. I have also worked in collaboration with theorists. The aim was the Higgs couplings extraction using exclusive Higgs channels [p25]. I have also extended the diphoton search to larger invariant masses ($>150\text{GeV}$) [cms22] and the analysis is public [p34].

I have worked on the analysis of the Higgs decays to two vector bosons (ZZ, WW) [p21], where one decays to leptons and the other one to jets. The advantage of these channels is represented by the larger cross section (about 10 times for ZZ and 5 times for WW) compared to the traditional four lepton channels. However, the drawback is instead in the presence of jets in the final state, which induces large backgrounds and poor energy resolution. To increase the sensitivity, kinematic fits are used. In addition, a fine detailed study of the jet constituents and jet shape allows to discriminate between jets produced by quarks and gluons

has been also added to the analysis [cms15]. Thanks to these techniques, the analyses contributed in a significance manner to the exclusion of the Higgs at high masses ($M_H > 250 \text{ GeV}$) and these results have been included in the 7 TeV paper where all Higgs channels have been combined [p23bis].

Work on jets

High momentum jets are present in almost every collision selected at the LHC and they are used in many analyses. Given that they are reconstructed using the energy deposited in the hadronic calorimeters, their energy calibration is not trivial. My work has been devoted to the extraction of the energy corrections using control samples of data, like gamma+jets events. Thanks to my experience on this topic, in 2010 I have been appointed as the convener of the JetMET working group, that is responsible for the reconstruction and the commissioning of jets and missing transverse energy (MET). This group had about 100 members. It produced several CMS public notes and two papers [p18,p19]. The calibration and the commissioning of jets and MET have been crucial for the earliest CMS searches for new physics [p18bis, p20bis, p22bis]. I worked also on analysis tools, which exploit the jet composition (particle type, number of particles, jet shapes) and are aimed to discriminate between jets originated by quarks and gluons or to reject jets coming from extra interactions (pile-up) [cms15].

Work on the electromagnetic calorimeter (ECAL).

Since I joined the collaboration in 2006, I have been always involved in the maintenance, commissioning, and calibration of the ECAL. First of all, I have been contributing to the maintenance of the high voltage system of the barrel sector of the ECAL [p13, p14bis]. I also worked on the calibration of the ECAL by using electrons and neutral pions produced at the testbeams, which took place at Cern H2 and H4 in 2006 and 2007 [p14, p16] and with the first collisions data [cms8]. Later, I have studied the time measurement of the ECAL, crucial for the identification of off-time new physics signatures and for the rejection of the backgrounds, which come from additional pp interactions. Using samples of cosmic rays muons, testbeam electrons and beam splash events, the performance of the time measurement and intercalibration of the ECAL crystals have been determined [p17, cms21].

My work in BaBar has been mainly devoted to five main topics:

Measurement of the CKM parameter $|V_{ub}|$.

The measurement of the $|V_{ub}|$ parameter is crucial since it allows to put constraints on the unitary plane, in order to verify the validity of the Standard Model. I have studied charmless semileptonic B decays to extract this parameter [o2]. The smallness of $|V_{ub}|$ makes the measurement very complicated because of the tiny branching ratio compared to the one of the overwhelming background represented by charm decays. Both inclusive and exclusive decays have been used. The measurement was based on the so-called “recoil” technique, where one of the two B mesons from the $Y(4S)$ decay is fully reconstructed in hadronic modes. This analysis has been presented at several conferences [c18, c19] and produced two published papers [p9, p10]. They represent the first publications in B physics with this novel technique and set the reference for the following $|V_{ub}|$ measurements.

Analysis of the B decays in fully hadronic modes

The reconstruction of B decays in fully hadronic modes is crucial at the B factories. Several parameters can be measured with the study of these decays, from the CKM parameters $\sin(2\beta+\gamma)$ and angle γ , to the study of Heavy Quarks and the search for new resonances and exotics. My work on these decays produced a paper [p11, c17] where, with a novel approach, several $B \rightarrow D^{(*)} D_{sJ}^{(*)}$ branching ratios have been extracted. In addition, the branching ratios of the new state $D_{sJ}(2460)$ discovered in 2004 have been measured for the first time.

Thanks to the experience in this kind of physics I have been nominated as the convener of the BaBar group that studies the exclusive hadronic B meson decays in final states with charm

($B \rightarrow DX$). This group was the largest one in the BaBar experiment, with about 70 physicists. During my convenership, this group produced 20 journal publications, e.g. [p10bis].

Work on recoil physics

I am the author of the so-called “semiexclusive reconstruction”. This algorithm is able to reconstruct hadronic B decays, with up to 10 particles in the final state, high efficiency, and fast computation. It was originally created for the $|V_{ub}|$ analysis but, later, it was adopted by several analyses in BaBar, like the measurement of the $B \rightarrow \tau \nu$ branching ratio. There are about 15 published papers which made use of it. I have been also nominated as the coordinator of the “Recoil Forum” group, whose main charge was to discuss and coordinate the strategies and tool implementations that are in common among the analyses performed on the recoil of reconstructed B mesons.

Measurement of the mixing parameter Δm_d

The B^0 - B^0 bar mixing was measured by studying the high statistics sample of events with two charged leptons in the final states [p5, cs3]. This information is extracted from the time dependent study of the distance between the two B meson decay vertexes and their charge correlation. At the time of the publication, it provided the most precise determination of the parameter Δm_d .

Work on the BaBar drift chamber

I have been the main responsible for the monitoring of the drift chamber of the experiment [p1, o1]. I implemented the code for the monitoring of both the online (raw) and offline (reconstructed) physics quantities. I have actively participated to the commissioning period in the years 1998-2000 when the cosmic runs and first collisions took place.

CMS and LHC related publications quoted in the CV

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- p44 R. Abbott et al. [CMS MTD collaboration], *Test beam characterization of sensor prototypes for the CMS Barrel MIP Timing Detector*, JINST **16** P07023 (2021)
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- p41 A. M. Sirunyan et al. [CMS Collaboration], *Observation of $t\bar{t}b\bar{b}H$ Production*, Phys. Rev. Lett. 120, 231801 (2018)
- p40 A. M. Sirunyan et al. [CMS Collaboration], *Observation of the $\chi_{b1}(3P)$ and $\chi_{b2}(3P)$ and measurement of their masses*, Phys. Rev. Lett. 121, 092002 (2018)
- p39 A. M. Sirunyan et al. [CMS Collaboration], *Search for excited quarks of light and heavy flavor in γ +jet final states in proton-proton collisions at $\sqrt{s}=13$ TeV*, Phys. Lett. B 781, 390 (2018)
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- p37 L. Brianza et al., “Response of microchannel plates to single particles and to electromagnetic showers”, Nucl.Instrum.Meth. A797 (2015) 216-221
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- p36 V.Khachatryan et al. [CMS Collaboration], “Search for Narrow Resonances Decaying to Dijets in Proton-Proton Collisions at $\sqrt{s} = 13$ TeV”, PRL 116, 071801 (2016)
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Main Seminars

- cs17 Feb 15 Scuola Normale di Pisa, Seminar “Searches for New Heavy Resonances at the LHC”
- cs16 Dec 13 Electroweak Symmetry Breaking, Flavour and Dark matter after the Higgs discovery “Status and perspectives of Higgs Physics at LHC”
- cs15 Sep 12 Electroweak Symmetry Breaking, Flavour and Dark Matter: One Solution for Three Mysteries (DaMeSyFla) Workshop “Experimental review on the Higgs”
- cs14 Jul 12 Università di Roma, Sapienza “Observation of a new boson with a mass at 125GeV”
- cs13 May 12 Frascati, workshop on the Higgs search “ $H \rightarrow \gamma \gamma$ ”
- cs12 May 08 Riunione commissione Scientifica Gruppo 1 INFN, Ferrara. Seminar “CMS Preparation for Discovery: GMSB, and Heavy Stable Particles”
- cs11 Jan 05 Università di Roma “La Sapienza”. Seminar INFN “B Beam Physics with the Babar experiment”
- cs10 Dec 03 Vxb workshop. SLAC. Seminar “Introduction to session: “ $b \rightarrow ul\nu, b \rightarrow sy$ ”

- inclusive*"
- cs9 Apr 03 UCSD. Seminar "Vub on the recoil from Babar"
 - cs8 May 03 Università di Roma "La Sapienza" . Seminar INFN "Vub from Babar"
 - cs7 Apr 03 Università di Roma III. Seminar "Misura di Vub con l'esperimento BaBar"
 - cs6 Dec 02 Vxb workshop. SLAC. Seminar " $b \rightarrow ulv$: hadronic recoil mass method"
 - cs5 Oct 02 Università di Roma "La Sapienza". Seminar INFN "BaBar: Fisica del B con $100fb^{-1}$."
 - cs4 Sep 02 Società Italiana di Fisica. Alghero. Seminar "Studio del rapporto di decadimento semileptonico inclusivo del mesone B in stati senza il quark charm e misura dell'elemento di matrice CKM Vub."
 - cs3 Apr 02 American Physical Society. Albuquerque. 4 seminars "A Precise Measurement of B Meson Lifetimes with Inclusive Dilepton Events", "Measurement of the $B0B0$ Oscillation Frequency with Inclusive Dilepton Events", "Measurement of the Fraction of Charmless Semileptonic Decays of B Mesons and the Determination of Vub/Vcb, "Reconstruction of Hadronic B Meson Decays"
 - cs2 Dec 01 Vxb workshop. SLAC. Seminar "Vub from fully reconstructed B samples"
 - cs1 Apr 01 American Physical Society. Washington. Seminar "Two Body Charmless Hadronic B Decays: $B \rightarrow K0h, h+\pi0$ "

Proceedings

- pr9 D. del Re, *Precision Timing with the CMS MTD Barrel Timing Layer for HL-LHC*, Proceedings of the 22nd Particles and Nuclei Interaction Conference (PANIC 2021), Lisboa
- pr8 D. del Re, *Exotics at the LHC*, Proceedings of the 39th International Conference on High Energy Physics (ICHEP 2018), Seoul
- pr7 D. del Re, *Exotica in CMS*, Proceedings of the 11th Rencontres de Moriond, QCD conference.
- pr6 D. del Re, *Timing performance of the CMS ECAL and prospects for the future*, Proceedings of the 16th International conference on calorimetry in high energy physics (CALOR), Giessen
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