Curriculum Vitae

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Personal information.

- *Date and place of birth*: Barcelona, Spain, 15/02/1980.
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Education.

- *07/07/2006*: PhD in Theoretical Physics, University of Barcelona (Spain).
  Supervisors: Prof. J. I. Latorre and Prof. S. Forte.
- *2004*: MSc in Physics, University of Barcelona (Spain).
- *2002*: BSc in Physics, University of Barcelona (Spain).

Current position. Associate Professor of Theoretical Physics, Department of Physics and Astronomy, Vrije Universiteit Amsterdam; and Staff Member, Theory group, Nikhef, The Netherlands.

Previous positions.

- *2016-2018*: Assistant Professor, Department of Physics and Astronomy, Vrije Universiteit Amsterdam.
- *2014-2016*: STFC Rutherford Fellow (Junior Faculty), University of Oxford, United Kingdom.
- *2011-2014*: Marie Sklodowska-Curie Fellow, Theory Department, CERN, Switzerland.
- *2008-2011*: Postdoctoral researcher, INFN and Milano University, Milano, Italy.
- *2006-2008*: Postdoctoral researcher, LPTHE, Université Paris VI, Paris, France.

A career in a nutshell.

- (Co-)authored more than 100 peer-reviewed papers on a wide variety of topics, from the structure of the proton and Higgs pair production with jet substructure to calculations of neutrino fluxes at IceCube.
- Author of two of the five most-cited papers in theoretical particle physics published since 2010.
- Secured more than € 3M in grant funding as PI, including an ERC Starting Grant, which has been supporting 4 PhD students, 6 postdocs, and a large number of undergraduate students and temporary guests.
- Regularly invited at international conferences and workshops to give review talks.
- Nominated "Physics Coordinator" of the NNPDF Collaboration.
- Leadership in the particle physics theory community recognized by election as Affiliate Scientist both within the CMS (2011-2014) and ATLAS (2014-now) collaborations of the LHC.
- Awarded a Visiting Professorship at the University of Oxford, elected Fellow of Young Academy of Europe.

Supervision of graduate students and postdocs.

- Supervisor (completed and ongoing) of 5 PhD thesis: E. R. Nocera (Milano 2014), L. Rottoli (Oxford 2018), F. Giuli (Oxford 2018), E. Slade (Oxford 2019), R. A. Khalek (Amsterdam 2021).
- Supervisor of 5 postdoctoral researchers: N. P. Hartland (Oxford and Amsterdam 14-18), V. Bertone (Oxford and Amsterdam 15-18), M. Bonvini (Oxford 14-16), E. Nocera (Oxford 15-17), J. Ethier (Amsterdam 18-21).
- Supervisor of 7 BSc thesis, 5 MSc thesis, and 4 summer projects in Milano, CERN, Oxford, and Amsterdam.

Organization of scientific meetings and conferences (selection).

- *from 2018*: *"Dutch National Seminar of Theoretical High Energy Physics"* (Nikhef), organiser.
- *06/2017*: *"Big data tools for physics and astronomy"* conference (Amsterdam), organiser.
- *04/2017*: *"Deep Inelastic Scattering 2017"* workshop (Birmingham), organiser.
- *03/2017*: *"Parton Distributions and Lattice Calculations in the LHC Era"* workshop (Oxford), organiser.
- *08/2016*: *"Parton Distributions"* session, QCD@LHC2016 Conference (Zurich), convener.
- *07/2015*: *European Physical Society Conference on High Energy Physics* 2015, convener of QCD session.

- *02/2015*: *"Parton Distributions for the LHC"* workshop, Benasque Center for Science, organiser.
- *09/2014*: *"Topical workshop on $t\bar{t}$ distributions* (Cannes), organiser.
- *11/2014*: *"Implications of LHCb measurements and future prospects"* workshop (CERN), convener.
- *2012-2014*: *CMS PDF Forum* (CERN), convener and organiser of kick-off workshop.
- *09/2010*: *"Taller de Altas Energias"* (Barcelona), the Spanish national HEP PhD school, organiser.

Institutional responsibilities

- *2019-now*: Member of the Scientific and Education Advisory Committees of Nikhef.
- *2017-now*: Bachelor Coordinator of the Medical Natural Sciences program at the VU Amsterdam.
- *2017-now*: *Management committee member*, COST action *"ParticleFace"*.
- *2017-now*: *Outreach committee member*, Department of Physics and Astronomy, VU Amsterdam.
- *2017-now*: *Physics Coordinator* of the NNPDF Collaboration
- *2016-now*: *Coordinator* of Visiting Professorships of Amsterdam's Institute of Physics and Astronomy.
- *2016-now*: *Member*, Joint Activities Committee, Amsterdam's Institute of Physics and Astronomy.
- *2014-2016*: *Coordinator*, graduate admissions of Ph. D. candidates in the Particle Theory group, Oxford.
- *2014-2016*: *Examiner for undergraduate admissions*, Balliol College, Oxford.

Teaching activities.

- *from 2020*: *"Quantum Mechanics"*, joint UvA/VU BSc Physics and Astronomy.
- *2017-now*: *"Quantum Field Theory"*, joint UvA/VU MSc Physics and Astronomy.
- *2017-now*: *"Introduction to Elementary Particles"*, BSc Applied Physics, Delft University of Technology.
- *2017*: *"Topical Lectures on Symmetries"*, graduate course for Nikhef Ph. D. students.
- *2016-now*: *"From Quantum to Molecules"*, BSc Medical Natural Sciences, VU Amsterdam.
- *2014-2016*: *Lecturer at Balliol College*, University of Oxford. Courses taught: Electromagnetism, Thermal Physics, Atomic and Laser Physics, Subatomic Physics, Special Relativity.
- *2014-2016*: *"The Standard Model"*, MSc in Mathematical and Theoretical Physics, University of Oxford.
- *2010-2011*: *"Computational Methods in Physics"*, BSc in Physics, Milano University.
- *2004-2006*: Teaching Assistant of *"Calculus"* and *"Advanced Quantum Mechanics"*, University of Barcelona.

In 2017 I obtained my University Teaching Qualification (*Basiskwalificatie Onderwijs*), official certification of didactic competence for university professors in the Netherlands. This was followed in 2019 by the Senior Teaching Qualification (*Seniorkwalificatie Onderwijs*) aimed at academics with education and managerial responsibilities.

Membership of scientific societies.

- Member of the Young Academy of Europe (YAE), elected in 2017.
- Member of the Dutch Research School of Theoretical Physics (DRSTP).
- Member of the Dutch Physical Society (*Nederlandse Natuurkundige Vereniging*).

Refereeing activities. I am referee for the following *national science funding agencies*: German Research Foundation (DFG), Israel Science Foundation, Agencia Nacional de Evaluación y Prospectiva (ANEP, Spain), Centro Nacional de Fisica de Particulas, Astroparticulas y Nuclear (CPAN, Spain), Netherlands Organisation for Scientific Research (NWO), and the Romanian National Science Foundation.
I am referee for the following *scientific journals*: Physics Letters B, Journal of High Energy Physics, Nuclear Physics, European Journal of Physics, International Journal of Modern Physics A, Journal of Physics G.

Writing of popular science books.

- *2017*: *"La vida íntima de las partículas" ("The inner life of particles")*, popular science book released in Spanish, Italian, and Portuguese, Editorial Materia.

Outreach activities (selection).

- *2017*: *"Deciphering the secret code of Nature: from the Higgs particle to gravity waves"*, outreach lecture to high-school students at the *International School of Den Haag*, November 2017 (slides).
- *2017*: *"Eureka: the adventure of scientific discovery"*, interview for the *London Encounter* 2017 exhibit.
- *2015*: *"Particle Physics, CERN and the Large Hadron Collider,"*, presentation at the *Science Fair* of *St. Aloysius* school, Oxford (slides).

- *2015*: *"The Standard Model and the Large Hadron Collider in the Higgs Boson Era"*, Oxford Saturday Mornings of Theoretical Physics, Oxford (video recording).
- 2014: *"Beyond the Boson: Higgs discovery and the next steps for particle physics"'*, Physics Department Newsletter, University of Oxford (.pdf).

Media apperances (selection).

- *"After 40 years of studying the strong nuclear force, a revelation"*, *The Guardian*, December 2017.
- *"There's still a lot we don't know about the proton"*, interview for *Science News*, April 2017.
- *"What goes inside a proton?"*, *The Guardian*, February 2015.
- *"Proton Spin Mystery Gains a New Clue"*, interview for *Scientific American*, July 2014.

Research achievements highlights.

- Formulated and led the neural network (NNPDF) approach to parton distributions (main outcome of my PhD thesis) as well as its extension to polarised PDFs and to fragmentation functions.
- Demonstrated that LHC data provides unique constraints on the proton structure, from top quark to charm production, and quantified how the latter allows for precision predictions in ultra-high energy astrophysics.
- Provided evidence for BFKL dynamics in HERA data culminating 30 years of searches.
- Showed that Higgs self-couplings can be probed in the $b\bar{b}b\bar{b}$ final state at the LHC, thought to be impossible.
- Successfully applied machine learning tools to a variety of problems in high-energy physics.
- Developed the PDF reduction techniques used in the official PDF4LHC recommendations for LHC Run II.
- Author of widely-used high-energy physics software tools such as `APFEL`, `HOPPET`, and `aMCfast`.

Invited talks at international conferences (selection).

- *"Bridging collider physics and neutrino telescopes with charm production"*, Physics@Veldhoven2018 *Focus Session*, Veldhoven, the Netherlands, January 2108 (slides).
- *"Parton Distributions in the high-precision LHC era"*, Zurich Phenomenology Workshop 2018 (ZPW18): Flavours, Light, Heavy, and Dark, Zurich, January 2018 (slides).
- *"Precision QCD Processes at the LHC"*, ICFA seminar on Future Perspectives in High Energy Physics, Ottawa, Canada, November 2017 (slides).
- *"Neural networks and machine learning in high energy physics"*, Trends in Theory 2017, Dutch Research School of Theoretical Physics, Delfsen, The Netherlands, May 2017 (slides).
- *"Recent progress in proton and nuclear PDFs"*, Large Hadron Collider Physics Conference 2017 (LHCP2017), Shangai, China, May 2017 (slides).
- *"Neural network fits of parton distributions"*, 4th workshop on the QCD structure of the nucleon (QCD-N'2016), Bilbao, July 2016 (slides).
- *"The structure of the proton and precision LHC phenomenology"*, Center for Theoretical Physics, MIT, Boston, November 2016 (slides).
- *"Parton Distributions at the LHC: lesson from Run I and preparation for Run II"*, ATLAS Standard Model Workshop, Annecy, February 2015 (slides).

Awards, prizes, and distinctions.

- *2017*: Elected member of the Young Academy of Europe.
- *2016-2019*: Awarded a *Visiting Professorship*, Departament of Physics, University of Oxford.
- *2014-now*: Elected *Short Term Affiliate* within the ATLAS Collaboration.
- *2011-2014*: Elected *Affiliate Scientist* within the CMS Collaboration, convener of CMS PDF fit forum.
- *2002*: *Undergraduate Award* of the Physics Faculty (best grades of cohort), University of Barcelona.

Selected publications in leading international peer-reviewed journals. In my field, authors are always listed in alphabetical order. Number of citations and other bibliometric indicators have been obtained from the InspireHep database as of September 25, 2019. I indicate the publications more directly related to the proposal.

(1) R. D. Ball, V. Bertone, M. Bonvini, S. Marzani, **J. Rojo**, and L. Rottoli, *"Parton distributions with small-x resummation: evidence for BFKL dynamics in HERA data"*, Eur. Phys. J. C in press (2018), arXiv:1710.05935. **# cit. 54**

(2) J. Gao, L. Harland-Lang, and **J. Rojo**, *"The Structure of the Proton in the LHC Precision Era"*, Physics Reports in press (2018), arXiv:1709.04922. **74**

(3) R. D. Ball, V. Bertone, S. Carrazza, L. D. Debbio, S. Forte, A. Guffanti, N. P. Hartland, Z. Kassabov, J. Latorre, E. Nocera, **J. Rojo**, L. Rottoli, E. Slade, and M. Ubiali, *"Parton distributions from high-precision collider data"*, Eur. Phys. J. C77 (2017) no.10, 663 , arXiv:1706.00428. **340**

(4) V. Bertone, S. Carrazza, N. P. Hartland, E. R. Nocera and **J. Rojo**, *"A determination of fragmentation functions of pions, kaons and protons with faithful uncertainties"*, Eur. Phys. J. C 77, no. 8, 516 (2017), arXiv:1706.07049. **47**

(5) R. Gauld and **J. Rojo**, *"Precision determination of the small-x gluon from charm production at LHCb"*, Phys. Rev. Lett. 118, 072001 (2017), arXiv:1610.09373. **55**

(6) R. D. Ball, V. Bertone, S. Carrazza, C. S. Deans, L. Del Debbio, S. Forte, A. Guffanti, N. P. Hartland, J. I. Latorre, **J. Rojo**, and M. Ubiali, *"Parton distributions for the LHC Run II"*, JHEP **1504**, 040 (2015), arXiv:1410.8849. **1538**

(7) E. R. Nocera, R. D. Ball, S. Forte, G. Ridolfi, and **J. Rojo**, *"A first unbiased global determination of polarized PDFs and their uncertainties"*, Nucl. Phys. B 867 (2013) 244, arXiv:1406.5539. **174**

(8) V. Bertone, S. Carrazza and **J. Rojo**, *"APFEL: A PDF Evolution Library with QED corrections"*, Comp. Phys. Comm. 185 (2014) 1647, arXiv:1310.1394. **142**

(9) R. D. Ball, V. Bertone, S. Carrazza, C. S. Deans, L. Del Debbio, S. Forte, A. Guffanti, N. P. Hartland, J. I. Latorre, **J. Rojo**, and M. Ubiali, *"Parton Distributions with LHC data"*, Nucl. Phys. B 867 (2013) 244, arXiv:1207.1303. **1290**

(10) R. D. Ball, V. Bertone, F. Cerutti, L. Del Debbio, S. Forte, A. Guffanti, J. I. Latorre, **J. Rojo** and M. Ubiali, *"Impact of Heavy Quark Masses on Parton Distributions and LHC Phenomenology"*, Nucl. Phys. B 849 (2011) 296, arXiv:1101.1300. **492**

My 99 peer-reviewed publications, published in the highest-impact journals of my field, accumulate **13144 citations** and average **133 cit/paper**, with an *h-index* of $\mathbf{h = 54}$. They include 6 renowned papers (over 500 citations), s6 famous papers (over 250 citations) and 19 very well-known ones (over 100 citations). An updated publication list and citation metrics can be found at `http://tinyurl.com/JRpub` and `http://tinyurl.com/JRcite` respectively.

Scientific software development.

- `NNPDF` Parton Distributions, available via `LHAPDF` and the NNPDF website, nnpdf.mi.infn.it.
- `APFEL-GUI`, online graphical user interface for PDFs, luminosities, and cross-sections, apfel.mi.infn.it.
- `aMCfast`: automation of fast NLO calculations for PDF fits, amcfast.hepforge.org.
- `APFEL`: PDF DGLAP evolution and DIS structure functions up to NNLO, apfel.hepforge.org.
- `HOPPET`: a Higher Order Perturbative Parton Evolution Toolkit, hoppet.hepforge.org
- `PromptNuFlux`, calculation of the prompt atmospheric neutrino flux, promptnuflux.hepforge.org.

Involvement in future HEP planning.

- Convener of the PDF section (Standard Model WG) of the *HL/HE-LHC* Physics Yellow Report.
- Author of Standard Model (PDF section convener) and Higgs chapters of *Future Circular Collider* Report.
- Member of the *Snowmass Community HEP Planning* WG, author of QCD and electroweak physics reports.
- Member of the *TLEP/FCC-ee* WG, author of first overview of physics potential of this future e^+e^- collider.
- Member of the *Large Hadron Electron Collider* (LHeC) WG and author of its Conceptual Design Report.

Grants and funding as PI.

Grant	Amount	Funding source	Year of award
Marie-Sklodowska Curie Intra-European Fellowship	€ 180k	European Commission	2010
Rutherford Fellowship	£541k (≃€690k)	Science and Technology Facilities Council (UK)	2013
Starting Grant	€ 1330k	European Research Council	2013
Ramon y Cajal Fellowship (declined)	€ 359k	Ministry of Economy (Spain)	2013
Rutherford Grant	£233k (≃€298k)	Science and Technology Facilities Council (UK)	2015
Physics Projectruimte	€ 420k	Netherlands Organization for Scientific Research (NWO)	2017
Total funding	**€3.277M**		