

Juan M. Cruz-Martinez

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Born 02/08/1991, Nationality: Spanish

Research Career

University of Milan

Assegnista di ricerca

Working on the N3PDF research project. PI Stefano Forte. Financed by the European Research Council through an Advanced Grant (n 740006) within the Horizon 2020 Research & Innovation Programme

Milan (Italy)

2018-currently

Durham University

PhD Thesis, Supervisor: Nigel Glover

Next-to-Next-to-Leading Order QCD Corrections to Higgs Boson Production in Association with two Jets in Vector Boson Fusion

Durham (UK)

2014-2018

University of Zurich

Academic Secondment, supervisor: Thomas Gehrmann

Zurich (Switzerland)

Oct-Dec 2016

IFIC (Valencia)

Research Stay, Supervisor: M. Vos

Project Title: Experimental Limitations to Charge Asymmetry measurement in top quark pair production at hadron colliders

Valencia (Spain)

2014

University of Valencia & IFIC

Master in Advanced Physics: Theoretical Physics, 94.6%

Master Thesis supervisor: German Rodrigo

Study of charge asymmetry in $t\bar{t}$ production through axigluons

Valencia (Spain)

2013-2014

National Accelerators Center (CNA Sevilla)

Research Stay, Supervisor: J.M. Lopez-Gutierrez

Project Title: Development of computing tools for the analysis of Accelerator Mass Spectrometry results at the National Accelerators Center

Seville (Spain)

June 2013

University of Seville

Degree in Physics, 82.3%

Bachelor's Thesis supervisor: Antonio Moro

Application of numerical resolution of a system with coupled differential equations to Quantum Scattering Problems with Internal Degrees of Freedom

Seville (Spain)

2009-2013

Teaching Experience

Teaching Assistant

Corso di Informatica, 36h

University of Milan (Italy)

2020-2021 (ongoing)

Teaching Assistant

Fisica Quantistica II, 26h

University of Milan (Italy)

2020-2021 (ongoing)

Teaching Assistant <i>Fisica Quantistica I, 10h</i>	University of Milan (Italy) 2019-2020
Teaching Assistant <i>Corso di informatica, 36h</i>	University of Milan (Italy) 2019-2020
Co-director of master Thesis <i>Investigating GPU hardware for fast PDF convolutions, E. Villa</i>	University of Milan (Italy) 2019
NNPDF Code Meeting <i>Course on the usage of the Keras and Tensorflow libraries, 5h</i>	Cambridge (UK) June 2019
Co-director of bachelor Thesis <i>Stability in the determination of parton distributions, F. Settimo</i>	University of Milan (Italy) 2018-2019
Teaching Assistant <i>First Year experimental methods course, weekly exercises, 36 h</i>	Durham University (UK) 2017-2018

Conference Talks and Seminars

40th International Conference on High Energy Physics, ICHEP <i>VegasFlow: accelerating Monte Carlo simulation across platforms with dataflow graphs</i>	Prague (Virtual meeting) August 2020
NNPDF Collaboration meeting <i>Optimizing the hyperoptimization</i>	Amsterdam (The Netherlands) February 2020
Artificial Intelligence for Science, Industry and Society Symposium (AISIS 2019) <i>Studying the parton content of the proton with deep learning models</i>	Ciudad de Mexico (Mexico) October 2019
James Stirling Memorial Conference & PDF4LHC <i>Methodological improvements in PDF determination</i>	Durham (UK) September 2019
NNPDF Collaboration meeting <i>n3fit and hyperoptimization in the context of NNPDF 4.0</i>	Varenna (Italy) August 2019
QCD@LHC 2019 <i>Towards a new generation of PDFs with deep learning models</i>	Buffalo, New York (USA) July 2019
NNLOJET Collaboration meeting <i>Numerical Integration with Neural Networks</i>	Zurich (Switzerland) May 2019
NNPDF Collaboration meeting <i>N3PDF studies of new methodologies</i>	Amsterdam (The Netherlands) February 2019
NNPDF Collaboration & N3PDF Kickoff Meeting <i>Recent developments within NNLOJET</i>	Gargnano, Lake Garda (Italy) September 2018
Loops and Legs in Quantum Field Theory 2018 <i>NNLO corrections to VBF Higgs boson production</i>	St. Goar (Germany) May 2018
HiggsTools Final Meeting <i>NNLO phenomenology with Antenna Subtraction</i>	Durham (UK) September 2017
Internal Seminar <i>ϕ_η^* observable for Higgs production</i>	Durham (UK) May 2017

Student Seminar <i>Higgs phenomenology with antenna subtraction</i>	Durham (UK) <i>February 2017</i>
Invited Seminar <i>Higgs phenomenology with antenna subtraction</i>	Valencia (Spain) <i>January 2017</i>
HiggsTools Second Annual Meeting <i>NNLO calculations for Higgs processes</i>	Granada (Spain) <i>April 2016</i>
Internal Seminar <i>Renormalisation Scale Dependence as a Testing Ground for NNLO calculations</i>	Durham (UK) <i>February 2016</i>
Student Seminar <i>Building and Playing with NNLO Monte Carlos</i>	Durham (UK) <i>February 2016</i>
HiggsTools First Annual Meeting <i>NNLO predictions for Higgs production at LHC</i>	Freiburg (Germany) <i>April 2015</i>

Complementary Education

Xilinx Developer Forum <i>Developers Forum</i>	The Hague (The Netherlands) <i>November 2019</i>
ExotHiggs <i>Summer School</i>	Zuoz (Switzerland) <i>August 2016</i>
YETI <i>Winter School</i>	Durham (UK) <i>January 2016</i>
Higgstools Summer School <i>Summer School</i>	Aosta Valley (Italy) <i>July 2015</i>
Higgstools First Young Researches Meeting <i>Teamwork, Communication and Media training</i>	Durham (UK) <i>February 2015</i>

Work Experience

Shell (Projects & Technology Division) <i>Fortran and C Developer</i>	Rijswijk (The Netherlands) <i>2016</i>
<p>Dutch division of the Seismic Applications team (managed by Rob Eppenga). As part of the Higgstools ITN I was given the opportunity of working at Shell for several months. In Shell I worked on the SIPMAP package, a suite of programs used for oil exploration and seismic tomography. While the formal detail of the algorithms used fall under a completely different branch of physics, the computing side was actually quite close to what it is done in high energy physics research. My task during this internship consisted on the development and maintenance of the program (the oldest pieces written in Fortran, some of the more modern features C and C++). Runs of this code are very costly and thus optimisation is key, my focus during those months was on improving some of the algorithms and streamlining the workflow of the software. I also worked on porting parts of the code to new hardware (32 bits to 64 bits and GPU accelerators).</p>	
FamilyApp <i>Frontend and Backend Developer, Python, HTML</i>	Seville (Spain) <i>2014</i>
<p>Sole developer of both the web interface and administration backend of the service.</p>	

Participation in grants

New hardware for HEP

Linea 2A
Co-Author

University of Milan (Italy)

2019-2020

Management Experience

YTF (Young Theorist Forum 10)

Member of the organising Committee

Durham (UK)

January 2018

HiggsTools Final Meeting

Member of the organising Committee

Durham (UK)

September 2017

YTF (Young Theorist Forum 9)

Member of the organising Committee

Durham (UK)

January 2017

YTF (Young Theorist Forum 8)

Member of the organising Committee

Durham (UK)

January 2016

ICHEP 2014

Outreach activities

Valencia (Spain)

July 2014

Awards

Highest Distinction: Bachelor's Thesis: Numerical resolution of a system with coupled differential equations: applied to Quantum Scattering Problems with Internal Degrees of Freedom

Third Prize: IV Concurso Nacional para promocion de Jovenes Escritores Cientifico-Tecnicos
ACTA-CEDRO Scientific Writing

Other Projects

pyHepGrid

Developer, github.com/scarlehoff/pyHepGrid

Python, grid computing

2016-2019

Core developer of the pyHepGrid tool for distributed computing. Used to run in a systematic and coherent manner resource-hungry programs typically used for HEP simulations. The development of pyHepGrid was done with the focus on NNLOJET but has since being extended successfully to also run other programs such as MCFM, Sherpa or HEJ.

Relevant computer skills

Programming Languages: Fortran, Python, C, C++, OpenCL, Cuda

Operating System: Linux, MacOS, Windows

Scripting/Macro Languages: Bash, Latex, gnuplot

Computing Tools: Maple, Mathematica, Matlab, Grid Computing

HEP Tools: Madgraph, Sherpa, root

Technologies: Grid Computing, multiprocessing, FPGA computing, GPU computing

ML Libraries: Keras, Tensorflow

Languages

Spanish: Native

English: Fluent

PhD studies carried out in Durham (United Kingdom)

Italian: Fluent

B1 Course by Milan University, university level courses taught in Italian

French: Basic knowledge

Japanese: Basic knowledge

A1.2 level certified

PhD Thesis

Title: Next-to-Next-to-Leading Order QCD Corrections to Higgs Boson Production in Association with two Jets in Vector Boson Fusion

Supervisors: Nigel Glover (Durham U.) & Thomas Gehrmann (Zurich U.)

Abstract: In this thesis the second-order QCD corrections to electroweak production of a Higgs boson in association with two jets through vector boson fusion are considered. This calculation is fully differential in the kinematics of the Higgs boson and of the final state jets. Infrared divergences are regulated using the antenna subtraction method. We detail the implementation of the process in the parton-level Monte Carlo integrator NNLOJET and present inclusive calculations as well as differential distributions for a wide range of observables at different center-of-mass energies.

Grant: European Union, PITN-GA-2012-316704. Higgstools Initial Training Network

URL: <http://theses.dur.ac.uk/12806/>

Publications

[A⁺19] P. Azzi et al., *Report from Working Group 1*, CERN Yellow Rep. Monogr. **7**, 1–220 (2019), 1902.04070.

[A⁺20] S. Amoroso et al., Les Houches 2019: Physics at TeV Colliders: Standard Model Working Group Report, in *11th Les Houches Workshop on Physics at TeV Colliders: PhysTeV Les Houches*, 3 2020.

[B⁺18] M. Boggia et al., *The HiggsTools handbook: a beginners guide to decoding the Higgs sector*, J. Phys. **G45**(6), 065004 (2018), 1711.09875.

[CCM19] S. Carrazza and J. Cruz-Martinez, *Towards a new generation of parton densities with deep learning models*, Eur. Phys. J. **C79**(8), 676 (2019), 1907.05075.

[CCM20] S. Carrazza and J. M. Cruz-Martinez, *VegasFlow: accelerating Monte Carlo simulation across multiple hardware platforms*, Comput. Phys. Commun. **254**, 107376 (2020), 2002.12921.

[CCMG⁺16] X. Chen, J. Cruz-Martinez, T. Gehrmann, E. W. N. Glover and M. Jaquier, *NNLO QCD corrections to Higgs boson production at large transverse momentum*, JHEP **10**, 066 (2016), 1607.08817.

[CCMH20] S. Carrazza, J. Cruz-Martinez and F. Hekhorn, N3PDF/eko., June 2020.

[CCMR20] S. Carrazza, J. M. Cruz-Martinez and M. Rossi, *PDFFlow: parton distribution functions on GPU*, (9 2020), 2009.06635.

[CCMUEV19] S. Carrazza, J. Cruz-Martinez, J. Urtasun-Elizari and E. Villa, *Towards hardware acceleration for parton densities estimation*, Frascati Phys. Ser. **69**, 1–6 (2019), 1909.10547.

- [CM18a] J. Cruz-Martinez, *Higgs Production at NNLO in VBF*, Acta Phys. Polon. Supp. **11**, 277–284 (2018).
- [CM18b] J. M. Cruz-Martinez, *Next-to-Next-to-Leading Order QCD Corrections to Higgs Boson Production in Association with two Jets in Vector Boson Fusion*, PhD thesis, Durham U. (main), 2018.
- [CMC20] J. M. Cruz-Martinez and S. Carrazza, N3PDF/vegasflow: Accelerating Monte Carlo simulation across multiple hardware platforms, March 2020.
- [CMCS20] J. M. Cruz-Martinez, S. Carrazza and R. Stegeman, Studying the parton content of the proton with deep learning models, in *Artificial Intelligence for Science, Industry and Society*, 2 2020.
- [CMGGH18a] J. Cruz-Martinez, T. Gehrmann, E. W. N. Glover and A. Huss, *Second-order QCD effects in Higgs boson production through vector boson fusion*, Phys. Lett. **B781**, 672–677 (2018), 1802.02445.
- [CMGGH18b] J. Cruz-Martinez, E. W. N. Glover, T. Gehrmann and A. Huss, *NNLO corrections to VBF Higgs boson production*, PoS **LL2018**, 003 (2018), 1807.07908.
- [CMSC20] J. M. Cruz-Martinez, R. Stegeman and S. Carrazza, N3PDF/evolutionary_keras: An evolutionary algorithm implementation for Keras, February 2020.
- [CMWW19] J. Cruz-Martinez, D. Walker and J. Whitehead, pyHepGrid: Distributed computing made easy, May 2019.
- [G⁺18] T. Gehrmann et al., *Jet cross sections and transverse momentum distributions with NNLOJET*, PoS **RADCOR2017**, 074 (2018), 1801.06415.
- [JRC20] Juacumar, M. Rossi and S. Carrazza, N3PDF/pdfflow: PDFFlow 1.0, September 2020.