


Dr Héctor de la Torre Pérez

RESEARCH ASSOCIATE · MICHIGAN STATE UNIVERSITY

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Education

PhD in Physics

UNIVERSIDAD AUTÓNOMA DE MADRID

Madrid, Spain

February 2016

- Measurement of photon plus jets production and identification of boosted top quarks in pp collisions at the LHC using the ATLAS detector
- Passed with *Cum Laude* mention

MSc in Theoretical Physics

UNIVERSIDAD AUTÓNOMA DE MADRID

Madrid, Spain

January 2011

BSc in Physics

UNIVERSIDAD AUTÓNOMA DE MADRID

Madrid, Spain

September 2008

- One academic year at the Humboldt-Universität in Berlin, Germany (2006-2007) with an *Erasmus Mundus* scholarship

Fellowships and contracts

Research associate

MICHIGAN STATE UNIVERSITY

East Lansing, USA

Since May 2016

Research contract

UNIVERSIDAD AUTÓNOMA DE MADRID

Madrid, Spain

August 2013 - April 2016

FPU fellowship of the Spanish Ministry of Education and Science

UNIVERSIDAD AUTÓNOMA DE MADRID

Madrid, Spain

August 2009 - August 2013

Internship in the summer student programme

DEUTSCHES ELEKTRONEN-SYNCHROTRON (DESY)

Hamburg, Germany

July 2007 - September 2007

Positions and appointments

Leadership positions

Analysis contact: $W' \rightarrow tb$ at 13 TeV

Convener

Analysis contact: γ +jets measurement at 8 TeV

Run coordinator

EXOTICS GROUP, ATLAS COLLABORATION

HQT SUBGROUP, ATLAS COLLABORATION

STANDARD MODEL GROUP, ATLAS COLLABORATION

LAR CALORIMETER GROUP, ATLAS COLLABORATION

Since Nov. 2018

Jan. 2019 - Mar. 2021

Sep. 2015 - Mar. 2017

Nov. 2011 - Jan. 2013

Editor and reviewer roles

Editorial board: Mono-top search at 13 TeV

Referee

Expert reviewer and sign-off, several searches

Thesis committee member

Thesis committee member

Paper editor: $W' \rightarrow tb$ at 13 TeV preliminary results

Paper editor: γ +jets measurement at 8 TeV

EXOTICS GROUP, ATLAS COLLABORATION

JOURNAL OF HIGH ENERGY PHYSICS

ATLAS COLLABORATION

UNIVERSIDAD DE VALENCIA

UNIVERSIDAD AUTÓNOMA DE MADRID

EXOTICS GROUP, ATLAS COLLABORATION

STANDARD MODEL GROUP, ATLAS COLLABORATION

Since Aug. 2021

Since May 2021

Since April. 2021

Defended Jan. 2022

Defended Dec. 2021

Published Aug. 2021

Published Mar. 2017

Teaching, supervision and mentoring

Graduate student supervision

Student mentoring

Physics and math mentoring and teaching

THREE CURRENT STUDENTS, TWO MORE GRADUATED IN 2021

WOMEN AND MINORITIES IN THE PHYSICAL SCIENCES, MSU

HIGH-SCHOOL AND UNDERGRADUATE LEVELS, PRIVATE TUITION

Since May 2016

Summer 2021

Jan. 2006 - Dec. 2009

Other appointments in the ATLAS Collaboration

Derivation contact

Heavy resonance combination liaison

Monte Carlo production contact

Production manager for upgrade samples

Software on-call expert

Developer and maintainer of the Calibration Hits Method

EXOTICS GROUP

HQT SUBGROUP

EXOTICS AND UPGRADE PHYSICS GROUPS

MC PRODUCTION GROUP

LAR CALORIMETER GROUP

EGAMMA GROUP

Since Oct. 2021

Since Sept. 2018

Jan. 2017 - Jan. 2019

Jan. 2017 - April. 2018

Aug. 2011 - Jan. 2013

Feb. 2010 - Aug. 2011

International conferences and seminars

14th Conference on the Intersections of Particle and Nuclear Physics (CIPANP 2022)

CONVENER OF THE PHYSICS AT HIGH ENERGIES SESSIONS (ORGANISING)

Lake Buena Vista, USA

August 2022 (in preparation)

40th International Conference on High Energy Physics (ICHEP 2020)

SEARCH FOR NEW PHYSICS IN FINAL STATES WITH HEAVY-FLAVOUR QUARKS USING THE ATLAS DETECTOR

Virtual conference

August 2020

US ATLAS Physics Workshop 2019

OVERVIEW OF THE EXOTICS SEARCH PROGRAM: PRESENT AND FUTURE

Amherst, USA

August 2019

39th International Conference on High Energy Physics (ICHEP 2018)

EXPECTED PERFORMANCE OF THE UPGRADED ATLAS EXPERIMENT FOR HL-LHC

Seoul, South Korea

July 2018

ATLAS Overview Week 2018

PHYSICS STUDIES FOR THE HL(HE)-LHC

Tokyo, Japan

June 2018

Deep Inelastic Scattering 2017 (DIS 2017)

HIGH- E_T ISOLATED-PHOTON PLUS JETS PRODUCTION IN pp COLLISIONS AT $\sqrt{s} = 8$ TeV WITH THE ATLAS DETECTOR

Birmingham, United Kingdom

April 2017

ATLAS TDAQ week 2016

IMPLEMENTING TRIGGER CLUSTERING ALGORITHMS FOR PHASE 2

Barcelona, Spain

September 2016

6th International Workshop on QCD at the LHC (QCD@LHC2015)

MEASUREMENTS OF JET AND PHOTON PRODUCTION IN PP COLLISIONS WITH THE ATLAS DETECTOR

London, United Kingdom

September 2015

Calorimetry for the High Energy Frontier 2013 (CHEF2013)

STATUS OF THE ATLAS LIQUID ARGON CALORIMETER AND ITS PERFORMANCE AFTER THREE YEARS OF LHC OPERATION

Paris, France

April 2013

Selected publications

ON A TOTAL OF 1019 RESEARCH PAPERS. FULL LIST CAN BE ACCESSED THROUGH THE ORCID LINK INCLUDED IN THE HEADER OF THIS DOCUMENT

1. Hector de la Torre and Trisha Farooque, *Looking beyond the Standard Model with Third Generation Quarks at the LHC*, Symmetry **14.3** (2022), ISSN: 2073-8994, URL: <https://www.mdpi.com/2073-8994/14/3/444>
2. ATLAS Collaboration, *Search for heavy particles in the b -tagged dijet mass distribution with additional b -tagged jets in proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS experiment*, Phys. Rev. D **105.1** (2022) 012001, arXiv: [2108.09059](https://arxiv.org/abs/2108.09059) [hep-ex]
3. ATLAS Collaboration, *Search for vector boson resonances decaying to a top quark and a bottom quark in the hadronic final state using pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS-CONF-2021-043, 2021, URL: <https://cds.cern.ch/record/2779178>
4. ATLAS Collaboration, *Search for single vector-like B quark production and decay via $B \rightarrow bH(b\bar{b})$ in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS-CONF-2021-018, 2021, URL: <https://cds.cern.ch/record/2760012>
5. ATLAS Collaboration, *Search for $t\bar{t}$ resonances in fully hadronic final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, JHEP **10** (2020) 061, arXiv: [2005.05138](https://arxiv.org/abs/2005.05138) [hep-ex]
6. ATLAS Collaboration, *Search for vector-boson resonances decaying to a top quark and bottom quark in the lepton plus jets final state in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **788** (2019) 347, arXiv: [1807.10473](https://arxiv.org/abs/1807.10473) [hep-ex]
7. Xabier Cid Vidal et al., *Report from Working Group 3: Beyond the Standard Model physics at the HL-LHC and HE-LHC*, CERN Yellow Rep. Monogr. **7** (2019) 585, ed. by Andrea Dainese et al., arXiv: [1812.07831](https://arxiv.org/abs/1812.07831) [hep-ph]
8. ATLAS Collaboration, *Search for $W' \rightarrow t\bar{b}$ decays in the hadronic final state using pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **781** (2018) 327, arXiv: [1801.07893](https://arxiv.org/abs/1801.07893) [hep-ex]
9. Hector De la Torre Perez, *High- E_T isolated-photon plus jets production in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector*, PoS DIS2017 (2018) 160, ed. by Uta Klein
10. ATLAS Collaboration, *Technical Design Report for the Phase-II Upgrade of the ATLAS TDAQ System*, tech. rep. CERN-LHCC-2017-020. ATLAS-TDR-029, CERN, 2017, URL: <https://cds.cern.ch/record/2285584>
11. ATLAS Collaboration, *High- E_T isolated-photon plus jets production in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector*, Nucl. Phys. B **918** (2017) 257, arXiv: [1611.06586](https://arxiv.org/abs/1611.06586) [hep-ex]

Skills

Languages	Mother tongue Spanish, fluent English, basic French and German
Operative systems	Administrator level knowledge of Linux systems
Programming	Proficient with C, C++, Python, Octave, Shell scripting and \LaTeX
Atlas software	Extensive experience with Athena, including sample production, simulation and reconstruction
Other software	Root, RooFit, RooStats, MadGraph5_aMC@NLO, fastjet, Pandas, version control, Docker

Research experience

Simulation and processing of simulated samples for physics groups

Since 2018

AS RESEARCH ASSOCIATE WITH MICHIGAN STATE UNIVERSITY

- **Derivation production for the exotics group (Since 2021):** Responsible for the group's derivation framework. This framework is used to process the common Monte Carlo simulation ATLAS format into simplified formats, with less content and/or events, that are easier to work with for specific analyses. I also process and submit to the grid production system the derivation requests from the different teams in the group.
- **Monte carlo sample production for the exotics group (2018-2019) :** In charge of collecting, validating and processing the Monte Carlo requests of the different analysis teams of the group.

ATLAS Upgrade programme

Since 2017

AS RESEARCH ASSOCIATE WITH MICHIGAN STATE UNIVERSITY

- **Ongoing studies on the Global trigger (Since 2017):** Conducting performance studies related to cluster and jet reconstruction at the trigger level with High-Luminosity LHC (HL-LHC) conditions as part of the effort to design the Global trigger. This new planned trigger system consists of a layer of incoming multiplexing nodes that feed into a layer of global event processors. With this structure the whole event is available on a single processor (one FPGA), decoupled from the LHC bunch-crossing rate. It will be able to run complex algorithms to maintain or improve the performance of the ATLAS trigger in the challenging environment of the HL-LHC.
- **Monte Carlo sample production for HL(HE)-LHC studies (2017-2019):** Designed and executed sample simulation strategy for physics and performance studies used for the six Technical Design Reports (TDR) published by ATLAS in 2017. These TDR compiled the plans for the HL-LHC upgrade of the ATLAS detector. The same set of samples was used to perform studies included in the Yellow report on the physics potential of the HL(HE)-LHC, a fundamental input for the update of the European strategy for particle physics finalised in 2020. Coordinated with relevant experts and analysers to ensure the samples were created according to specifications and took care of the production of the samples with the ATLAS grid production system.
- **Performance studies for Trigger and Data Acquisition TDR (2016-2017):** Led calorimeter performance studies for the global trigger and provided inputs for other members of the team using a custom-built analysis framework.

Searches for new physics beyond the Standard Model

Since 2016

AS RESEARCH ASSOCIATE WITH MICHIGAN STATE UNIVERSITY

- **Ongoing monotop search (Since 2021):** Member of the editorial board. Search for new physics in final states composed of one top quark accompanied by missing transverse energy with interpretations in dark matter and Vector-like quarks (VLQ) models.
- **Ongoing $VH, H \rightarrow b\bar{b}$ search (Since 2021):** Developing a new machine learning based strategy to improve the sensitivity to a low mass scalar/pseudoscalar resonance that plays a large role in 2HDM models. Supervising a student.
- **Ongoing heavy resonance combination (Since 2018):** Participating in the current effort of the statistical combination of 18 searches dedicated to heavy vector resonances. Liaison for the searches with top quarks in the final state, $W' \rightarrow t\bar{b}$ and $Z' \rightarrow t\bar{t}$.
- **Ongoing $W' \rightarrow t\bar{b}$ searches (Since 2018):** Leader of current iteration of the search, looking for new heavy vector resonances decaying into a top quark and a bottom quark, using the complete run-2 dataset. Preliminary results on the $W' \rightarrow t\bar{b} \rightarrow qqbb$ channel published in 2021, significantly improving the sensitivity with respect to previous analyses from both ATLAS and CMS. Complete paper under preparation combining both decay channels. Supervision of two students, one of them graduated in 2021.
- **Completed $b\bar{b}Z' \rightarrow b\bar{b}b\bar{b}$ search (2019-2022):** Responsible for the definition and study of new signal samples using Madgraph and performed the truth-level analyses needed to determine the analysis strategy. This novel analysis published in 2022 was focused on vector-like resonances that couple exclusively to third generation quarks. Specially relevant in the context of models incorporating lepton flavour universality violation.
- **Convener of Heavy Quarks, Top and composite Higgs (HQT) subgroup (2019-2021):** Managed search subgroup, part of the exotics group, focused on physics beyond the SM with final states of third generation quarks. Coordinated 20 analyses with approximately 200 analysers under my care dealing with many resonance searches and the full ATLAS programme of VLQ analyses. Reviewed relevant talks, internal notes and papers. Organised meetings and dedicated discussions. Advised the exotics group conveners on overall group matters.
- **Completed $VLB \rightarrow bh(bb)$ search (2019-2021):** Participated as HQT convener in the full run-2 version of the analysis, with preliminary results published in 2021. Supervised the main analyser, a student, graduated the same year. The analysis took advantage of an innovative background estimation method to improve the sensitivity with respect to previous VLB searches in a challenging all-hadronic final-state.
- **Completed $Z' \rightarrow t\bar{t}$ search (2019-2020):** Participated as HQT convener in the all-hadronic, full run-2 version of the analysis, published in 2020. Worked closely with the team in the validation of the background estimation process, based on a functional form. First analysis to introduce deep neural network top-taggers in ATLAS.
- **Completed $W' \rightarrow t\bar{b}$ searches (2016-2019):** Main analyser of first 13 TeV iteration of $W' \rightarrow t\bar{b} \rightarrow qqbb$ search, published in 2018. Led on statistical analysis, framework development and strategy design. Responsible for sample generation and truth-level studies for the same search and another on the complementary channel, $W' \rightarrow t\bar{b} \rightarrow l\nu b\bar{b}$. Combination of both searches published in 2019.

Physics measurements of standard model processes

2013-2017

AS GRADUATE STUDENT WITH UNIVERSIDAD AUTÓNOMA DE MADRID

- Led new physics analysis effort in the Standard Model group for the photon + jets analysis at 8 TeV, published in 2017. Performed differential cross section measurements as a function of 15 different observables in events with one photon and up to three additional jets. First test of color coherence effects in photon + jets events in ATLAS.

Jet reconstruction performance studies

2013-2015

AS GRADUATE STUDENT WITH UNIVERSIDAD AUTÓNOMA DE MADRID

- Developed new top-quark reconstruction method combining the advantages of the Kt and the anti-Kt jet algorithms to achieve good identification efficiency in addition to good reconstruction of the top-quark kinematics.

Liquid argon (LAr) calorimeter operations

2011-2013

AS GRADUATE STUDENT WITH UNIVERSIDAD AUTÓNOMA DE MADRID

- **LAr run coordinator (2011-2013):** Led of the LAr operations team, managing a team of around 15 experts and shifters. The team ensured the smooth operation of LAr within the ATLAS detector during the whole 8 TeV data taking period. Point of contact between the LAr operations team and ATLAS management.
- **LAr software on-call (2011-2013):** Expert position available 24 hours a day to investigate and repair issues related to the LAr online software and back-end electronics
- **LAr online software developer (2011-2013):** Developed two tools running on the ATLAS online framework during data taking. One tool to investigate single event upsets in LAr front-end boards and a monitoring tool to check the LAr configuration at the beginning of each run.

Calibration Hits Method Developer

2011-2012

AS GRADUATE STUDENT WITH UNIVERSIDAD AUTÓNOMA DE MADRID

- In charge of the framework processing the dedicated simulations with detailed detector information used to calibrate electron and photons in ATLAS. Developed new machine learning based implementation. Electron performance studies published in 2012.