Dr Héctor de la Torre Pérez

Research associate · Michigan State University

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Education

PhD in Physics
Madrid, Spain

Universidad Autónoma de Madrid — *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
Madrid, Spain

Universidad Autónoma de Madrid — *January 2011*

BSc in Physics
Madrid, Spain

Universidad Autónoma de Madrid — *September 2008*

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

Fellowships and contracts

Research associate
East Lansing, USA

Michigan State University — *Since May 2016*

Research contract
Madrid, Spain

Universidad Autónoma de Madrid — *August 2013 - April 2016*

FPU fellowship of the Spanish Ministry of Education and Science
Madrid, Spain

Universidad Autónoma de Madrid — *August 2009 - August 2013*

Internship in the summer student programme
Hamburg, Germany

Deutsches Elektronen-Synchrotron (DESY) — *July 2007 - September 2007*

Positions and appointments

Leadership positions

Analysis contact: $W' \to tb$ at 13 TeV	Exotics group, ATLAS Collaboration	*Since Nov. 2018*
Convener	HQT subgroup, ATLAS Collaboration	*Jan. 2019 - Mar. 2021*
Analysis contact: γ+jets measurement at 8 TeV	Standard model group, ATLAS Collaboration	*Sep. 2015 - Mar. 2017*
Run coordinator	LAr calorimeter group, ATLAS Collaboration	*Nov. 2011 - Jan. 2013*

Editor and reviewer roles

Editorial board: Mono-top search at 13 TeV	Exotics group, ATLAS Collaboration	*Since Aug. 2021*
Referee	Journal of High Energy Physics	*Since May 2021*
Expert reviewer and sign-off, several searches	ATLAS Collaboration	*Since April. 2021*
Thesis committee member	Universidad de Valencia	*Defended Jan. 2022*
Thesis committee member	Universidad Autónoma de Madrid	*Defended Dec. 2021*
Paper editor: $W' \to tb$ at 13 TeV preliminary results	Exotics group, ATLAS Collaboration	*Published Aug. 2021*
Paper editor: γ+jets measurement at 8 TeV	Standard model group, ATLAS Collaboration	*Published Mar. 2017*

Teaching, supervision and mentoring

Graduate student supervision	Three current students, two more graduated in 2021	*Since May 2016*
Student mentoring	Women and Minorities in the Physical Sciences, MSU	*Summer 2021*
Physics and math mentoring and teaching	High-school and undergraduate levels, Private tuition	*Jan. 2006 - Dec. 2009*

Other appointments in the ATLAS Collaboration

Derivation contact	Exotics group	*Since Oct. 2021*
Heavy resonance combination liaison	HQT subgroup	*Since Sept. 2018*
Monte Carlo production contact	Exotics and Upgrade physics groups	*Jan. 2017 - Jan. 2019*
Production manager for upgrade samples	MC production group	*Jan. 2017 - April. 2018*
Software on-call expert	LAr calorimeter group	*Aug. 2011 - Jan. 2013*
Developer and maintainer of the Calibration Hits Method	Egamma group	*Feb. 2010 - Aug. 2011*

International conferences and seminars

14th Conference on the Intersections of Particle and Nuclear Physics (CIPANP 2022) — *Lake Buena Vista, USA*
Convener of the Physics at High Energies sessions (Organising) — *May 2022 (in preparation)*

40th International Conference on High Energy Physics (ICHEP 2020) — *Virtual conference*
Search for new physics in final states with heavy-flavour quarks using the ATLAS detector — *August 2020*

US ATLAS Physics Workshop 2019 — *Amherst, USA*
Overview of the Exotics search program: present and future — *August 2019*

39th International Conference on High Energy Physics (ICHEP 2018) — *Seoul, South Korea*
Expected performance of the upgraded ATLAS experiment for HL-LHC — *July 2018*

ATLAS Overview Week 2018 — *Tokyo, Japan*
Physics studies for the HL(HE)-LHC — *June 2018*

Deep Inelastic Scattering 2017 (DIS 2017) — *Birmingham, United Kingdom*
High- E_{T} isolated-photon plus jets production in pp collisions at $\sqrt{s} = 8\,\mathrm{TeV}$ with the ATLAS detector — *April 2017*

ATLAS TDAQ week 2016 — *Barcelona, Spain*
Implementing trigger clustering algorithms for Phase 2 — *September 2016*

6th International Workshop on QCD at the LHC (QCD@LHC2015) — *London, United Kingdom*
Measurements of jet and photon production in pp collisions with the ATLAS detector — *September 2015*

Calorimetry for the High Energy Frontier 2013 (CHEF2013) — *Paris, France*
Status of the ATLAS Liquid Argon Calorimeter and its performance after three years of LHC operation — *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. 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 [hep-ex]`
2. 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`
3. ATLAS Collaboration, *Search for single vector-like B quark production and decay via $B \to bH(b\bar{b})$ in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, ATLAS-CONF-2021-018, 2021, URL: `https://cds.cern.ch/record/2760012`
4. 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 [hep-ex]`
5. 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 [hep-ex]`
6. 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 [hep-ph]`
7. ATLAS Collaboration, *Search for $W' \to tb$ 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 [hep-ex]`
8. 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
9. 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`
10. 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 [hep-ex]`
11. ATLAS Collaboration, *Electron performance measurements with the ATLAS detector using the 2010 LHC proton–proton collision data*, Eur. Phys. J. C **72** (2012) 1909, arXiv: `1110.3174 [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 $VH, H \to b\bar{b}$ 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, $W' \to tb$ and $Z' \to t\bar{t}$.
- **Ongoing $W' \to tb$ 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 $W' \to tb \to qqbb$ 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 $b\bar{b}Z' \to b\bar{b}b\bar{b}$ 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 $VLB \to bh(bb)$ 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 $Z' \to t\bar{t}$ 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 $W' \to tb$ searches (2016-2019):** Main analyser of first 13 TeV iteration of $W' \to tb \to qqbb$ 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, $W' \to tb \to l\nu bb$. 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.