Francisco Martínez López

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Education

2021 – 2024 **Ph.D.** in Particle Physics — Queen Mary University of London, UK and University of Southampton, UK

I worked within the DUNE collaboration under the supervision of Dr. Linda Cremonesi, Prof. Stefano Moretti and Prof. Claire Shepherd-Themistocleous. I passed my viva on December 2024.

My research focuses on the development of the simulation and reconstruction software for a candidate near detector design for DUNE using gaseous argon. I developed the particle identification algorithms of the detector using traditional reconstruction techniques as well as machine learning methods. Moreover, I put together the infrastructure to produce analysis-ready files for the detector, to be used in the long baseline analysis.

Furthermore, I have worked on the data acquisition system of the DUNE far detector, developing techniques to allow for triggering on low-energy events. Also, I explored the capabilities of the far detector to detect neutrino fluxes from Dark Matter annihilations inside the Sun.

From May 2021 to June 2022 I was based at Rutherford Appleton Laboratory (Didcot, Oxfordshire, UK), where I primarily worked on the validation of the firmware-based trigger primitive generation for the DUNE FD.
From June 2022 to July 2023 I was based at CERN (Geneva, Switzerland), working on the commissioning of the DAQ for ProtoDUNE-II at the HD and VD ColdBox setups.

2019 – 2020 **M.Sc.** in Theoretical Physics — Universitat de València, Spain

Dissertation title: "TeV-scale bulk neutrino in warped extra-dimensions as a DM candidate".
Study of the possibility to identify one of the right-handed neutrinos entering the type-I seesaw mechanism as a Dark Matter candidate, within the warped extra-dimensions paradigm. I explored the parameter space of the model, study the current experimental bounds, determine its potential flaws and finally propose a series of extensions to solve them.

2015 – 2019 **B.Sc.** in Physics — Universidad de Murcia, Spain

Dissertation title: "The information loss paradox".
Review of the black hole information paradox, discussing the case of a free scalar field propagating in a curved spacetime. I studied how the paradox arises from the entanglement between the radiation quanta and the mass in the black hole, and showed how asymptotic symmetries might help solve the problem.

Teaching experience

2022 – present Mentoring and Student Support — Queen Mary University of London, UK and CERN, Switzerland

As a senior student with a wide experience of the DUNE software stack, I have been able to mentor fellow student both at the university and at CERN. I have supported new PhD students in the Queen Mary neutrino group, helping them with both university-related and technical problems. Also, during my stay at CERN, I mentored a M.Sc. student working on DUNE DAQ. We had meetings every month to advise them on their project. Similarly, I have supported undergraduate students working on DUNE ND-GAr projects at Queen Mary.

January – May 2024 Machine Learning and Artificial Intelligence Queen Mary University of London, UK

I was demonstrating for the module, in a class of 30 undergraduate students, 4 hours of class per week during 11 weeks. I helped the students with their coding assessments and any other queries about the module and its contents. Additionally, I assessed their work, checking the state and quality of their code, as well as their theory knowledge.

Conferences and schools

- **PIC 2024**, International Symposium on Physics in Collision, October 2024.
  "DUNE: science and status", on behalf of the DUNE collaboration.
- **Neutrino 2024**, International Conference on Neutrino Physics and Astrophysics, June 2024.
  Poster: "Developing the Reconstruction of a Magnetised Gaseous Argon TPC for the DUNE Near Detector".
- **Institute of Physics**, High Energy Particle Physics, Astroparticle Physics and Nuclear Physics Annual Conference, April 2024.
  "Developing the Reconstruction of a Magnetised Gaseous Argon TPC for the DUNE Near Detector".
- **NuPhys 2023**, Prospects in Neutrino Physics, December 2023.
  Poster: "A Magnetised High-Pressure Gaseous Argon TPC for the DUNE Near Detector".
- **Institute of Physics**, High Energy Particle Physics and Astroparticle Physics Annual Conference, April 2023.
  Poster: "Searching for Dark Matter in the Sun using DUNE".
- **Institute of Physics**, High Energy Particle Physics and Astroparticle Physics Annual Conference, April 2022.

Selected publications

- DUNE Collaboration, "*DUNE Phase-II: Scientific Opportunities, Detector Concepts, Technological Solutions*", JINST **19**, 12, P12005 (2024).
- DUNE Firmware Readout Group, "*Firmware Trigger Primitive Generation in DUNE Data Acquisition System*", DUNE Technical Note, DUNE-doc-29412 (2023).
- DUNE DAQ Project, "*Trigger and Data AcQuisition (TDAQ) System Design*", DUNE-DAQ Design Review, EDMS-2826454 (2022).
- DUNE Collaboration, "*First measurement of the total inelastic cross section of positively charged kaons on argon at energies between 5.0 and 7.5 GeV*", Phys.Rev.D **110**, 9, 092011 (2024).
- DUNE Collaboration, "*Performance of a modular ton-scale pixel-readout liquid argon time projection chamber*", Instruments **8**, 3, 41 (2024).
- DUNE Collaboration, "*Doping Liquid Argon with Xenon in ProtoDUNE Single-Phase: Effects on Scintillation Light*", JINST **19**, 08, P08005 (2024).
- DUNE Collaboration, "*Impact of cross-section uncertainties on supernova neutrino spectral parameter fitting in the Deep Underground Neutrino Experiment*", Phys. Rev. D **107**, 11, 112012 (2023).
- DUNE Collaboration, "*Identification and reconstruction of low-energy electrons in the ProtoDUNE-SP detector*", Phys. Rev. D **107**, 9, 092012 (2023).

Outreach

May 2024 – present **DUNE Education and Outreach Committee**

In May 2024 I was appointed Young DUNE representative on the DUNE Education and Outreach Committee. My primary role is to early-career members of the collaboration, as well as manage the social media accounts of DUNE.

July 2024 **DUNE Royal Society Exhibition**

Volunteer on the DUNE exhibit at the Royal Society Summer Science Exhibition 2024. This is a week-long event which brings cutting-edge research to the general public. As volunteers, we introduce visitors to the science of DUNE and guide them through the different items of the stand.

Personal skills

Languages

Spanish:	native speaker
English:	fluent
French:	basic

Computer skills

Operating systems:	macOS, Linux, Windows
Programming languages:	Python, C/C++, FORTRAN, Unix/Bash
Others:	LaTeX, ROOT, TensorFlow

References

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□ **Dr. Patrick J. Dunne**, DUNE ND-GAr group co-convener
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□ **Prof. Alysia D. Marino**. DUNE ND-GAr group co-convener
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□ **Dr. Alessandro Thea**, DUNE DAQ Consortium leader
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