

Pablo Villanueva Domingo

PhD in Physics & Data Scientist

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I recently obtained my **PhD in theoretical physics** at the Instituto de Física Corpuscular. During my research, I have led international collaborations, presenting the results in multiple seminars and conferences. I have focused on employing **data analysis** and **deep learning** techniques in cosmology, which now I aim to apply in data science and industry. See section [Skills](#) for details on my machine learning and data analysis experience.

Personal data

Present position Research assistant at the Instituto de Física Corpuscular (IFIC) - Universitat de València (UV).
Webpage <https://PabloVD.github.io/>
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INSPIRE-HEP [P.Villanueva.Domingo.1](https://inspirehep.net/literature/1811111)
Main interests Machine Learning, Deep learning, Data science, Natural Language Processing.
Research Cosmology, Dark Matter, 21 cm cosmology, Reionization, Primordial Black Holes.

Education

2016-2021 **PhD in Physics, *cum laude***, Instituto de Física Corpuscular - Universitat de València.
PhD thesis: [Shedding light on Dark Matter through 21 cm Cosmology and Reionization constraints](#).
Advisors: Olga Mena Requejo, Sergio Palomares Ruiz.
2015-2016 **Master in Advanced Physics**, Speciality in theoretical physics. Universitat de València .
2011-2015 **Bachelor of Physics**, Universitat de València.

Fellowships, contracts & awards

2021-Now Research contract *Técnico superior de apoyo a la investigación, CIDEAGENT/2018/019, CPI-21-108*. Instituto de Física Corpuscular.
2017-2021 PhD fellowship *Ayuda para contrato predoctoral para la formación de doctores (FPI), Ref. SEV-2014-0398-16-3* . Instituto de Física Corpuscular.
Dec. 2016 1st prize, in collaboration with Jaime Bautista Navío, in the *XXVII edición del Premio Rotary al Fomento del Trabajo Experimental en Física* awarded by the Rotary Club Valencia-Centro.
Advisor: Vicent J. Martínez.
Title of the work: *Medida del brillo superficial límite con corrientes de marea*.
2016-2017 PhD contract *Sabor y origen de la materia (SOM).CPI-16-242. PROMETEU per a grups d'investigació d'Excel·lència de la Conselleria d'Educació, Cultura i Esport. CPI-16-242* . Instituto de Física Corpuscular.
2016 Research introduction fellowship *Iniciación a la investigación Severo Ochoa*. Instituto de Física Corpuscular.

Seminars

Dec. 6 2019 *Constraining Dark Matter scenarios through 21 cm cosmology*. Université Libre de Bruxelles, Brussels, Belgium.

- Oct. 14 2019 *Constraining Primordial Black Hole scenarios with 21 cm cosmology*. Department of Astrophysical Sciences, Princeton University, USA.
- May 6 2019 *Exploring Dark Matter scenarios through 21 cm Cosmology*. IFIC.
- Dec. 7 2018 *Constraints on Dark Matter scenarios through 21 cm Cosmology*. IFIC.
- Oct. 25 2018 *Constraining astrophysical and Dark Matter scenarios with EDGES and Reionization data*. University of Nagoya, Japan.
- Oct. 23 2018 *Constraining astrophysical and Dark Matter scenarios with EDGES and Reionization data*. Kavli IPMU, University of Tokyo, Japan.

Conferences, workshops & meetings

- Jul. 2021 *CAMELS meeting*, online, organized by Princeton University and Flatiron CCA.
 - **Talk:** *Predicting halo masses with Graph Neural Networks*.
- Nov. 2020 *AI@IFIC (Artificial Intelligence at IFIC)*. Instituto de Física Corpuscular.
 - **Talk:** *Recovering the Dark Matter density field from 21cm maps via CNNs*.
- Apr. 2020 Hackaton *CoronaHack - AI vs. Covid-19*. Online, organized by mindstream-ai.
- Jun. 2019 *Invisibles19 Workshop*. Jardí Botànic de la UV, València. **Member of the local organizing committee.**
 - **Talk and poster:** *Local 21 cm signal from Primordial Black Holes*.
- Mar. 2019 Symposium *Data science symposium, bridging fundamental research and industry*. Universidade do Minho, Braga, Portugal.
- Sep. 2018 *IGM 2018: Revealing Cosmology and Reionization history with the Intergalactic Medium*. Kavli IPMU, University of Tokyo, Japan.
- May 2018 *Statistical Challenges in 21st Century Cosmology*. Universitat de València.
- Nov. 2017 *Physics opportunities with a new universe's view: the SKA radio telescope*. Instituto de Física Corpuscular.
 - **Talk:** *Warm dark matter and cosmic reionization*.
- Sep. 2017 *Meeting on Fundamental Cosmology*. Centro de Estudios de Física del Cosmos de Aragón (CEFCA).
 - **Talk:** *Warm dark matter and the ionization history of the Universe*.

Courses & schools

- Apr.-May 2020 Course *Introduction to Machine Learning for Particle Physicists*. Instituto de Física Corpuscular.
- Jun. 2019 *Invisibles19 School*. Laboratorio subterráneo de Canfranc (LSC). **Member of the local organizing committee.**
 - **Poster:** *Local 21 cm signal from Primordial Black Holes*.
- Mar. 2019 School *Data science in (astro)particle physics and cosmology: the bridge to industry*. Universidade do Minho, Braga, Portugal.
- Jun. 2018 School *Cosmological Applications from First Stars, Reionization and 21-cm Observations*. Institut de Ciències del Cosmos Universitat de Barcelona (ICCUB).
 - **Talk and poster:** *EDGES result versus CMB and low-redshift constraints on ionization histories*.
- May 2018 School *Astronomical Data Analysis school ADA IX*. Universitat de València.
- Feb. 2017 Course *Data analysis and machine learning -Phyton-*. Universitat de València.

As well as other special courses and schools on theoretical physics, cosmology and computational tools.

Research stays

- Nov.- Dec. 2019 3 weeks at Service de Physique Théorique, Université Libre de Bruxelles, Brussels, Belgium.

- Sep.- Oct. 2019 1 month at Department of Astrophysical Sciences, Princeton University, New Jersey, USA.
- Sep.- Nov. 2018 2 months at Kavli IPMU, University of Tokyo, Japan, within the project *RISE InvisiblesPlus(69057–InvisiblesPlus–H2020–MSCA–RISE)*.
- Jun.- Jul. 2018 1 month at Institut de Ciències del Cosmos - Universitat de Barcelona (ICCUB).
- Apr.- May. 2018 1 month at Institut de Ciències del Cosmos - Universitat de Barcelona (ICCUB).
- Jun.- Aug. 2017 2 months at Fermi National Accelerator Laboratory (Fermilab), Illinois, USA, within the project *RISE InvisiblesPlus(69057–InvisiblesPlus–H2020–MSCA–RISE)*.

Skills

Computation

- Programming Python (NumPy, SciPy, Matplotlib, pandas...), C, C++, C#, Fortran, SQL, HTML, CSS, JavaScript.
- Software Mathematica, LaTeX, MATLAB, Gnuplot.
- Data scraping Beautiful Soup, tweepy.

Machine Learning

- ML packages PyTorch, Tensorflow/Keras, PyTorch Geometric, Scikit-learn.
- Neural Nets Convolutional Neural Nets (CNNs), U-Nets, Generative Adversarial Nets (GANs), Graph Neural Nets (GNNs), Long short-term memory (LSTM).
- Other Random forests, Natural Language Processing, Reinforcement Learning.
[See my webpage for some examples of my work with neural networks.](#)

Languages

Spanish (mother tongue), Catalan (mother tongue), English (fluent), Portuguese (basics).

Outreach & additional work experience

- Feb. 2021 [Outreach video](#) about the astronomer Sandra M. Faber within the project *Pioneras - Recordando a Lise Meitner*.
- 2020 - Now Journal referee for Monthly Notices of the Royal Astronomical Society (MNRAS).
- 2016 - 2017 Collaboration in the organization of the outreach event *Feria-Concurso Experimental*. València.
- Apr. - May 2016 Research work: *Baryonic acoustic oscillations and wavelets*. Observatorio Astronómico de la Universitat de València (OAUV). Advisors: Vicent J. Martínez, Pablo Arnalte Mur.
- 2013 Teacher of private math and physics lessons.

Publications

- May 2021 Pablo Villanueva-Domingo, Olga Mena and Sergio Palomares-Ruiz.
A brief review on primordial black holes as dark matter.
[Front. Astron. Space Sci.](#), 28 May 2021; [arXiv:2103.12087](#)
- Apr. 2021 Pablo Villanueva-Domingo and Kiyotomo Ichiki.
21 cm Forest Constraints on Primordial Black Holes.
[arXiv:2104.10695](#)
- Jan. 2021 Pablo Villanueva-Domingo and Francisco Villaescusa-Navarro.
Removing Astrophysics in 21 cm maps with Neural Networks.
[The Astrophysical Journal](#), 907(1):44, 2021; [arXiv:2006.14305](#)
- Jun. 2020 Laura Lopez-Honorez, Olga Mena, Sergio Palomares-Ruiz, Pablo Villanueva-Domingo and Samuel J. Witte.
Variations in fundamental constants at the cosmic dawn.
[JCAP](#), 2006(06):026, 2020; [arXiv:2004.00013](#)

- Apr. 2020 Pablo Villanueva-Domingo, Olga Mena and Jordi Miralda-Escudé.
Maximum amplitude of the high-redshift 21-cm absorption feature.
[Phys. Rev. D101\(8\):083502, 2020; arXiv:1912.09488](#)
- Aug. 2019 Olga Mena, Sergio Palomares-Ruiz, Pablo Villanueva-Domingo, and Samuel J. Witte.
Constraining the primordial black hole abundance with 21-cm cosmology.
[Phys. Rev., D100\(4\):043540, 2019; arXiv:1906.07735](#)
- Jan. 2019 Laura Lopez-Honorez, Olga Mena and Pablo Villanueva-Domingo.
Dark Matter microphysics and 21 cm observations.
[Phys. Rev., D99\(2\):023522, 2019; arXiv:1811.02716](#)
- Jun. 2018 Miguel Escudero, Laura Lopez-Honorez, Olga Mena, Sergio Palomares-Ruiz and Pablo Villanueva-Domingo.
A fresh look into the interacting dark matter scenario.
[JCAP, 1806\(06\):007, 2018; arXiv:1803.08427](#)
- May 2018 Samuel Witte, Pablo Villanueva-Domingo, Stefano Gariazzo, Olga Mena and Sergio Palomares-Ruiz.
EDGES result versus CMB and low-redshift constraints on ionization histories.
[Phys. Rev., D97\(10\):103533, 2018; arXiv:1804.03888](#)
- Apr. 2018 Pablo Villanueva-Domingo, Stefano Gariazzo, Nickolay Y. Gnedin and Olga Mena.
Was there an early reionization component in our universe?
[JCAP, 1804\(04\):024, 2018; arXiv:1712.02807](#)
- Jan. 2018 Pablo Villanueva-Domingo, Nickolay Y. Gnedin, and Olga Mena.
Warm Dark Matter and Cosmic Reionization.
[The Astrophysical Journal, 852\(2\):139, 2018; arXiv:1708.08277](#)
- Nov. 2017 Laura Lopez-Honorez, Olga Mena, Sergio Palomares-Ruiz and Pablo Villanueva-Domingo.
Warm dark matter and the ionization history of the Universe.
[Phys. Rev., D96\(10\):103539, 2017; arXiv:1703.02302](#)

References

Dr. Olga Mena Requejo

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