

Research Fellow in explainable artificial intelligence and cosmology at University College London
Member of the Physics & Astronomy group and the Cosmoparticle Initiative

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WORK

[UCL – University College London](#) (UK) since 2021
Research Fellow in explainable AI applied to cosmology.
PIs: Hiranya Peiris and Andrew Pontzen.

EDUCATION

[UCL – University College London](#) (UK) 2017-2021
Doctor of Philosophy (PhD) in Data Intensive Science, 4-year programme.
Advisors: Benjamin Joachimi and John Shawe-Taylor.
Thesis: [Accelerating inference in cosmology and seismology with machine learning](#).

[University of Padova](#) (Italy) 2015-2017
2-year master course in Physics. Final grade: 110/110 *cum laude*.
Advisor: Sabino Matarrese.
[Final project](#) on characterising the intrinsic alignment of bright structures in dark matter haloes using simulation and real data.

[University of Padova](#) (Italy) 2012-2015
Undergraduate course in Physics. Final grade: 110/110 *cum laude*.
Advisor: Denis Bastieri.
[Final project](#) on testing various phenomenological dark matter models using Fermi LAT data.

INDUSTRY

[Faculty AI](#) (UK) 2020
8-month internship in the R&D team working on privacy, fairness, explainability and robustness in the context of artificial intelligence (AI). I collaborated with data scientists and software engineers to develop AI solutions for other companies and organisations. My work led to a scientific publication on data privacy submitted to a major machine learning conference.

[ASI Data Science](#) (UK) 2018
4-month group project in natural language processing applied to topic modelling. We developed and built an interactive web interface for fast topic modelling of large corpora of text.

SELECTED PUBLICATIONS

MNRAS: Monthly Notices of the Royal Astronomical Society

GJI: Geophysics Journal International

1. [Fast and realistic large-scale structure from machine-learning-augmented random field simulations](#)
D. Piras, B. Joachimi, F. Villaescusa-Navarro. Submitted to MNRAS.
We produced a dataset of pairs of highly correlated cheap and expensive dark matter fields, and trained a machine-learning model to learn the mapping between the two. I devised the idea, produced the dataset, ran the experiments and wrote the paper.
2. [CosmoPower: emulating cosmological power spectra for accelerated Bayesian inference from next-generation surveys](#)
A. Spurio Mancini, **D. Piras**, J. Alsing, B. Joachimi, M. P. Hobson. 2022. MNRAS, 511 (2), 1771-1788.
We developed neural emulators of cosmological power spectra that can speed up cosmological Bayesian inference by many orders of magnitude. I led part of the analysis, helped with the development of the remainder and wrote the corresponding parts of the paper.
3. [Towards fast machine-learning-assisted Bayesian posterior inference of realistic microseismic events](#)
D. Piras, A. Spurio Mancini, B. Joachimi, M. P. Hobson. 2021. Submitted to GJI.
We used machine learning techniques to speed up the Bayesian inference of any type of microseismic event and identify the source type. I devised the algorithms, implemented the experiments, validated the results and wrote the paper.
4. [The mass dependence of dark matter halo alignments with large-scale structure](#)
D. Piras, B. Joachimi, B. M. Schäfer, S. Hilbert, M. Bonamigo, E. van Uitert. 2018. MNRAS, 474 (1), 1165-1175.
We developed a theoretical framework to characterise the intrinsic alignment of galaxies as a function of the mass of the hosting dark matter haloes. I led the data analysis and the model verification, and wrote the paper.

The full publication list is available [at this link](#).

GRANTS & AWARDS

ATI Post-Doctoral Enrichment Award (2022, £2.0k)

To facilitate post-doctoral activity throughout the UK on topics related to data science and AI.

From: Alan Turing Institute, London.

Valentino Baccin Prize (2017, €5.0k)

For the excellent work done in preparing and publishing a master's degree thesis in the field of physics.

One prize per year among about thirty thousand students.

From: City of Bassano del Grappa, Vicenza.

Sergio Gambi Prize (2017, €2.5k)

For the best 2nd year performance among all 2-year scientific master's degrees.

Two prizes per year among about ten thousand students.

From: University of Padova, Padova.

Erasmus+ at University College London (2017, €2.5k)

6-month traineeship in the department of Physics & Astronomy. I led a scientific publication and received a PhD offer.

From: European Union.

Fermi High School Prize (2012, €1.0k)

For obtaining the highest marks in high school, which was completed one year in advance.

From: Enrico Fermi High School, Padova.

INVITED & CONTRIBUTED TALKS

Mar 2022, AI UK 2022, London, UK

Simulations of the Universe from random fields, invited

Oct 2021, Debating the potential of machine learning in astronomical surveys, IAP, Paris, France

From lognormal fields to realistic simulations, video available at [this https link](#)

May 2021, Data Science Department, SISSA, Trieste, Italy

What can data science do for cosmology?, invited

Feb 2021, CDT seminar, UCL, London, UK

Differential privacy for high-dimensional data, invited

Nov 2020, Geophysics Group Meeting, UCL, London, UK

Accelerated Bayesian inference of microseismic events using deep learning, invited

Dec 2019, Data Science for Physics and Astronomy, Alan Turing Institute, London, UK

Using machine learning to generate virtual universes

Sep 2019, CDT in DIS Annual Meeting, UCL, London, UK

Using machine learning to generate virtual universes

Jun 2019, Artificial Intelligence methods in Cosmology, ETH, Ascona, Switzerland

Generating virtual uniVAErses

May 2019, PhysAstroData Round Table, UCL, London, UK

Introduction to TensorFlow, invited

Dec 2018, CDT in DIS – Upgrade talks, UCL London, UK

Generating virtual universes

Jul 2018, STFC's Summer School in Artificial Intelligence and Machine Learning, UCL, London, UK

A semi-supervised approach to topic modelling, invited

SOFTWARE SKILLS

Python (including advanced TensorFlow and PyTorch)

C++

FORTRAN (basic)

IDL (basic)

HTML (basic)

CSS (basic)

TEACHING

UCL – University College London (UK)	2017-2021
Teaching assistant, demonstrator, marker and invigilator for the following courses:	
Practical Physics and Computing 1	Electromagnetic Theory
Classical Mechanics	Electricity and Magnetism
Practical Astrophysics and Computing	Machine Learning with Big Data
London Business School (UK)	2018-2021
Teaching assistant and demonstrator for the following courses:	
Python Programming – Master in Management	Introduction to Python for Data Science
Python Programming – Master of Business Administration	Machine Learning for Big Data
Applied Programming Course: Basic Python	Decision Analytics and Modelling
Applied Programming Course: Intermediate Python	Python for Finance

OUTREACH AND OTHER ACTIVITIES

SkillsGap panel member	2022
Took part in a panel discussion for 15–19 year olds discussing AI in astrophysics and providing career guidance	
Postgraduate outreach talk in the Department of Physics, UCL, London	2022
<i>Leap of lognormal (LOL): accelerating cosmological simulations with machine learning</i>	
UCL-Jordan Machine Learning workshops	2021
Prepared and delivered a series of 4 hands-on workshops in machine learning topics.	
UCL Data Science MSc	2020-2021
Helped MSc students by providing guidance and support through workshops and Q&A sessions.	
UCL-Jordan DIS	2020-2021
Tutored for the machine learning course held between UCL and the University of Jordan .	
ML Journal Club	2019-2021
Set up and co-hosted a machine learning journal club in the Centre for Doctoral Training in Data Intensive Science at UCL.	
MSc Open Day talk at UCL, London	2019
<i>Generating virtual universes using machine learning</i>	
For Inquisitive Minds	2019
Presented and discussed my PhD topic with experts from different fields.	
PhD peer mentoring	2018-2020
Provided friendly support to 1 st year PhD students in the Department of Physics and Astronomy at UCL.	
UCL Certificate of Higher Education in Astronomy	2018
Helped mature students by marking and providing feedback to their final dissertations.	
DataKind UK – Data Dive	2017
Collaborated to explore applications of data science to help charities during a 2-day hackathon.	