

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; Raymond Dolan.

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.

[UCL – University College London](#) (UK) 2017-2017
6-month traineeship funded by the Erasmus+ programme.

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

INDUSTRY

[Faculty AI](#) (UK) 2020
8-month internship in the most experienced Artificial Intelligence (AI) company in Europe. Worked in the R&D team dealing with AI privacy, fairness, explainability and robustness. Collaborated with data scientists, computer scientists and software engineers to develop AI solutions for companies and organisations.

[ASI Data Science](#) (UK) 2018
4-month group project in Natural Language Processing applied to topic modelling. Developed and built a web interface for fast topic modelling of large corpora of text.

PUBLICATIONS

MNRAS: Monthly Notices of the Royal Astronomical Society
NeurIPS: Neural Information Processing Systems

GJI: Geophysics Journal International
* indicates joint effort

1. [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. 2021. Submitted to MNRAS.
We developed neural emulators of cosmological power spectra that can speed up cosmological Bayesian inference by many orders of magnitude. I ran part of the analysis, helped with the development of the remainder and wrote the corresponding parts of the paper.
2. [Towards Machine Learning-Based Meta-Studies: Applications to Cosmological Parameters](#)
T. Crossland, P. Stenettorp, D. Kawata, T. Kitching, **D. Piras**, et al. 2021. Submitted to MNRAS.
We developed a machine learning method to extract measurements of cosmological parameters from scientific abstracts for historical trend analysis. I helped creating the annotation dataset and reviewed 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 algorithm, implemented the experiments, validated the results and wrote the paper.

4. [Learning to Noise: Application-Agnostic Data Sharing with Local Differential Privacy](#)
A. Mansbridge*, G. Barbour*, **D. Piras***, C. Frye, I. Feige, D. Barber. 2020. Submitted to NeurIPS 2021.
We developed a machine learning variational approach to guarantee the privacy of high-dimensional data. I co-lead the implementation and the experimental validation of the method, and helped with its theoretical design and paper writing.
5. [Accelerating Bayesian microseismic event location with deep learning](#)
A. Spurio Mancini, **D. Piras**, A. M. G. Ferreira, M. P. Hobson, B. Joachimi. 2021. Solid Earth, 12, 1683–1705.
We applied 7 different machine learning models to seismic traces to obtain a huge speed-up in the Bayesian inference of their locations. I helped devise the algorithms, lead their validation and wrote the corresponding parts of the paper.
6. [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 lead the data analysis and the model verification, and wrote the paper.

GRANTS & AWARDS

ATI Post-Doctoral Enrichment Award (2022)

Award to facilitate post-doctoral activity throughout the UK on topics related to data science and AI (£2.0k).
From: Alan Turing Institute, London.

Valentino Baccin Prize (2017)

Prize for the excellent work done in preparing and publishing a master's degree thesis in the field of Physics (€5.0k).
From: City of Bassano del Grappa, Vicenza.

Sergio Gambi Study Prize (2017)

Prize for the best 2nd year performance amongst all 2-year scientific master's degrees (€2.5k).
From: University of Padova, Padova.

Fermi High School Prize (2012)

Prize for obtaining the highest marks in high school, which was completed one year in advance (€1.0k).
From: Enrico Fermi High School, Padova.

TALKS, SEMINARS AND CONFERENCE PRESENTATIONS

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?

Feb 2021, CDT seminar, UCL, London, UK

Differential privacy for high-dimensional data

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

Accelerated Bayesian inference of microseismic events using deep learning

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

Mar 2019, MSc Open Day, UCL, London, UK

Generating virtual universes using machine learning

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 (poster session)

SOFTWARE SKILLS

Python (including advanced TensorFlow and PyTorch)	IDL (basic)
C++	HTML (basic)
FORTTRAN (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

Postgraduate outreach talk in the Department of Physics, UCL, London <i>Leap of lognormal (LOL): accelerating cosmological simulations with machine learning</i>	2022
UCL-Jordan Machine Learning workshops Prepared and delivered a series of 4 hands-on workshops in machine learning topics.	2021
UCL Data Science MSc Helping the MSc students by providing guidance and support through workshops and Q&A sessions.	2020-2021
UCL-Jordan DIS Tutor for the Machine Learning course held between UCL and the University of Jordan .	2020-2021
ML Journal Club Set up and co-hosting a journal club in machine learning in the Centre for Doctoral Training in Data Intensive Science at UCL.	2019-2021
For Inquisitive Minds An outreach podcast where I discussed my PhD topic with non-experts.	2019
PhD peer mentoring Providing friendly support to 1 st year PhD students in the Department of Physics and Astronomy at UCL.	2018-2020
UCL Certificate of Higher Education in Astronomy Helped mature students by marking and providing feedback to their final dissertations.	2018
DataKind UK – Data Dive A 2-day hackathon to explore applications of data science to help charities.	2017