Summary

Physicist, PhD in data science at UCL, 8+ years of research in machine learning applied to scientific problems.
Currently postdoctoral researcher in machine learning for astrophysics & AI consultant.
Strong statistical and programming skills, extensive experience in interdisciplinary work and mentoring.

Industry Work

SQAIX since 2024
Freelance AI consultant. Current projects on personalising education experience & improving food safety while reducing food waste.

Faculty AI 2020
8-month internship in the R&D team working on privacy, fairness, explainability and robustness for AI algorithms. Worked in a 50+ team.

Academic Work

University of Geneva since 2023
Postdoc between computer science and physics. Working for large space telescope collaborations to optimise data analysis using AI.

UCL – University College London 2021-2022
Research fellow in explainable AI. Developed novel estimator of mutual information. Started project on intuitive physics in human brain.

Education

UCL – University College London 2017-2021
4-year PhD in data intensive science. Perren PhD Prize winner. Thesis on accelerating Bayesian inference through machine learning.

University of Padova (Italy) 2015-2017
2-year physics master. 110/110 with honours. Final project on modelling physical systematics with simulations and real data.

University of Padova (Italy) 2012-2015
Physics undergraduate. 110/110 with honours. Final project on testing dark matter models using Fermi telescope data.

Software (GitHub)

Fluent | Python: TensorFlow (7+ years), JAX (4+ years), PyTorch (5+ years), numpy, scipy, pandas, scikit-learn
Advanced | C++
Basic | Fortran, IDL, HTML

Academic publications (a selection; full list at this link; 21 publications, 9 as lead author)

The future of cosmological likelihood-based inference: accelerated high-dimensional parameter estimation and model comparison
D. Piras, A. Polanska, A. Spurio Mancini, M. A. Price, J. D. McEwen. 2024. Open Journal of Astrophysics, volume 7.
We demonstrated a framework for next-generation Bayesian cosmological analyses, combining machine learning and robust statistics to perform parameter estimation and model selection. I led the data analysis and paper writing, and secured the computing resources as well.

A representation learning approach to probe for dynamical dark energy in matter power spectra
D. Piras, L. Lombriser. 2024. Physical Review D, 110, 2.
We proposed a representation learning architecture to compress multiple physical models, and showed some remarkable results when applied to a particular extension of the standard model of cosmology. I led the code implementation, data analysis, experiments and paper writing.

CosmoPower-JAX: high-dimensional Bayesian inference with differentiable cosmological emulators
D. Piras, A. Spurio Mancini. 2023. Open Journal of Astrophysics, Vol. 6. Code available here.
We developed differentiable neural emulators of cosmological power spectra in JAX, demonstrating a speed-up of up to 4 orders of magnitude in high-dimensional Bayesian inference using Hamiltonian Monte Carlo. I led the algorithm implementation, data analysis, experiments and paper writing.

A robust estimator of mutual information for deep learning interpretability
D. Piras, H. V. Peiris, A. Pontzen, L. Lucie-Smith, N. Guo, B. Nord. 2023. Machine Learning: Science and Technology. Code available here.
Shorter version accepted at the Machine Learning and the Physical Sciences workshop at NeurIPS 2022. Featured on IOP for its impact.
We developed GMM-MI, an estimator of mutual information based on Gaussian mixture models, and applied it to interpret deep representation learning models. I led the analysis, implemented and validated the algorithm, and wrote the paper.

Fast and realistic large-scale structure from machine-learning-augmented random field simulations
D. Piras, B. Joachimi, F. Villaescusa-Navarro. 2023. Monthly Notices of the Royal Astronomical Society, 520 (1).
We produced a dataset of highly-correlated cheap and expensive dark matter fields, and trained a custom GAN model to learn the mapping between the two. I devised the idea, produced the dataset, ran the experiments and wrote the paper.

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. Monthly Notices of the Royal Astronomical Society, 511 (2).
We developed neural emulators of cosmological power spectra to significantly accelerate cosmological Bayesian inference. I led part of the analysis, helped with the development of the remainder and wrote the corresponding parts of the paper.

Grants & Awards (£10k+ in personal awards, £100k+ in scholarships)

Doctoral Research Awards (2022, finalist and honourable mention)
For best PhD thesis and research in the field of natural and life sciences. Top 1% in UK. Awarded annually by the Association of British Turkish Academics.

ATI Post-Doctoral Enrichment Award (2022, £2k)
To facilitate post-doctoral activity internationally on data science and AI.12 awards across university. Awarded by the Alan Turing Institute.

Perren PhD Prize in Data Intensive Science 2020-2021 (2021, £0.3k)
In recognition of an exceptional PhD thesis submitted to the UCL Centre for Doctoral Training in Data Intensive Science. Awarded annually to 1 student.

UCL CDT in DIS studentship (2017-2021, £120k)
To pursue a PhD in data intensive science at University College London.

Valentino Baccin Prize (2017, €5k)
For the excellent work done towards a master's degree thesis in the field of physics. One prize per year among about thirty thousand students..

Sergio Gambi Prize (2017, €2.5k)
For the best performance among all 2-year scientific master's degrees. Two prizes per year among about ten thousand students.

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 (accepted).

Fermi High School Prize (2012, €1k)
For obtaining the highest marks in high school, which I completed one year in advance (4 years instead of the standard 5).

Talks & Public Engagement (a selection; 30+ talks, 10+ invited)

Feb 2025, AI+Astro talk, Geneva, CH, invited
Jan 2025, SKACH winter meeting, Bern, CH, contributed
Oct 2024, EuclidCH meeting, ISSI, Bern, CH, invited
Sept 2024, Swiss SKA days, Geneva, CH, contributed
May 2024, Cosmo21, Chania, GR, contributed
May 2024, Tea Time Chat, EPFL, Lausanne, CH, invited
Jan 2024, SKACH winter meeting, Neuchâtel, CH, contributed
Nov 2023, Debating the potential of machine learning in astronomical surveys, IAP/CCA, Paris/New York, FR/US, contributed, video
Nov 2023, Cosmo/ExGal seminar, UCL, London, UK, invited
Apr 2023, CosmoClub, ETH, Zurich, CH, invited
Dec 2022, MSSL seminar series, UCL, Surrey, UK, invited
Jul 2022, ML Summer School, UCL, London, UK, invited
Mar 2022, AI UK 2022, London, UK, invited
Oct 2021, Debating the potential of machine learning in astronomical surveys, IAP, Paris, FR, contributed, video
May 2021, Data Science Colloquium, SISSA, Trieste, IT, invited
Nov 2020, Geophysics Group Meeting, UCL, London, UK, invited
Dec 2019, Data Science for Physics and Astronomy, Alan Turing Institute, London, UK, contributed
Aug 2019, For Inquisitive Minds, invited podcast guest, discussed my PhD topic for the general public
Jun 2019, Artificial Intelligence methods in Cosmology, ETH, Ascona, CH, contributed
Jul 2018, STFC's Summer School in Artificial Intelligence and Machine Learning, UCL, London, UK, invited
Nov 2017, DataKind UK – Data Dive, collaborated on th exploration of applications of data science for charities in a 2-day hackathon

Teaching & Mentoring

University of Geneva since 2023
Teaching assistant for Labo 4 (General Relativity) master's course. Supervised master student on final project: "The power of gravitational waves".
Supervised 2 undergraduate students on project: "Machine Learning accelerated estimates on primordial gravitational waves" for *Projets d'Informatique*.

Referee for MNRAS, UKRI, STFC, JCAP, Entropy, IEEE, Geophysics, RMxAA since 2023

PhD jury member for PhD student of the University of Geneva 2025

Bath AI Society 2023
Invited speaker to discuss applications of machine learning to physical sciences with undergraduate students.

Supervisor to summer student in Geneva (Liam Staras, undergraduate, University of Cambridge) 2022

Alan Turing Institute Roundtable: How to thrive in your PhD 2022
Panel member for a discussion with 30+ UK PhD students about best practices during postgraduate studies.

SkillsGap panel member 2022
Took part in a panel discussion for 15-19 year olds discussing AI in astrophysics and providing career guidance.

UCL-Jordan Machine Learning workshops 2021
Prepared and delivered a series of 4 hands-on workshops in machine learning topics.

UCL-Jordan DIS 2021
Tutored for the machine learning course held between UCL and the University of Jordan.

London Business School 2018-2021
Teaching assistant and demonstrator for the following courses:
Python Programming for Master in Management (MiM)
Python Programming for Master of Business Administration (MBA)
Applied Programming: Basic Python
Applied Programming: Intermediate Python
Introduction to Python for Data Science
Machine Learning for Big Data
Decision Analytics and Modelling
Python for Finance

University College London (UK) 2017-2021
Teaching assistant, demonstrator, marker and invigilator for the following courses:
Practical Physics and Computing 1
Classical Mechanics
Practical Astrophysics and Computing
Electromagnetic Theory
Electricity and Magnetism
Machine Learning with Big Data