Postdoctoral researcher in machine learning applied to radio astronomy at the University of Geneva. Member of the Centre Universitaire d'Informatique. Member of SKACH and the Euclid Consortium.

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Work

University of Geneva (Switzerland)   since 2023
Postdoctoral Assistant in machine learning applied to radio astronomy. PI: Sviatoslav (Slava) Volonshynovskiy and Daniel Schaerer.

University of Geneva (Switzerland)   2022-2023
Postdoctoral Assistant in machine learning applied to cosmology. PI: Lucas Lombriser.

UCL – University College London (UK)   2021-2022
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.
Perren PhD Prize winner. 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 (published) on analysing 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 journal.

Selected Publications (full publication list available at this link; 23 publications, 10 as lead author)

MLST: Machine Learning: Science and Technology	OJAp: Open Journal of Astrophysics
MNRAS: Monthly Notices of the Royal Astronomical Society	PRD: Physical Review D
JCAP: Journal of Cosmology and Astroparticle Physics	NeurIPS: Neural Information Processing Systems

1. **Anchors no more: Using peculiar velocities to constrain H_0 and the primordial Universe without calibrators**
   D. Piras, F. Sorrenti, R. Durrer, M. Kunz. Submitted. Code available here.
   We developed a differentiable pipeline including emulators to constrain cosmological parameters using supernova data without relying on calibrators, obtaining competitive estimates of H_0. I led the data analysis, developed the pipeline and wrote the paper.

2. **ΛCDM and early dark energy in latent space: a data-driven parametrization of the CMB temperature power spectrum**
   D. Piras, L. Herold, L. Lucie-Smith, E. Komatsu. 2025. Accepted for publication on PRD. Code available here.
   We investigated optimal parameterisations of CMB temperature power spectra for two different cosmological models using representation learning. I developed the methodology and led the data analysis, software implementation, and paper writing.

3. **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. OJAp, 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.

4. **A representation learning approach to probe for dynamical dark energy in matter power spectra**
   D. Piras, L. Lombriser. 2024. PRD, 110, 2.
   We proposed a representation learning architecture to compress multiple cosmological models, and showed its remarkable results when applied to a particular extension ($w_0 w_a$CDM). I led the code implementation, data analysis, experiments and paper writing.

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

6. **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. MLST, 4, 025006. 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.

7. **Fast and realistic large-scale structure from machine-learning-augmented random field simulations**
   D. Piras, B. Joachimi, F. Villaescusa-Navarro. 2023. MNRAS, 520 (1), 668-683.
   We produced a dataset 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.

8. [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 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.

9. [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.

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 the UK. Awarded annually by the Association of British Turkish Academics, London.

[ATI Post-Doctoral Enrichment Award](#) (2022, £2k)
To facilitate post-doctoral activity throughout the UK on topics related to data science and AI.
12 awards across the entire university, 1st cohort. Awarded by the Alan Turing Institute, London.

Perren PhD Prize in Data Intensive Science 2020-2021 (2021, £300)
In recognition of an exceptional PhD thesis submitted to the UCL Centre for Doctoral Training in Data Intensive Science.
Awarded annually to 1 student out of the entire cohort (~10 students) by the UCL CDT in DIS, London.

UCL CDT in DIS studentship (2017-2021, £120k)
To pursue a PhD in Data Intensive Science at University College London. Includes £10k/year for travel and equipment.

Valentino Baccin Prize (2017, €5k)
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. Awarded by the 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. Awarded by the 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 (accepted).
Awarded by the European Union.

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).
Awarded by the Enrico Fermi High School, Padova.

Invited & Contributed Talks (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

Apr 2024, Ecogia seminar series, UniGe, Geneva, 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, Mullard Space Science Laboratory, 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 Dept., SISSA, Trieste, IT, invited

Feb 2021, CDT seminar, UCL, London, UK, invited

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

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

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

Teaching _____

[University of Geneva](#) (Switzerland)   since 2023
Teaching assistant for Labo 4 (General Relativity). 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*.

[London Business School](#) (UK)   2018-2021
Teaching assistant and demonstrator for the following courses:

Python Programming for Master in Management (MiM)	Applied Programming: Basic Python	Decision Analytics and Modelling
	Applied Programming: Intermediate Python	Python for Finance
Python Programming for Master of Business Administration (MBA)	Introduction to Python for Data Science	
	Machine Learning for Big Data	

UCL – University College London (UK)		2017-2021

Teaching assistant, demonstrator, marker and invigilator for the following courses:

Practical Physics and Computing 1	Practical Astrophysics and Computing	Electricity and Magnetism
Classical Mechanics	Electromagnetic Theory	Machine Learning with Big Data

Software Skills _____

Advanced: Python (including TensorFlow, JAX, PyTorch), C++. *Basic*: FORTRAN, IDL, HTML, CSS.

Refereeing & Examination Panels _____

Referee for MNRAS, UKRI, STFC, JCAP, Entropy, IEEE Signal Processing Letters, Geophysics, RMxAA	since 2023
PhD jury member for Christopher Finlay (University of Geneva)	2025
Supervisor to summer student in Geneva (Liam Staras, undergraduate, University of Cambridge)	2023
Panel member to select undergraduate students for a paid Research Experience Placement	2022

"From galaxies to the earth: studying earthquakes with astronomical machine learning", funded by the London NERC DTP.

Outreach & Public Engagement _____

— Bath AI Society	2023

Invited speaker to discuss applications of machine learning to physical sciences with undergraduate students.

— 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
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
Title: *Leap of lognormal (LOL): accelerating cosmological simulations with machine learning*.

— UCL-Jordan Machine Learning workshops	2021

Prepared and delivered a series of 4 hands-on workshops in machine learning topics.
— UCL Data Science MSc
Helped MSc students by providing guidance and support through workshops and Q&A sessions.
— UCL-Jordan DIS
Tutored for the machine learning course held between UCL and the University of Jordan.

— ML Journal Club	2020

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

Title: *Generating virtual universes using machine learning*.
— For Inquisitive Minds
Presented and discussed my PhD topic during a podcast with experts from different fields.

— PhD peer mentoring	2018

Provided friendly support to 1st year PhD students in the Department of Physics and Astronomy at UCL.
— UCL Certificate of Higher Education in Astronomy
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.