Noemi Anau Montel

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Research Interests

My research interests lie towards analyzing complex astrophysical and cosmological datasets at various observable scales for new physics searches. In particular, my work uses novel probabilistic machine learning techniques - simulation-based inference, generative modeling, and differentiable programming - to develop innovative data analysis pipelines and statistical algorithms. The aim is to alleviate the statistics challenges facing the fields of astrophysics and cosmology in light of high-quality data from current and future observatories. On the application side, I am working on gravitational lensing, large scale structure, and gamma-ray data.

Education

ORCiD

University of Amsterdam, GRAPPA Institute — **Amsterdam, NL**
Ph.D. in Physics — Oct. 2020 – present
Advisor: Christoph Weniger

Università di Torino — **Torino, IT**
M.Sc. (Hons.) in Theoretical Physics — Oct. 2018 – Jul. 2020
Advisor: Nicolao Fornengo

Università di Torino — **Torino, IT**
B.Sc. (Hons.) in Physics — Oct. 2015 – Jul. 2018

Publications

arXiv Inspire HEP

6. N. Anau Montel, J. Alvey, C. Weniger, *Scalable inference with Autoregressive Neural Ratio Estimation*, [arXiv:2308.08597]
5. K. Karchev, N. Anau Montel, A. Coogan, C. Weniger, *Strong-Lensing Source Reconstruction with Denoising Diffusion Restoration Models*, Machine Learning and the Physical Sciences Workshop at the 36th Conference on Neural Information Processing Systems (NeurIPS 2022) [Paper] [Poster] [arXiv:2211.04365]
4. N. Anau Montel, C. Weniger, *Detection is truncation: studying source populations with truncated marginal neural ratio estimation*, Machine Learning and the Physical Sciences Workshop at the 36th Conference on Neural Information Processing Systems (NeurIPS 2022) [Paper] [Poster] [arXiv:2211.04291]
3. A. Coogan, N. Anau Montel, K. Karchev, M. W. Grootes, F. Nattino, C. Weniger, *The effect of the perturber population on subhalo measurements in strong gravitational lenses*, [arXiv:2209.09918]
2. C. Correa, M. Schaller, S. Ploeckinger, N. Anau Montel, C. Weniger, S. Ando, *TangoSIDM: Tantalizing models of Self-Interacting Dark Matter*, Mon.Not.Roy.Astron.Soc. 517 (2022) 3045 [arXiv:2206.11298]
1. N. Anau Montel, A. Coogan, C. Correa, K. Karchev, C. Weniger, *Estimating the warm dark matter mass from strong lensing images with truncated marginal neural ratio estimation*, Mon.Not.Roy.Astron.Soc. 518 (2023) 2746 [arXiv:2205.09126]

Scientific Presentations

† = remote, ⋆ = poster

Presentations to broad and specialized audiences in physics, astrophysics, and machine learning:

- GRAPPA 10 year anniversary conference [slides] — Amsterdam, NL, Jul. 2023
- The Road to Differentiable and Probabilistic Programming in Physics [slides] — Munich, DE, Jun. 2023
- Third EuCAPT annual symposium at CERN [slides] — Geneva, CH, May. 2023
- Cosmic Connections (Symposium at Flatiron Institute) ⋆ — New York (NY), US, May. 2023
- Novel approaches to characterise the Galactic Centre Excess [slides] — Annecy, FR, Mar. 2023
- Simulation-based inference with Swyft Workshop [slides] — Amsterdam, NL, Jan. 2023
- NeurIPS 2022, ML and the Physical Sciences Workshop ⋆ [poster] — New Orleans (LA), US, Dec. 2022
- Identification of Dark Matter (IDM) 2022 [slides] — Vienna, AU, Jul. 2022
- Likelihood-free in Paris [slides] — Paris, FR, Mar. 2022
- UK National Astronomy Meeting (NAM) 2021 † [slides] — Jul. 2021

Teaching and Supervising Experience

Teaching assistant (designing and leading tutorials) for the following master courses:

- Advanced Cosmology (16 hours) — Winter 2024
- Machine Learning for Physics and Astronomy (64 hours) — Spring 2022, 2023
- Quantum Field Theory 3 (16 hours) — Winter 2023
- Quantum Field Theory (32 hours) — Fall 2020

Project supervisor for 3 MSc students [Auke Schuringa (2023-present), Spyrydon Markesinis (2022-2023), Elias Dubbeldam (2021-2022)] and 1 BSc student [Dan Hagen (2022)].

Workshops and Schools

- ISAPP School on Exploring the Dark Universe — Texel, NL, Nov. 2023
- MIAPbP Workshop on Differentiable and Probabilistic Programming — Munich, DE, May. 2023
- Lorentz Center School on Fundamentals of the Universe — Leiden, NL, Apr. 2023
- GGI School on Astroparticle Physics, Cosmology and Gravitation — Firenze, IT, Mar. 2021 and 2022

Professional Services and Community

- *Workshop Reviewer*, NeurIPS Machine Learning and the Physical Sciences Workshop — 2023
- *Co-Organizer*, Simulation-based inference with Swyft Workshop — 2023
- *Member*, GRAPPA Colloquium Committee — 2022 – Present

Skills

Programming: Python (including `PyTorch`, `Pyro`, `JAX`); bash; vim; slurm; Git; basic ability with C++.

Languages: fluent English, native Italian, intermediate French.