

# Adam Coogan

Curriculum vitae

🌐 <https://adam-coogan.github.io/>

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**Objective** I aim to uncover the fundamental properties of dark matter in complex astrophysical datasets by creating new statistical analyses and physics models.

**Experience** **Université de Montréal and Mila**, Montréal, Canada  
Postdoctoral researcher, October 2021 — present  
Supervisors: Yashar Hezaveh and Laurence Perreault Levasseur  
**GRAPPA, University of Amsterdam**, Amsterdam, The Netherlands  
Postdoctoral Researcher, October 2018 — October 2021  
eTEC-BIG postdoc ([DarkGenerators project](#)), January 2021 — October 2021  
Supervisors: Gianfranco Bertone and Christoph Weniger

**Education** **University of California Santa Cruz**, Santa Cruz, CA, USA  
Ph.D., Physics, September 2012 — August 2018  
M.S., Physics, March 2014  
Advisor: Stefano Profumo  
**Brown University**, Providence, RI, USA  
Sc. B. *magna cum laude* with honors, Mathematical Physics, May 2012

**Publications** 15 publications (11 fully peer-reviewed), including one in hydrology. Full list of physics publications available on [InspireHEP](#).

**Presentations** [Detection and Analysis of Gravitational Waves](#), November 2021  
*Observing and characterizing the dark matter environments of black hole binaries with gravitational waves* (invited talk)  
Harvard University (Dvorkin group), October 2021  
*Targeting dark matter substructures in strong lenses with machine learning* (invited talk)  
[MODE Workshop on Differentiable Programming](#), September 2021  
*Targeted dark matter substructure inference with differentiable strong lensing* (invited talk)  
European Physical Society conference on high energy physics, July 2021  
*Measuring the dark matter environments of black hole binaries with gravitational waves* (talk)  
[Holding a Lens to Dark Matter Substructure](#) parallel session at the UK National Astronomy Meeting, July 2021  
*Precision searches for subhalos in strong lensing images with targeted inference networks* (poster)  
GRAPPA Colloquium, June 2021  
*New inference techniques for unveiling dark matter substructure in strong gravitational lenses* (invited talk)  
American Physical Society April Meeting, April 2021  
*Targeted Likelihood-Free Inference of Dark Matter Substructure in Strongly-Lensed Galaxies* (talk)

NeurIPS *Machine Learning and the Physical Sciences* workshop, December 2020  
*Targeted Likelihood-Free Inference of Dark Matter Substructure in Strongly-Lensed Galaxies* (poster)

TeV Particle Astrophysics (TeVPA), December 2019  
*Primordial Black Holes as Silver Bullets for New Physics at the Weak Scale* (talk)

TeV Particle Astrophysics (TeVPA), December 2019  
*Differentiable Strong Lensing: Uniting Gravity and Neural Nets through Differentiable Probabilistic Programming* (poster)

Light Antinuclei as a Probe for New Physics, October 2019  
*Primordial black holes as a probe for new physics* (invited talk)

Paris–Amsterdam–London–Stockholm meeting, September 2019  
*Primordial Black Holes as Silver Bullets for New Physics at the Weak Scale* (talk)

Matera Oscura, September 2019  
*Deep Lensing: Uniting Gravity and Neural Nets through Differentiable Programming* (poster)

Accelerating the Search for Dark Matter with Machine Learning, April 2019  
*Strong Gravitational Lensing and ML: Generative Models for Galaxies* (talk)

American Geophysical Union Fall Meeting, December 2017  
*A Gap-Filling Procedure for Hydrologic Data Based on Kalman Filtering and Expectation Maximization: Application to Data from the Wireless Sensor Networks of the Sierra Nevada* (poster)

Supersymmetry and Unification of Fundamental Interactions (SUSY), July 2016  
*Indirect Detection of Sub-GeV Dark Matter* (talk)

Supersymmetry and Unification of Fundamental Interactions (SUSY), August 2015  
*Monochromatic Gamma Rays from Dark Matter Annihilation to Leptons* (talk)

**Supervision** Capstone project supervisor for Amsterdam University College bachelor's student Pieter Parlevliet (microlensing constraints on clustered primordial black holes), 2020 —2021

Daily supervision of GRAPPA Ph.D. student Noemi Anau Montel (strong lensing, machine learning, dark matter substructure), 2020 —2021

Daily supervision of GRAPPA bachelors student Jesse Franzua (strong lensing, machine learning, dark matter substructure), 2021

**Teaching** [GRAPPA Student Seminar](#) for first-year masters students (four weeks; literature overview lectures; University of Amsterdam, 2020)

[GRAPPA Student Seminar](#) for first-year masters students (one week; introductory dark matter lecture & programming project supervision; [course materials](#); University of Amsterdam, 2019)

Teaching assistant for 13 undergraduate courses, including Introduction to Physics, Mathematical Methods in Physics and General Relativity (UC Santa Cruz, 2012 —2016)

**Organizing** [Weekly journal club](#), GRAPPA, fall 2019 —summer 2020

Head of organizing committee for [Gravitational Wave Probes of Fundamental Physics](#), Amsterdam, November 2019

Graduate student organizer for particle theory faculty search, UC Santa Cruz, 2017

**Technologies** *Currently using:* python (including [numpy](#), [scipy](#), [jax](#), [pytorch](#), [pyro](#), [keops](#), [matplotlib](#)), Git,  $\LaTeX$ , Mathematica

*Substantial past experience:* C++, [Julia](#), Java, Javascript (including [React](#)), [Firebase](#), HTML & CSS, [Figma](#)

**Awards** Koret Scholar Mentor, UC Santa Cruz, 2018

ARCS Foundation Scholar Award, ARCS Northern California Chapter, 2015—2016

Elmer A. Fridley Scholarship in the Physical Sciences, UC Santa Cruz, 2015

Outstanding Teaching Assistant Award, UC Santa Cruz, 2015

Elmer A. Fridley Scholarship in the Physical Sciences, UC Santa Cruz, 2014 Regents Fellowship, UC Santa Cruz, 2012—2013

Undergraduate Teaching and Research Award, Brown University, 2011

Rhode Island Space Grant, Brown University, 2010

Undergraduate Teaching and Research Award, Brown University, 2009

**Press** [Zwaartekrachtsgolven kunnen zwarte gaten met donkere jurken onthullen](#)

Dorine Schenk, New Scientist (Dutch version)

Based on [Coogan et al 2021](#)

[New possibilities for detecting Hawking radiation emitted by primordial black holes](#)

Ingrid Fadelli, Phys.org

Based on [Coogan, Morrison & Profumo, PRL 126, 171101 \(2021\)](#)

**Other** Reviewer for [NeurIPS Machine Learning and the Physical Sciences workshop](#)

Member of the GRAPPA Diversity, Equity and Inclusion Committee

Member of the Laser Interferometer Space Antenna (LISA) consortium

Developing an interacting gravitational lensing webpage: <https://adam-coogan.github.io/lensing-multisub/>

Co-creator of [Tasty Base](#), a recipe-sharing web application

**Physics  
publications**

Full list of physics publications available on [InspireHEP](#).

14. *EuCAPT White Paper: Opportunities and Challenges for Theoretical Astroparticle Physics in the Next Decade*  
135 authors, including **A. Coogan**  
[arXiv:2110.10074](#)
13. *Measuring the dark matter environments of black hole binaries with gravitational waves*  
**A. Coogan**, G. Bertone, D. Gaggero, B. J. Kavanagh, D. A. Nichols  
Phys. Rev. D **105**, 043009 (2022), [arXiv:2108.04154](#). Code: 
12. *Strong-lensing source reconstruction with variationally optimised Gaussian processes*  
K. Karchev, **A. Coogan**, C. Weniger  
MNRAS, stac311, (2022), [arXiv:2105.09465](#)
11. *Precision Gamma-Ray Constraints for Sub-GeV Dark Matter Models*  
**A. Coogan**, L. Morrison, S. Profumo  
JCAP **08** (2021) 044, [arXiv:2104.06168](#)
10. *Hunting for Dark Matter and New Physics with (a) GECCO*  
**A. Coogan**, A. Moiseev, L. Morrison, S. Profumo  
Submitted, [arXiv:2101.10370](#)
9. *Direct Detection of Hawking Radiation from Asteroid-Mass Primordial Black Holes*  
**A. Coogan**, L. Morrison, S. Profumo  
Phys. Rev. Lett. **126**, 171101 (2021), [arXiv:2010.04797](#)
8. *Targeted Likelihood-Free Inference of Dark Matter Substructure in Strongly-Lensed Galaxies*  
**A. Coogan**, K. Karchev, C. Weniger  
Machine Learning and the Physical Sciences workshop at NeurIPS 2020,  
[arXiv:2010.07032](#)
7. *Differentiable Strong Lensing: Uniting Gravity and Neural Nets through Differentiable Probabilistic Programming*  
M. Chianese, **A. Coogan**, P. Hofma, S. Otten, C. Weniger  
MNRAS **496** (2020) 1, 381-393, [arXiv:1910.06157](#)
6. *Hazma: A Python Toolkit for Studying Indirect Detection of Sub-GeV Dark Matter*  
**A. Coogan**, L. Morrison, S. Profumo  
JCAP **01** (2020) no.01, 56, [arXiv:1907.11846 \[hep-ph\]](#). Code: 
5. *Primordial Black Holes as Silver Bullets for New Physics at the Weak Scale*  
G. Bertone, **A. Coogan**, D. Gaggero, B. J. Kavanagh, C. Weniger  
Phys. Rev. D **100**, 123013 (2019), [arXiv:1905.01238 \[hep-ph\]](#). Code: 
4. *Connecting direct and indirect detection with a dark spike in the cosmic-ray electron spectrum*  
**A. Coogan**, B. Lehmann, S. Profumo  
JCAP **10** (2019) 063, [arXiv:1903.07177 \[astro-ph.HE\]](#)
3. *Origin of the tentative AMS antihelium events*  
**A. Coogan**, S. Profumo  
Phys. Rev. D **96**, 083020 (2017), [arXiv:1705.09664 \[astro-ph.HE\]](#)
2. *Monochromatic Gamma Rays from Dark Matter Annihilation to Leptons*  
**A. Coogan**, S. Profumo, W. Shepherd  
JHEP **1508** (2015) 074, [arXiv:1504.05187 \[hep-ph\]](#)
1. *Antihelium from Dark Matter*  
E. Carlson, **A. Coogan**, S. Profumo, A. Ibarra, S. Wild

Phys. Rev. D **89** 076005 (2014), [arXiv:1401.2461 \[hep-ph\]](#)

**Non-physics publications** *Gap-filling snow-depth time-series with Kalman Filtering-Smoothing and Expectation Maximization: Proof of concept using spatially dense wireless-sensor-network data*  
F. Avanzi, Z. Zheng, **A. Coogan**, R. Rice, R. Akella, M. H. Conklin  
Cold Regions Science and Technology, volume 175, July 2020, 103066,  
<https://doi.org/10.1016/j.coldregions.2020.103066>