Adam Coogan

Curriculum vitae

https://adam-coogan.github.io/
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Montréal, QC H2V 0B3, Canada

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 17 physics publications and one hydrology publication. Full list of physics publications available on InspireHEP.

Presentations

Université de Montréal Astrophysics Seminar, March 2022
Measuring dark matter halos in strong gravitational lenses with machine learning (invited talk)

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 Seminar (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 superviser 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.

17. *Snowmass2021 Cosmic Frontier White Paper: Primordial Black Hole Dark Matter*
16 authors, including **A. Coogan**
arXiv:2203.08967

16. *Dark Matter In Extreme Astrophysical Environments*
37 authors, including **A. Coogan**
arXiv:2203.07984

15. *Efficient Template Bank Generation with Differentiable Waveforms*
A. Coogan, T. D. P. Edwards, H. S. Chia, R. N. George, K. Freese, C. Messick, C. N. Setzer, C. Weniger, A. Zimmerman
arXiv:2202.09380

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