ADRIAN E. BAYER

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📍 New York Metropolitan Area, USA

EDUCATION

University of California, Berkeley, USA — 2018–2023
Ph.D. Physics — Thesis adviser: Uroš Seljak

University of Cambridge, UK — 2017–2018
Master of Advanced Study, Mathematics

Imperial College London, UK — 2013–2017
MSci Physics with Theoretical Physics — Thesis adviser: Fay Dowker
Graduated top of the cohort (approx. 250 students).

ACADEMIC APPOINTMENTS

Princeton University, USA — 2023–
Postdoctoral Researcher — Adviser: David Spergel

Simons Foundation, USA — 2023–
Guest Researcher — Adviser: David Spergel

The University of Tokyo (Kavli IPMU), Japan — 2022
Visiting Researcher (3 months) — Adviser: Jia Liu

Massachusetts Institute of Technology, USA — 2016
Undergraduate Researcher (2 months) — Adviser: Lindley Winslow

Imperial College London, UK — 2015
Undergraduate Researcher (3 months) — Adviser: Henrique Araújo

HONORS AND AWARDS

Outstanding Graduate Student Instructor Award, Univeristy of California, Berkeley, 2022

Berkeley Distinguished Graduate Fellows Video Prize ($1,000 grant), University of California, Berkeley, 2019

The Berkeley Fellowship, University of California, Berkeley, 2018

Abdus Salam Undergraduate Prize, Imperial College London, 2017

Governors' MSci Prize in Physics, Imperial College London, 2017

Ken Allen Prize, Imperial College London, 2016

Winton Capital Prize for Outstanding Performance in Second Year Physics, Imperial College London, 2015

EPSRC Summer Vacation Bursary (£2,200 grant), Engineering and Physical Sciences Research Council, 2015

BIBLIOGRAPHY

1. **Bayer, A. E.**, U. Seljak, and C. Modi. "Field-Level Inference with Microcanonical Langevin Monte Carlo". In: *40th International Conference on Machine Learning*. July 2023. arXiv: [2307.09504 \[astro-ph.CO\]](https://arxiv.org/abs/2307.09504)

2. **Bayer, A. E.**, C. Modi, and S. Ferraro. "Joint velocity and density reconstruction of the Universe with nonlinear differentiable forward modeling". In: J. Cosmology Astropart. Phys. 2023.6, 046 (June 2023), p. 046. DOI: [10.1088/1475-7516/2023/06/046](https://doi.org/10.1088/1475-7516/2023/06/046). arXiv: [2210.15649 \[astro-ph.CO\]](https://arxiv.org/abs/2210.15649)

3. **Bayer, A. E.**, J. Liu, R. Terasawa, A. Barreira, Y. Zhong, and Y. Feng. "Super-sample covariance of the power spectrum, bispectrum, halos, voids, and their cross covariances". In: Phys. Rev. D 108.4 (2023), p. 043521. DOI: [10.1103/PhysRevD.108.043521](https://doi.org/10.1103/PhysRevD.108.043521). arXiv: [2210.15647 \[astro-ph.CO\]](https://arxiv.org/abs/2210.15647)

4. Ding, Z., C.-H. Chuang, Y. Yu, L. H. Garrison, **A. E. Bayer**, Y. Feng, C. Modi, D. J. Eisenstein, M. White, A. Variu, C. Zhao, H. Zhang, J. Meneses Rizo, D. Brooks, K. Dawson, P. Doel, E. Gaztanaga, R. Kehoe, A. Krolewski, M. Landriau, N. Palanque-Delabrouille, and C. Poppett. "The DESI N-body Simulation Project - II. Suppressing sample variance with fast simulations". In: MNRAS 514.3 (Aug. 2022), pp. 3308–3328. DOI: 10.1093/mnras/stac1501. arXiv: 2202.06074 [astro-ph.CO]

5. **Bayer, A. E.**, A. Banerjee, and U. Seljak. "Beware of fake ν 's: The effect of massive neutrinos on the nonlinear evolution of cosmic structure". In: Phys. Rev. D 105.12, 123510 (June 2022), p. 123510. DOI: 10.1103/PhysRevD.105.123510. arXiv: 2108.04215 [astro-ph.CO]

6. Kreisch, C. D., A. Pisani, F. Villaescusa-Navarro, D. N. Spergel, B. D. Wandelt, N. Hamaus, and **A. E. Bayer**. "The GIGANTES Data Set: Precision Cosmology from Voids in the Machine-learning Era". In: ApJ 935.2, 100 (Aug. 2022), p. 100. DOI: 10.3847/1538-4357/ac7d4b. arXiv: 2107.02304 [astro-ph.CO]

7. **Bayer, A. E.**, U. Seljak, and J. Robnik. "Self-calibrating the look-elsewhere effect: fast evaluation of the statistical significance using peak heights". In: MNRAS 508.1 (Nov. 2021), pp. 1346–1357. DOI: 10.1093/mnras/stab2331. arXiv: 2108.06333 [astro-ph.IM]

8. **Bayer, A. E.**, F. Villaescusa-Navarro, E. Massara, J. Liu, D. N. Spergel, L. Verde, B. D. Wandelt, M. Viel, and S. Ho. "Detecting Neutrino Mass by Combining Matter Clustering, Halos, and Voids". In: ApJ 919.1, 24 (Sept. 2021), p. 24. DOI: 10.3847/1538-4357/ac0e91. arXiv: 2102.05049 [astro-ph.CO]

9. **Bayer, A. E.**, A. Banerjee, and Y. Feng. "A fast particle-mesh simulation of non-linear cosmological structure formation with massive neutrinos". In: J. Cosmology Astropart. Phys. 2021.1, 016 (Jan. 2021), p. 016. DOI: 10.1088/1475-7516/2021/01/016. arXiv: 2007.13394 [astro-ph.CO]

10. **Bayer, A. E.** and U. Seljak. "The look-elsewhere effect from a unified Bayesian and frequentist perspective". In: J. Cosmology Astropart. Phys. 2020.10, 009 (Oct. 2020), p. 009. DOI: 10.1088/1475-7516/2020/10/009. arXiv: 2007.13821 [physics.data-an]

11. Tomás, A., H. M. Araújo, A. J. Bailey, **A. Bayer**, E. Chen, B. López Paredes, and T. J. Sumner. "Study and mitigation of spurious electron emission from cathodic wires in noble liquid time projection chambers". In: *Astroparticle Physics* 103 (Dec. 2018), pp. 49–61. DOI: 10.1016/j.astropartphys.2018.07.001. arXiv: 1801.07231 [physics.ins-det]

SELECTED TALKS

Center for Data Driven Discovery (CD3), Kavli IPMU, University of Tokyo, Japan — January 2024
The CD3 x Simons Foundation workshop: AI-driven discovery in physics and astrophysics
"Cosmological Field-Level Inference with Microcanonical Langevin Monte Carlo"

High Energy Accelerator Research Organization (KEK), Tskuba, Japan — January 2024
ML at HEP workshop
"Cosmological Field-Level Inference with Microcanonical Langevin Monte Carlo"

Center for Computational Astrophysics, Flatiron Institute, New York NY, USA — November 2023
Debating the potential of machine learning for astronomical surveys (#2) – IAP/CCA Conference
"Cosmological Field-Level Inference with Microcanonical Langevin Monte Carlo"

Imperial College London, London, UK — November 2023
Seminar
"Towards an Optimal Cosmological Detection of Neutrino Mass"

Monte Verità, Ascona, Switzerland — October 2023
Hamers & Nails, Frontiers in Machine Learning in Cosmology, Astro & Particle Physics
"Cosmological Field-Level Inference with Microcanonical Langevin Monte Carlo"

Hawaii Convention Center, Honolulu HI, USA — July 2023
International Conference on Machine Learning (ICML), Workshop on Machine Learning for Astrophysics
"Field-Level Inference with Microcanonical Langevin Monte Carlo"

Sexten Center for Astrophysics, Sexten, Italy — July 2023
New Strategies For Extracting Cosmology From Future Galaxy Surveys Workshop
"Field-Level Inference with Microcanonical Hamiltonian Monte Carlo"

Center for Computational Astrophysics, Flatiron Institute, New York NY, USA   May 2023
Cosmic Connections Symposium
"Field-Level Inference with Microcanonical Hamiltonian Monte Carlo"

Stanford University, Stanford CA, USA (zoom)   January 2023
LSST Higher-Order Statistics Meeting
"Super-Sample Covariance of Higher-Order Statistics"

Institute for Advanced Studies, Princeton NJ, USA   December 2022
Cosmology Lunch
"Towards Optimal Measurement of the Neutrino Mass using Large-Scale Structure"

Center for Computational Astrophysics, Flatiron Institute, New York NY, USA   December 2022
Cosmology X Data Science Meeting
"Towards Optimal Measurement of the Neutrino Mass using Large-Scale Structure"

University of Pennsylvania, Philadelphia PA, USA   December 2022
CMB Meeting
"Towards Optimal Measurement of the Neutrino Mass using Large-Scale Structure"

Université de Montréal, Montréal, Canada   November 2022
Astromerique Speaker Series
"Massive Neutrino Information in Large-Scale Structure and Field-Level Inference"

Vipolže, Slovenia   July 2022
Berkeley Center for Cosmological Physics Summer Workshop
"Massive Neutrino Information in Large-Scale Structure and Field-Level Inference"

The University of Tokyo (Hongo Campus), Tokyo, Japan   May 2022
GPU Workshop
"Cosmological simulations on GPU with tensorflow"

The University of Tokyo (Kavli IPMU), Kashiwanoha, Japan   April 2022
APEC Seminar
"Towards detecting neutrino mass using non-linear cosmic structure"

Kyoto University (Yukawa Institute for Theoretical Physics), Kyoto, Japan   April 2022
Cosmology with Weak Lensing: Beyond the 2-pt Statistics
"Detecting neutrino mass using nonlinear cosmic structure"

Institut d'Astrophysique de Paris, Paris, France   February 2022
Journal Club – Univers
"Detecting neutrino mass using nonlinear cosmic structure"

Center for Computational Astrophysics, Flatiron Institute, New York NY, USA   August 2021
Learn the Universe
"The Look-Elsewhere Effect"

Pennsylvania State University, State College PA, USA   June 2021
Statistical Challenges in Modern Astronomy VII
"The Look-Elsewhere Effect from a Unified Bayesian and Frequentist Perspective"

University of Cambridge (Kavli Institute for Cosmology), Cambrigde, UK   September 2019
KICC 10th Anniversary Symposium
"Look Elsewhere" (poster)

TEACHING

Bayesian Data Analysis and Machine Learning for Physical Sciences
Graduate Student Instructor, UC Berkeley, 2021

Python for Physics
Teaching Assistant, Imperial College London, 2016

MENTORING

James Sunseri (Graduate Student), Princeton University
Project: Information Content of the Cosmic Web (co-advised with Jia Liu)

Yici Zhong (Graduate Student), The University of Tokyo
Project: HalfDome Cosmological Simulations for Stage IV Surveys (co-advised with Jia Liu)

Malika Golshan (Undergraduate Student), UC Berkeley
Project: Can AI reliably learn neutrino physics from N-body simulations? (co-advised with Vanessa Böhm)

OUTREACH TALKS

Neutrino Mass from Cosmology: Measuring the Mass of a Needle in a Haystack　　November 2023
Astronomy on Tap, Trenton NJ, USA

OUTREACH

Astronomy on Tap (Trenton), Host and Organizer (2023, 2024)

Berkeley Compass Mentor (2022)

Adopt-a-Physicist Mentor (2020)

REFEREEING

The Astrophysical Journal (ApJ)

Machine Learning and the Physical Sciences, Neural Information Processing Systems (NeurIPS)

Journal of Cosmology and Astroparticle Physics (JCAP)

Astrophysical Journal Letters (ApJL)

Monthly Notices of the Royal Astronomical Society (MNRAS)

Machine Learning for Astrophysics Workshop, International Conference on Machine Learning (ICML)