

# Oliver H. E. Philcox MSci MA

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## EDUCATION

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**Department of Astrophysical Sciences, Princeton University, USA**

2019 - Present

PhD Candidate

**Thesis:** ‘Cosmology from the bispectrum and  $N$ -point correlation functions (TBC)’

*Thesis Advisors:* Prof. David N. Spergel & Prof. Matias Zaldarriaga

M.A. in Astrophysics (2020)

**Center for Astrophysics | Harvard & Smithsonian, Cambridge, USA**

2018 - 2019

Pre-Doctoral Student, *Herchel-Smith Scholar*

*Advisor:* Prof. Daniel J. Eisenstein

**Institute of Astronomy, University of Cambridge**

2017 - 2018

MSci in Astrophysics

**Part III:** 1<sup>st</sup> Class (Rank 1/28, 97%)

**Thesis:** ‘Detection and Removal of B-mode CMB Dust Foregrounds with Signatures of Statistical Anisotropy’

*Thesis Advisor:* Dr. Blake D. Sherwin

Institute of Astronomy Prize

**Emmanuel College, University of Cambridge**

2014 - 2017

BA (Hons) in Natural Sciences, *Senior Scholar*

**Parts IA, IB, II:** 1<sup>st</sup> Class (Rank 1/20, 90%)

Holgate Pollard Memorial Prize (2017), College & Rowley Mainhood Prizes (2015-8)

## ADDITIONAL RESEARCH EXPERIENCE

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**Center for Computational Astrophysics**

Jul. 2021 - Present

*Guest Researcher with Prof. David N. Spergel*

*New York, USA*

**Institute for Advanced Study**

Sep. 2020 - Present

*Visiting Graduate Student with Prof. Matias Zaldarriaga*

*Princeton, USA*

**Max-Planck Institute for Astrophysics**

Aug. - Sep. 2020

*Visiting Graduate Student with Prof. Eiichiro Komatsu*

*Munich, Germany*

**Department of Applied Mathematics and Theoretical Physics**

May - Jul. 2020

*Visiting Graduate Student with Dr. Blake D. Sherwin*

*Cambridge, UK*

**Max-Planck-Institut für Astronomie**

Jul. - Sep. 2017

*Summer Intern with Dr. Jan Rybizki*

*Heidelberg, Germany*

**Center for Astrophysics | Harvard & Smithsonian**

Jun. - Aug. 2016

*Undergraduate Research Fellow with Dr. Ákos Bogdán*

*Cambridge, USA*

## PUBLICATIONS

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*Major Author*

1. **Philcox, O. H. E.** "Cosmology Without Windows: Cubic Estimators for the Galaxy Bispectrum", *submitted to Phys. Rev. D* (arXiv).
2. **Philcox, O. H. E.**, Slepian Z. "Efficient Computation of  $N$ -Point Correlation Functions in  $D$  Dimensions", *submitted to PNAS* (arXiv).

3. **Philcox, O. H. E.**, Slepian, Z., Hou, J., Warner, C., Cahn, R. N., Eisenstein, D. J. "ENCORE: Estimating Galaxy  $N$ -point Correlation Functions in  $\mathcal{O}(N_g^2)$  Time", *submitted to MNRAS* (arXiv).
4. **Philcox, O. H. E.**, Slepian, Z. "An Exact Integral-to-Sum Relation for Products of Bessel Functions", *submitted to Proc. Roy. Soc. A* (arXiv).
5. **Philcox, O. H. E.**, Goodman, J., Slepian Z. "Kepler's Goat Herd: An Exact Solution to Kepler's Equation for Elliptical Orbits", *accepted by MNRAS* (arXiv).
6. Slepian, Z., **Philcox, O. H. E.** "A Uniform Spherical Goat (Problem): Explicit Solution for Homologous Collapse's Radial Evolution in Time" (arXiv).
7. **Philcox, O. H. E.**, Slepian, Z. "Beyond Yamamoto: Anisotropic Power Spectra and Correlation Functions with Pairwise Lines-of-Sight", *Phys. Rev. D* **103**, 123509 (2021) (arXiv).
8. **Philcox, O. H. E.** "Cosmology Without Windows: Quadratic Estimators for the Galaxy Power Spectrum", *Phys. Rev. D* **103**, 103504 (2021) (arXiv).
9. **Philcox, O. H. E.**, Aviles, A., Massara, E. "Modeling the Marked Spectra of Matter and Biased Tracers in Real and Redshift Space", *JCAP* 03 038 (2021) (arXiv).
10. **Philcox, O. H. E.**, Ivanov, M. M., Simonović, M., Zaldarriaga, M., Schmittfull, M. "Fewer Mocks and Less Noise: Reducing the Dimensionality of Cosmological Observables with Subspace Projections", *Phys. Rev. D* **103**, 043508 (2021) (arXiv).
11. **Philcox, O. H. E.**, Sherwin, B. D., Farren, G. S., Baxter, E. J. "Determining the Hubble Constant without the Sound Horizon: Measurements from Galaxy Surveys", *Phys. Rev. D* **103**, 023538 (2021) (arXiv).
12. **Philcox, O. H. E.**, Massara, E., Spergel, D. N. "What does the Marked Power Spectrum Measure? Insights from Perturbation Theory", *Phys. Rev. D* **102**, 043516 (2020) (arXiv).
13. **Philcox, O. H. E.** "A Faster Fourier Transform? Computing Small-Scale Power Spectra and Bispectra for Cosmological Simulations in  $\mathcal{O}(N^2)$  Time", *MNRAS* **501**, 4004 – 4034 (2021) (arXiv).
14. **Philcox, O. H. E.**, Spergel, D. N., Villaescusa-Navarro, F. "The Effective Halo Model: Creating a Physical and Accurate Model of the Matter Power Spectrum and Cluster Counts", *Phys. Rev. D* **101**, 123520 (2020) (arXiv).
15. **Philcox, O. H. E.**, Ivanov, M. M., Simonović, M., Zaldarriaga, M. "Combining Full-Shape and BAO Analyses of Galaxy Power Spectra: A 1.6% CMB-Independent Constraint on  $H_0$ ", *JCAP* 05 032 (2020) (arXiv).
16. **Philcox, O. H. E.**, Rybizki, J. "Inferring Galactic Parameters from Chemical Abundances: A Multi-Star Approach", *ApJ* **887**, 9 (2019) (arXiv).
17. **Philcox, O. H. E.**, Eisenstein, D. J., "Computing the Small-Scale Galaxy Power Spectrum and Bispectrum in Configuration-Space", *MNRAS* **492** 1214 – 1242 (2019) (arXiv).
18. **Philcox, O. H. E.**, Eisenstein, D. J., "Estimating Covariance Matrices for Two- and Three-Point Correlation Function Moments in Arbitrary Survey Geometries", *MNRAS* **490**, 5931 – 5951 (2019) (arXiv).
19. **Philcox, O. H. E.**, Eisenstein, D. J., O'Connell, R., Wiegand, A., "RASCALC: A Jackknife Approach to Estimating Single and Multi-Tracer Galaxy Covariance Matrices", *MNRAS* **491**, 3290 – 3317 (2019) (arXiv).
20. **Philcox, O. H. E.**, Sherwin, B. D., van Engelen, A., "Detection and Removal of B-mode Dust Foregrounds with Signatures of Statistical Anisotropy", *MNRAS* **479**, 5577 – 5595 (2018) (arXiv).
21. **Philcox, O. H. E.**, Rybizki, J., Gutcke, T., "On the Optimal Choice of Nucleosynthetic Yields, Initial Mass Function, and Number of SNe Ia for Chemical Evolution Modeling", *ApJ* **861**, 40 (2018) (arXiv).

#### **Contributing Author**

22. Schmittfull, M., Simonović, M., Ivanov, M. M., **Philcox, O. H. E.**, Zaldarriaga, M. "Modeling Galaxies in Redshift Space at the Field Level", *JCAP* 05 059 (2021) (arXiv).
23. Villaescusa-Navarro, F., Anglés-Alcázar, D., Genel, S., *et al.* (inc. **Philcox, O. H. E.**) "The CAMELS project: Cosmology and Astrophysics with MachinE Learning Simulations", *ApJ*, **915**, 1 (2018) (arXiv).

24. Wang, Y., Zhao, G-B., Zhao, C., **Philcox, O. H. E.**, *et al.* "The clustering of the SDSS-IV extended Baryon Oscillation Spectroscopic Survey DR16 luminous red galaxy and emission line galaxy samples: cosmic distance and structure growth measurements using multiple tracers in configuration space", *MNRAS* **498**, 3470 – 3483 (2020) (arXiv).
25. Chudaykin, A., Ivanov, M. M., **Philcox, O. H. E.**, Simonović, M., "CLASS-PT: non-linear perturbation theory extension of the Boltzmann code CLASS", *Phys. Rev. D*, **102**, 063533 (2020) (arXiv).

## SELECTED TALKS

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Jul. 2021	Cosmology from Home Conference <i>Cosmology from the Galaxy Four-Point Correlation Function</i>
Apr. 2021	Princeton University (Gravity Group) <i>Have We Exhausted the Galaxy Two-Point Function?</i>
Mar. 2021	Southampton $H_0$ Workshop (Invited talk & panel discussion) <i><math>H_0</math> from Galaxy Surveys: With and Without the Sound Horizon</i>
Jan. 2021	University of Geneva (Cosmology & Particle Physics Group) <i>Have We Exhausted the Galaxy Two-Point Function?</i>
Nov. 2020	Institute for Advanced Study (Cosmology Group) <i>Tutorial on CLASS-PT and Large Scale Structure Parameter Inference</i>
Oct. 2020	DESI Galaxy & Quasar Clustering Working Group <i>Compressing Cosmological Observables via Subspace Projections</i>
Oct. 2020	Center for Astrophysics   Harvard & Smithsonian (Eisenstein Group) <i>Modeling and Interpreting Marked Power Spectra of Matter and Halos</i>
Sep. 2020	UK Cosmology Meeting <i>What's Next for the Effective Field Theory of Large Scale Structure?</i>
Sep. 2020	Institute for Advanced Study (Cosmology Group) <i>Data Compression via Subspace Projections &amp; <math>H_0</math> Without the Sound Horizon</i>
Aug. 2020	Cosmology from Home Conference <i>Measuring <math>H_0</math> from Galaxy Surveys: With and Without the Sound Horizon</i>
Aug. 2020	American Statistical Association (Joint Statistical Meeting, invited talk) <i>Inferring Galactic Parameters from Stellar Chemical Abundances</i>
Jun. 2020	Perimeter Institute for Theoretical Physics (Cosmology Colloquium) <i>What's Next for the Effective Field Theory of Large Scale Structure?</i>
May 2020	Berkeley Center for Cosmological Physics (Journal Club) <i>The Effective Halo Model: Accurate Models for the Power Spectrum and Cluster Counts</i>
Apr. 2020	NYU / CCA (Cosmology X Data Science Group) <i>The Effective Halo Model: Accurate Models for the Power Spectrum and Cluster Counts</i>
Mar. 2020	Institute for Advanced Study (Cosmology Group) <i>Constraining Cosmology from Galaxy Surveys: Combining Full Shape and BAO Analyses</i>
Dec. 2019	Princeton University (Gravity Group) <i>Detection and Removal of CMB B-mode Dust via Statistical Anisotropy</i>
Nov. 2019	JINA-CEE Nuclear Astrophysics Seminar <i>Inferring the Milky Way Stellar Initial Mass Function using Chemical Evolution Modelling</i>
Jul. 2019	Center for Astrophysics   Harvard & Smithsonian (Eisenstein Group) <i>Computing Clustering Statistics and Covariances in Configuration Space</i>
Apr. 2019	Center for Astrophysics   Harvard & Smithsonian (Joint Cosmology Group) <i>Detection and Removal of CMB B-mode Dust via Statistical Anisotropy</i>
Sep. 2017	Max-Planck-Institut für Astronomie (Rix Group) <i>Creating Objective Scores for Nucleosynthetic Yield Tables</i>
Sep. 2017	Heidelberg Institute for Theoretical Studies (Springel Group) <i>Choosing Nucleosynthetic Yield Tables for Hydrodynamical Simulations</i>

PROFESSIONAL ACTIVITIES

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**Referee**            MNRAS (2020–), JCAP (2020–), MPLA (2021–)  
**Coadvisor**        *Jess Boyland*    Simons-NSBP Undergraduate Scholars Program (2020–)

MISCELLANEOUS

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**Computing Languages**    PYTHON, C++, CUDA  
**Codes Developed**        ENCORE, EFFECTIVEHALOS, CLASS-PT, HIPSTER, RASCALC, CHEMPYMULTI, HADES  
**Teaching**                6 years of online tutoring (high-school to post-Masters level)  
                                 Teaching assistant for Princeton introductory astronomy class (AST203)  
                                 TEFL qualification in English teaching with 2 months experience in China

REFEREES

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<b>Prof. D N Spergel</b> <i>(Princeton Advisor)</i> Simons Foundation 160 5 <sup>th</sup> Ave. New York, NY 10010 <i>Tel:</i> +1 (609) 258-3589 dspergel@simonsfoundation.org	<b>Prof. M Zaldarriaga</b> <i>(IAS Advisor)</i> Institute for Advanced Study 1 Einstein Drive Princeton, NJ 08540 <i>Tel:</i> +1 (609) 734-8058 matiasz@ias.edu	<b>Prof. D J Eisenstein</b> <i>(Harvard Advisor)</i> CfA   Harvard & Smithsonian 60 Garden St. Cambridge, MA 02138, USA <i>Tel:</i> +1 (617) 495-7530 deisenstein@cfa.harvard.edu
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