

# Oliver H. E. Philcox, Ph.D.

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## POSITIONS & EDUCATION

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### **Simons Society of Fellows, New York, USA**

2022 - 2025

Junior Fellow, *Host Institution: Columbia University*

*Mentors:* Prof. J. Colin Hill & Prof. Lam Hui

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

2019 - 2022

PhD in Astrophysics (2022)

**Thesis:** ‘Probing Fundamental Cosmology with Galaxy Surveys’

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

MA 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, UK**

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

### **Emmanuel College, University of Cambridge, UK**

2014 - 2017

MA (Cantab.) in Natural Sciences, *Senior Scholar*

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

## LONG-TERM ACADEMIC VISITS

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### **Center for Computational Astrophysics**

Jul. 2021 - Present

*Guest Researcher*

*New York, USA*

### **Institute for Advanced Study**

Sep. 2020 - Jul. 2022

*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*

## PUBLICATION LIST

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\* = Author list alphabeticized

### Major Author

1. **Philcox, O. H. E.**, Shiraishi, M., “Testing Parity Symmetry with the Polarized Cosmic Microwave Background”, *submitted to Phys. Rev. D* ([arXiv](#)).
2. \*Coulton, W. R., **Philcox, O. H. E.**, Villaescusa-Navarro, F. A., “Signatures of a Parity-Violating Universe”, *submitted to Phys. Rev. D* ([arXiv](#)).
3. **Philcox, O. H. E.**, “Optimal Estimation of the Binned Mask-Free Power Spectrum, Bispectrum, and Trispectrum on the Full Sky: Tensor Edition”, *Phys. Rev. D*, **108**, 063506 (2023) ([arXiv](#)).
4. \*Ivanov, M. M., **Philcox, O. H. E.**, “Measuring  $H_0$  with Spectroscopic Surveys”, *chapter in “Hubble Constant Tension”* (Eds. Di Valentino, E. and Brout, D.) ([arXiv](#)).
5. **Philcox, O. H. E.**, “Do the CMB Temperature Fluctuations Conserve Parity?”, *submitted to Phys. Rev. Lett.* ([arXiv](#)).
6. **Philcox, O. H. E.**, “Optimal Estimation of the Binned Mask-Free Power Spectrum, Bispectrum, and Trispectrum on the Full Sky: Scalar Edition”, *Phys. Rev. D* **107**, 123516 (2023) ([arXiv](#)).
7. Creque-Sarbinowski, C., Alexander, S., Kamkonkowski, M., **Philcox, O. H. E.**, “Parity-Violating Trispectrum from Chern-Simons Gravity”, *accepted by JCAP* ([arXiv](#)).
8. Surrao, K. M., **Philcox, O. H. E.**, Hill, J. C., “ReMASTERed: Accurate Estimation of Angular Power Spectra for Maps with Correlated Masks”, *Phys. Rev. D* **107**, 083521 (2023) ([arXiv](#)).
9. Ivanov, M. M., **Philcox, O. H. E.**, Cabass, G., Nishimichi, T., Simonović, M., Zaldarriaga, M., “Cosmology with the Galaxy Bispectrum Multipoles: Optimal Estimation and Application to BOSS Data”, *Phys. Rev. D* **107**, 083515 (2023) ([arXiv](#)).
10. \*Cabass, G., Ivanov, M. M., **Philcox, O. H. E.**, Simonović, M., Zaldarriaga, M., “Constraining Single-Field Inflation with MegaMapper”, *Phys. Lett. B* **841**, 137912 (2023) ([arXiv](#)).
11. \*Cabass, G., Ivanov, M. M., **Philcox, O. H. E.**, “Colliders and Ghosts: Constraining Inflation with the Parity-Odd Galaxy Four-Point Function”, *Phys. Rev. D* **107**, 023523 (2023) ([arXiv](#)).
12. Goldstein, S., Esposito, A., **Philcox, O. H. E.**, Hui, L., Hill, J. C., Scoccimarro, R., Abitbol, M. H., “Squeezing  $f_{\text{NL}}$  out of the matter bispectrum with consistency relations”, *Phys. Rev. D* **106**, 123525 (2023) ([arXiv](#)).
13. **Philcox, O. H. E.**, Torquato, S., “The Disordered Heterogeneous Universe: Galaxy Distribution and Clustering Across Length Scales”, *Phys. Rev. X* **13**, 011038 (2023) ([arXiv](#)).
14. **Philcox, O. H. E.**, Johnson, M. C., “Novel Cosmological Tests from Combining Galaxy Lensing and the Polarized Sunyaev-Zel’dovich Effect”, *Phys. Rev. D* **106**, 083501 (2022) ([arXiv](#)).
15. **Philcox, O. H. E.**, “Probing Parity-Violation with the Four-Point Correlation Function of BOSS Galaxies”, *Phys. Rev. D* **106**, 063501 (2022) ([arXiv](#)).
16. **Philcox, O. H. E.**, Ivanov, M. M., Cabass, G., Simonović, M., Zaldarriaga, M., Nishimichi, T., “Cosmology with the Redshift-Space Galaxy Bispectrum Monopole at One-Loop Order”, *Phys. Rev. D* **106**, 043530 ([arXiv](#)).
17. **Philcox, O. H. E.**, Farren, G. S., Sherwin, B. D., Baxter, E. J., Brout, D. J., “Determining the Hubble Constant without the Sound Horizon: A 3.6% Constraint on  $H_0$  from Galaxy Surveys, CMB Lensing and Supernovae”, *Phys. Rev. D* **106**, 063530 (2022) ([arXiv](#)).
18. \*Cabass, G., Ivanov, M. M., **Philcox, O. H. E.**, Simonović, M., Zaldarriaga, M., “Constraints on Multi-Field Inflation from the BOSS Galaxy Survey”, *Phys. Rev. D* **106**, 043506 (2022) ([arXiv](#)).
19. \*Cabass, G., Ivanov, M. M., **Philcox, O. H. E.**, Simonović, M., Zaldarriaga, M., “Constraints on Single-Field Inflation from the BOSS Galaxy Survey”, *Phys. Rev. Lett.* **129**, 021301 (2022) ([arXiv](#)).

20. Farren, G. S., **Philcox, O. H. E.**, Sherwin, B. D. “Determining the Hubble Constant without the Sound Horizon: Perspectives with Future Galaxy Surveys”, *Phys. Rev. D* **105**, 063503 (2022) ([arXiv](#)).
21. **Philcox, O. H. E.**, Ivanov, M. M. “The BOSS DR12 Full-Shape Cosmology:  $\Lambda$ CDM Constraints from the Large-Scale Galaxy Power Spectrum and Bispectrum Monopole”, *Phys. Rev. D* **105**, 043517 (2022) ([arXiv](#)).
22. Ivanov, M. M., **Philcox, O. H. E.**, Nishimichi, T., Simonović, M., Takada, M., Zaldarriaga, M. “Precision analysis of the redshift-space galaxy bispectrum”, *Phys. Rev. D* **105**, 063512 (2022) ([arXiv](#)).
23. Ivanov, M. M., **Philcox, O. H. E.**, Simonović, M., Zaldarriaga, M., Nishimichi, T., Takada, M. “Cosmological constraints without nonlinear redshift-space distortions”, *Phys. Rev. D* **105**, 043531 (2022) ([arXiv](#)).
24. **Philcox, O. H. E.**, Hou J., Slepian, Z. “A First Detection of the Connected 4-Point Correlation Function of Galaxies using the BOSS CMASS Sample”, *submitted to Phys. Rev. D* ([arXiv](#)).
25. **Philcox, O. H. E.** “Cosmology Without Windows: Cubic Estimators for the Galaxy Bispectrum”, *Phys. Rev. D* **104**, 123529 (2021) ([arXiv](#)).
26. **Philcox, O. H. E.**, Slepian Z. “Efficient Computation of  $N$ -Point Correlation Functions in  $D$  Dimensions”, *PNAS* **119**, 33 (2022) ([arXiv](#)).
27. **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”, *MNRAS* **509**, 2457 – 2481 (2022) ([arXiv](#)).
28. **Philcox, O. H. E.**, Slepian, Z. “An Exact Integral-to-Sum Relation for Products of Bessel Functions”, *Proc. Roy. Soc. A* **477**, 2253 (2021) ([arXiv](#)).
29. **Philcox, O. H. E.**, Goodman, J., Slepian Z. “Kepler’s Goat Herd: An Exact Solution to Kepler’s Equation for Elliptical Orbits”, *MNRAS* **506**, 6111 – 6116 (2021) ([arXiv](#)).
30. Slepian, Z., **Philcox, O. H. E.** “A Uniform Spherical Goat (Problem): Explicit Solution for Homologous Collapse’s Radial Evolution in Time”, *MNRAS* **522**, L42-L45 (2023) ([arXiv](#)).
31. **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](#)).
32. **Philcox, O. H. E.** “Cosmology Without Windows: Quadratic Estimators for the Galaxy Power Spectrum”, *Phys. Rev. D* **103**, 103504 (2021) ([arXiv](#)).
33. **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](#)).
34. **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](#)).
35. **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](#)).
36. **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](#)).
37. **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](#)).
38. **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](#)).
39. **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](#)).
40. **Philcox, O. H. E.**, Rybizki, J. “Inferring Galactic Parameters from Chemical Abundances: A Multi-Star Approach”, *ApJ* **887**, 9 (2019) ([arXiv](#)).
41. **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](#)).

42. **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](#)).
43. **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](#)).
44. **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](#)).
45. **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

46. Rogers, K. K., Hložek, R., Laguë, A., Ivanov, M. M., **Philcox, O. H. E.**, *et al.* “Ultra-Light Axions and the  $S_8$  Tension: Joint Constraints from the Cosmic Microwave Background and Galaxy Clustering”, *accepted by JCAP* ([arXiv](#)).
47. \*Abdalla, E., *et al.* (inc. **Philcox, O. H. E.**) “Cosmology Intertwined: A Review of the Particle Physics, Astrophysics, and Cosmology Associated with the Cosmological Tensions and Anomalies” *Snowmass 2021 report*, *JHEA* **34**, 49 – 221 (2022) ([arXiv](#)).
48. Villaescusa-Navarro, F., Anglés-Alcázar, D., Genel, S., *et al.* (inc. **Philcox, O. H. E.**) “The CAMELS project: public data release”, *ApJS* **265** 54 (2023) ([arXiv](#)).
49. Hou, J., Cahn, R. N., **Philcox, O. H. E.**, Slepian, Z., “Analytic Gaussian Covariance Matrices for Galaxy  $N$ -Point Correlation Functions”, *Phys. Rev. D* **106**, 043515 (2022) ([arXiv](#)).
50. 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](#)).
51. 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](#)).
52. 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](#)).
53. \*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](#)).

### MEDIA

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1. “Universe’s ‘Cosmological Collider’ Lands 3 Scientists \$100,000 Physics Prize”, *Live Science*, 14 September 2024.
  2. “What Happened Right After the Universe Began?”, *Simons Foundation*, 30 August 2023.
  3. “The Cosmos as a Colloid”, *Physics Magazine*, 14 March 2023.
  4. “Pinpoint Simulations Provide Perspective on Universe Structure”, *IAS News & Phys.Org*, 14 March 2023.
  5. “Spatial Patterns in Distribution of Galaxies”, *Princeton News & ScienceDaily*, 14 March 2023.
  6. “Is the Universe Asymmetrical?”, *Columbia News*, 27 February 2023.
  7. “Do We Live in a Mirror Universe?”, *Into The Unknown Podcast*, 26 January 2023.
  8. “Asymmetry Detected in the Distribution of Galaxies”, *Quanta*, 5 December 2022.
  9. “The Universe is Surprisingly Lopsided and We Don’t Know Why”, *New Scientist*, 18 June 2022.

## SELECTED TALKS

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\* = *Virtual Talk*

- 2023    \*Early Universe / AliCPT Forum, University of Science and Technology of China, *Webinar*  
          New Strategies For Extracting Cosmology From Future Galaxy Surveys, Sexten, *Workshop* (Invited Plenary)  
          Cosmology with the Large Scale Structure of the Universe, Donostia, *Workshop* (Invited Talk)  
          University of Pennsylvania, *PDT Partners Retreat* (Invited Talk)  
          Future Science with CMB  $\times$  LSS, Kyoto, *Conference* (Invited Talk)  
          Kavli IPMU, *Astronomy Seminar*  
          Stony Brook, *Cosmology Seminar*  
          \*Newcastle University, *Astronomy Seminar*  
          Cosmology on Safari, *Conference*  
          Johns Hopkins University, *Particle Physics Seminar*  
          University of Maryland, *Particle Physics Seminar*  
          \*Copernicus Series, *Cosmology Webinar*  
          \*University of Oxford, *Cosmology Seminar*
- 2022    Essential Cosmology for the Next Generation, Mexico, *Conference* (Invited Plenary)  
          LSS  $\times$  Inflation, UCSD, *Workshop*  
          \*HEP / Astro Results Forum, Texas, *Seminar*  
          PNG 2022 Workshop, Madrid, *Conference*  
          Columbia University, *Theory Seminar*  
          Large Scale Structure Beyond the Two-Point Function, ICTP, Trieste, *Workshop*  
          BCCP Conference, Vipolže, Slovenia, *Conference*  
          Cosmology and Astrophysics with the Sunyaev-Zel'dovich Effect, Flatiron Institute, *Workshop*  
          \*L'Action Dark Energy, *Webinar*  
          \*University of Chicago, *KICP Lunch Talk*  
          Center for Computational Astronomy, *Tri-State Cosmology Meeting*  
          \*Simons Modern Inflationary Cosmology Group, *Seminar*
- 2021    \*Max Planck Institute for Astrophysics, *Seminar*  
          \*Perimeter Institute, *Cosmology & Gravitation Seminar*  
          \*University of Cambridge, *Cosmology Lunch Seminar*  
          Harvard University, *Cosmology Seminar*  
          \*Lawrence Berkeley National Laboratory, *Physics Division Seminar*  
          \*Jet Propulsion Laboratory, *Dark Sector Group*  
          Pennsylvania State University, *Quantum Gravity Seminar*  
          Johns Hopkins University, *Astronomy Colloquium*  
          University of Pennsylvania, *Astronomy & Astrophysics Seminar*  
          Berkeley Center for Cosmological Physics, *Cosmology Seminar*  
          Stanford University, *Theory Colloquium*  
          \*Columbia University, *Theory Seminar*  
          \*Cosmology from Home Conference  
          \*Princeton University, *Gravity Group*  
          \*Southampton University,  $H_0$  *Workshop* (Invited Talk)  
          \*University of Geneva, *Cosmology & Particle Physics Group*
- 2020    \*DESI, *Galaxy & Quasar Clustering Working Group*  
          \*Center for Astrophysics | Harvard & Smithsonian, *Eisenstein Group*  
          \*UK Cosmology Meeting  
          \*Institute for Advanced Study, *Joint Cosmology Group*  
          \*Cosmology from Home Conference  
          \*American Statistical Association, *Joint Statistical Meeting* (Invited Talk)  
          \*Perimeter Institute for Theoretical Physics, *Cosmology Colloquium*  
          \*Berkeley Center for Cosmological Physics, *Journal Club*  
          \*Center for Computational Astrophysics, *Cosmology  $\times$  Data Science Group*

## AWARDS & PRIZES

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2024	New Horizons in Physics Prize, <i>Breakthrough Prize Foundation</i>
2023	Buchalter Cosmology Prize (First Prize)
2022	Simons Society of Fellows (Junior Fellowship) NHFP Einstein Fellowship, <i>declined</i> LBL Chamberlain Fellowship, <i>declined</i> Cambridge Kavli Fellowship, <i>declined</i>
2018	Herchel-Smith Scholarship, <i>Cambridge</i> → <i>Harvard</i> Institute of Astronomy Prize, <i>Cambridge</i>
2017	Holgate Pollard Memorial Prize, <i>Cambridge</i>

## PROFESSIONAL ACTIVITIES

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<b>Referee</b>	MNRAS (2020–), JCAP (2020–), MPLA (2021–), Phys. Rev. Lett. (2022–) Phys. Rev. D (2022–), ApJS (2022–), Phys. Dark Univ. (2023–)
<b>Advisor</b>	<i>John Moynihan</i> Columbia Undergraduate Student (2023–)
<b>Coadvisor</b>	<i>Sam Goldstein</i> Columbia Graduate Student (2022–) <i>Kristen Surrao</i> Columbia Graduate Student (2022–) <i>Jess Boyland</i> Simons-NSBP Undergraduate Scholars Program (2020–2021)

## MISCELLANEOUS

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<b>Computing Languages</b>	PYTHON, C++, JULIA, MATHEMATICA, CUDA
<b>Codes Developed</b>	POLYBIN, ENCORE, NPCFs.jl, CLASS-PT, SPECTRA-WITHOUT-WINDOWS, EFFECTIVEHALOS, HIPSTER, RASCALC
<b>Teaching</b>	6 years of online tutoring (high-school to Masters level) Teaching assistant for Princeton introductory astronomy class (AST203) TEFL qualification in English teaching
<b>Other</b>	DipABRSM in Music Performance (Distinction)

## REFERENCES

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<b>Prof. J C Hill</b> ( <i>Postdoctoral Mentor</i> ) Columbia University 914 Pupin Hall New York, NY 10027 Tel: +1 (212) 854-7815 <a href="mailto:jch2200@columbia.edu">jch2200@columbia.edu</a>	<b>Prof. D N Spergel</b> ( <i>PhD Advisor</i> ) Simons Foundation 160 5 <sup>th</sup> Ave. New York, NY 10010 Tel: +1 (609) 258-3589 <a href="mailto:dspergel@simonsfoundation.org">dspergel@simonsfoundation.org</a>	<b>Prof. M Zaldarriaga</b> ( <i>PhD Advisor</i> ) Institute for Advanced Study 1 Einstein Drive Princeton, NJ 08540 Tel: +1 (609) 734-8058 <a href="mailto:matiasz@ias.edu">matiasz@ias.edu</a>
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