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Personal Statement

I am a cosmologist and an astrostatistician: I generate robust conclusions on the fundamental physics of the Universe by applying sophisticated Bayesian and likelihood-free inference techniques to large, modern datasets. I have set numerous definitive constraints on early-Universe physics using cosmic microwave background (CMB) data, including the first observational constraints on eternal inflation, the first full-sky constraints on topological defects called textures, and the definitive limits on the Universe's anisotropy and non-trivial topology. I have influenced the design of multiple next-generation CMB experiments: my public forecasting code, **CMB4CAST**, has been used by the CMB-S4, CORE, EBEX-IDS, LiteBIRD, Simons Array and Simons Observatory collaborations. In recent years, have focused on identifying the cause of the tension between estimates of the Hubble Constant from the local Universe and the CMB using upcoming multi-messenger datasets.

Employment

2016–2019: Flatiron Research Fellow, Center for Computational Astrophysics

2013–2016: Postdoctoral Researcher, Imperial College London

2012–2013: Postdoctoral Researcher, University College London

2006–2009: Systems Developer, Carbon Capital Ltd

Sole IT systems developer for Carbon Capital, an environmental finance company specializing in the creation of carbon trading and reforestation projects known as Carbon Trading Partnerships. Developed secure online database systems tracking the personal and investment details of all 900 investors and IFAs involved with the Partnerships, representing a total value of £325 million.

2004–2006: Web Developer, Qube Software Ltd

Sole web developer for Qube Software's flagship product, the Earthsim project, a Google Earth predecessor whose marketing strategy was entirely web-based.

Education

2009–2012: Department of Physics and Astronomy, University College London

PhD (Astrophysics)

Advisor: Prof. Hiranya V. Peiris

Thesis Title: *“Novel Algorithms for Early-Universe Cosmology”*

Awarded: 28 December 2012

2000–2004: Gonville and Caius College, Cambridge University

MSci Natural Sciences (Astrophysics): first class degree

BA Hons Natural Sciences (Astrophysics): first class degree

Awards

2018: **Gruber Cosmology Prize** (awarded to **Planck team** for “observational discoveries leading to fundamental advances in our understanding of the Universe”)

2018: Royal Astronomical Society **Group Achievement Award** (awarded to Planck team for “outstanding achievement by large consortia in astronomy”)

2016: Flatiron Institute **Research Fellowship** (three years' independent postdoctoral research funding)

2013: University College London **Jon Darius Memorial Prize** (outstanding postgraduate research in Astrophysics)

2012: Runner-up Royal Astronomical Society **Michael Penston Thesis Prize** (best doctoral thesis in Astronomy and Astrophysics)

2012: UK Science & Technology Facilities Council **Studentship Enhancement Programme** (STEP) award (three months' postdoctoral research funding "aimed at helping departments to retain in research the most promising researchers")

2004: Cambridge University **Institute of Astronomy Prize** (best examination result in Astrophysics)

Teaching

2014–2016: Imperial College London, PH2-LC Laboratory and Computing II, Computing Demonstrator

Core elements: (i) use of object-oriented Python programming in Physics problems; (ii) research project modelling either relativistic pion decay in simple detectors or optical systems using ray-tracing

2013–2014: Imperial College London, PH1-PSK Professional Skills I, Teaching Assistant

Core elements: (i) group research project leading to oral presentation; (ii) topical review of popular science journal article; (iii) individual scientific presentation; (iv) calculator-free problem-solving (order of magnitude estimation & dimensional analysis) exercises

2013: University College London, PHASM336 Advanced Physical Cosmology, Substitute Lecturer

Delivered three-hour lecture on behalf of Prof. Hiranya Peiris

Supervision and Mentoring

Undergraduate (Year 1) Summer Project supervisor: Lingyi Hu & Kumiko Kawato (2015), Andrew Counsell & Lucie Fortova (2016)

Seven-week project "*Forecasting Cosmological Constraints*" writing Python-based Fisher-matrix forecast of CMB polarization experiment, poster presentation and report

PhD mentor (2014–2016): Daniela Saadeh (Research Fellow, University of Nottingham)

Thesis: "*Testing the Isotropy of the Universe with the CMB*", winner of [2016 Institute of Physics Gravitational Physics Thesis Prize](#)

Refereed journal articles: "*A Framework for Testing Isotropy with the Cosmic Microwave Background*" (Mon. Not. Roy. Astron. Soc.) and "*How Isotropic is the Universe?*" (*Phys. Rev. Lett.*)

Masters co-supervisor (2014): Niccolò Dalmasso (PhD candidate, Carnegie Mellon University)

Thesis: "*How Fast is the Universe Expanding?*"

Refereed journal article: "*Clarifying the Hubble Constant Tension with a Bayesian Hierarchical Model of the Local Distance Ladder*" (Mon. Not. Roy. Astron. Soc.)

Masters co-supervisor (2012): Thibaut Josset (PhD, Aix-Marseille Université)

Thesis: "*Evidence for Bianchi Cosmologies from Observations of the CMB*"

Refereed journal article: "*Bayesian Analysis of Anisotropic Cosmologies: Bianchi VII_h and WMAP*" (Mon. Not. Roy. Astron. Soc.)

Leadership and Organisation

2018: Organiser [Tristate Postdoc Retreat](#): two-day meeting for astronomy postdocs in the New York area, featuring: lightning networking talks; “*Career-Path Strategy and Work-Life Balance*” and “*Careers in Data Science*” workshops; Decadal Survey white-paper planning session; academic and data-science careers panels.

2014–2018: Lead cosmology forecaster for EBEX-IDS CMB polarization mission collaboration.

2014–2015: Co-leader of topology and isotropy analyses in “*Planck 2015 Results. XVIII. Background Geometry & Topology*” (Astron. Astrophys.).

2013–2016: Postdoctoral cohort representative: Imperial College Astrophysics Group staff meetings, Department of Physics postdoc representative meetings.

2013–2016: Organiser [London Cosmology Discussion Meeting](#): quarterly half-day meetings designed to foster collaboration between London-based cosmologists.

2009–2013: PhD & Postdoctoral cohort representative at University College London departmental staff meetings

Press and Public Engagement

2018: Interviews in American Physical Society’s [Physics](#) and [APS News](#) after invited talk at April Meeting’s “*Crisis in Cosmology*” session.

2017: Interview with Sveriges Radio’s [Vetandets Värld \(World of Wisdom\)](#) programme.

2016: [Royal Society Summer Science Exhibition 2016](#) (14,371 visitors), demonstrator at Planck Collaboration’s “*What Happened at the Big Bang?*” stall; interview in Imperial College London [podcast](#).

2016: *Phys. Rev. Lett.* article “*How Isotropic is the Universe*” selected as Editors’ Suggestion; covered by American Physical Society’s [Physics](#) magazine; interviews in [Imperial College London](#) and [University College London](#) press releases; [full coverage](#).

2013: Science, Technology, Engineering and Mathematics “*Speed Careers*” event (five-minute interviews by pairs of schoolchildren), Whitgift School.

2012: “*Observing the Multiverse*” outreach talk at University College London’s Astronomy Diploma Club.

2012: *Phys. Rev. Lett.* article “*Robust Constraint on Cosmic Textures from the Cosmic Microwave Background*” selected as [Science](#)’s [Editors’ Choice](#); interviews by [BBC News](#) and [FQXi podcast](#).

2011: *Phys. Rev. Lett.* article “*First Observational Tests of Eternal Inflation*” selected as Editors’ Suggestion; covered by American Museum of Natural History’s [Science Bulletins](#); American Physical Society’s [Physics](#) magazine, [BBC’s Horizon](#) television programme, [BBC News](#), [BBC Science Focus](#), [National Geographic](#), [New Scientist](#), [New York Times](#).

2009: Demonstrator at University College London’s free [Your Universe](#) festival of astronomy and particle physics.

Programming Skills and Public Codes

Fluent in Python, Fortran 90, IDL, OpenMP, MPI, Stan, \LaTeX , HTML, CSS, PHP and SQL.

Publicly available codes (more available on [Github](#)):

[CMB4CAST](#). Forecasting CMB experiments’ ability to clean polarized foreground contamination, extract lensing from resulting CMB maps and constrain cosmology. Runs on NERSC supercomputers via web interface. Used in design studies of [CMB-S4](#), [CORE](#), [EBEX-IDS](#), [LiteBIRD](#), Simons Array and Simons Observatory experiments.

[DELFI](#). Python code coupling massive data compression with density-estimation likelihood-free inference to allow parameter estimation using only forward-simulation of data.

[HH0](#): Hierarchical models for inference of Hubble Constant (current expansion rate of Universe) from Cepheid distance ladder, inverse distance ladder and binary neutron star data. Python/Stan code.

Professional Affiliations and Service

Member: EBEX Collaboration, POLARBEAR Collaboration, Simons Observatory Collaboration, Royal Astronomical Society

Referee: Astron. Astrophys., J. Cosmol. Astropart. Phys., Mon. Not. Roy. Astron. Soc., Phys. Rev. D, Phys. Rev. Lett.

Publications

Refereed Journal Articles

“*Massive Optimal Data Compression and Density Estimation for Scalable, Likelihood-Free Inference in Cosmology*”, J. Alsing, B. Wandelt and **S. Feeney**, 2018, **Mon. Not. Roy. Astron. Soc.**, 477 (3) (arXiv:1801.01497 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Survey Requirements and Mission Design*”, J. Delabrouille, ... **S. Feeney (73/204)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 014 (arXiv:1706.04516 [astro-ph.IM])

“*Exploring Cosmic Origins with CORE: The Instrument*”, P. de Bernardis, ... **S. Feeney (77/130)**, ... and N. Vittorio, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 015 (arXiv:1705.02170 [astro-ph.IM])

“*Exploring Cosmic Origins with CORE: Inflation*”, F. Finelli, ... **S. Feeney (52/131)**, ... and K. Young, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 016 (arXiv:1612.08270 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Cosmological Parameters*”, E. Di Valentino, ... **S. Feeney (62/129)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 017 (arXiv:1612.00021 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Gravitational Lensing of the CMB*”, A. Challinor, ... **S. Feeney (5/114)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 018 (arXiv:1707.02259 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Cluster Science*”, J.-B. Melin, ... **S. Feeney (58/122)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 019 (arXiv:1703.10456 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Extragalactic sources in Cosmic Microwave Background maps*”, G. De Zotti, ... **S. Feeney (48/125)**, ... and K. Young, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 020 (arXiv:1609.07263 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Effects of Observer Peculiar Motion*”, C. Burigana, ... **S. Feeney (53/120)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 021 (arXiv:1704.05764 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: Mitigation of Systematic Effects*”, P. Natoli, ... **S. Feeney (59/127)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 022 (arXiv:1707.04224 [astro-ph.CO])

“*Exploring Cosmic Origins with CORE: B-mode Component Separation*”, M. Remazeilles, ... **S. Feeney (52/117)**, ... and M. Zannoni, 2018, **J. Cosmol. Astropart. Phys.**, 04 (2018), 023 (arXiv:1704.04501 [astro-ph.CO])

“*Clarifying the Hubble Constant Tension with a Bayesian Hierarchical Model of the Local Distance Ladder*”, **S. Feeney**, D. Mortlock and N. Dalmaso, 2017, **Mon. Not. Roy. Astron. Soc.**, 476 (3) (arXiv:1707.00007 [astro-ph.CO])

“*Optimization Study for the Experimental Configuration of CMB-S4*”, D. Barron, ... , **S. Feeney (6/12)**, ... and A. Suzuki, 2018, **J. Cosmol. Astropart. Phys.**, 02 (2018), 009, (arXiv:1702.07467 [astro-ph.CO])

“A Measurement of the Cosmic Microwave Background B-Mode Polarization Power Spectrum at Sub-Degree Scales from 2 years of POLARBEAR Data”, P. Ade, . . . , **S. Feeney (21/81)**, . . . and A. Zahn, 2017, **Astrophys. J.**, 848, 141, (arXiv:1705.02907 [astro-ph.CO])

“Wavelet-Bayesian Inference of Cosmic Strings Embedded in the Cosmic Microwave Background”, J. McEwen, **S. Feeney**, H. Peiris, Y. Wiaux, C. Ringeval and F. Bouchet, 2017, **Mon. Not. Roy. Astron. Soc.**, 472 (4) (arXiv:1611.10347 [astro-ph.IM])

“Cosmic Microwave Background Science at Commercial Airline Altitudes”, **S. Feeney**, J. Gudmundsson, H. Peiris, L. Verde and J. Errard, 2017, **Mon. Not. Roy. Astron. Soc. Lett.**, 469 (1) (arXiv:1610.07604 [astro-ph.IM])

“Making Maps of Cosmic Microwave Background Polarization for B-mode Studies: the POLARBEAR Example”, D. Poletti, . . . , **S. Feeney (16/49)**, . . . and N. Whitehorn, 2016, **Astron. Astrophys.** (arXiv:1608.01624 [astro-ph.IM])

“A Framework for Testing Isotropy with the Cosmic Microwave Background”, D. Saadeh, **S. Feeney**, A. Pontzen, H. Peiris, J. McEwen, 2016, **Mon. Not. Roy. Astron. Soc.**, 462 (2) (arXiv:1604.01024 [astro-ph.CO])

“How Isotropic is the Universe?”, D. Saadeh, **S. Feeney**, A. Pontzen, H. Peiris, J. McEwen, 2016, **Phys. Rev. Lett.** 117, 131302 (arXiv:1605.07178 [astro-ph.CO])

“The POLARBEAR-2 and the Simons Array Experiments”, A. Suzuki, . . . **S. Feeney (21/90)**, . . . and O. Zahn, 2016, **J. Low. Temp. Phys.**, 104, 3, 805 (arXiv:1512.0729 [astro-ph.IM])

“Planck 2015 Results. XVIII. Background Geometry and Topology of the Universe”, Planck Collaboration (inc. **S. Feeney**), 2016, **Astron. Astrophys.**, 594, A18 (arXiv:1502.01593 [astro-ph.CO])

“Robust Forecasts on Fundamental Physics from the Foreground-Obscured, Gravitationally-Lensed CMB Polarization”, **J. Errard and S. Feeney (co-first authors)**, H. Peiris and A. Jaffe, 2016, **J. Cosmol. Astropart. Phys.**, 03 (2016), 052 (arXiv:1509.06770 [astro-ph.CO])

“Planck 2015 Results. I. Overview of Products and Scientific Results”, Planck Collaboration (inc. **S. Feeney**), 2016, **Astron. Astrophys.**, 594, A1 (arXiv:1502.01582 [astro-ph.CO])

“POLARBEAR Constraints on Cosmic Birefringence and Primordial Magnetic Fields”, POLARBEAR Collaboration (inc. **S. Feeney**), 2015, **Phys. Rev. D**, 92, 123509, (arXiv:1509.02461 [astro-ph.CO])

“Forecasting Constraints from the Cosmic Microwave Background on Eternal Inflation”, **S. Feeney**, F. Elsner, M. Johnson and H. Peiris, 2015, **Phys. Rev. D**, 92, 083515 (arXiv:1506.01716 [astro-ph.CO])

“Modeling Atmospheric Emission for CMB Ground-based Observations”, J. Errard, . . . , **S. Feeney (19/75)**, . . . and O. Zahn, 2015, **Astrophys. J.**, 809, 1, 63, 19 (arXiv:1501.07911 [astro-ph.CO])

“Sparse inpainting and isotropy”, **S. Feeney**, D. Marinucci, J. McEwen, H. Peiris, B. Wandelt and V. Cammarota, 2014, **J. Cosmol. Astropart. Phys.**, 01 (2014), 050 (arXiv:1308.0602 [astro-ph.CO])

“(Lack of) Cosmological Evidence for Dark Radiation After Planck”, L. Verde, **S. Feeney**, D. Mortlock, and H. Peiris, 2013, **J. Cosmol. Astropart. Phys.**, 09 (2013), 013 (arXiv:1307.2904 [astro-ph.CO])

“The Importance of Local Measurements for Cosmology”, L. Verde, R. Jimenez and **S. Feeney**, 2013, **Phys. Dark Universe**, 2, 2, 65-71 (arXiv:1303.5341 [astro-ph.CO])

“Bayesian Analysis of Anisotropic Cosmologies: Bianchi VII_h and WMAP”, J. McEwen, T. Josset, **S. Feeney**, H. Peiris, A. Lasenby, 2013, **Mon. Not. Roy. Astron. Soc.**, 436 (4) (arXiv:1303.3409 [astro-ph.CO])

“Is There Evidence for Additional Neutrino Species from Cosmology?”, **S. Feeney**, H. Peiris and L. Verde, 2013, **J. Cosmol. Astropart. Phys.**, 04 (2013), 036 (arXiv:1302.0014 [astro-ph.CO])

“*Hierarchical Bayesian Detection Algorithm for Early-Universe Relics in the Cosmic Microwave Background*”, **S. Feeney**, M. Johnson, J. McEwen, D. Mortlock and H. Peiris, 2013, **Phys. Rev. D**, 88, 043012 (arXiv:1210.2725 [astro-ph.CO])

“*Robust Constraint on Cosmic Textures from the Cosmic Microwave Background*”, **S. Feeney**, M. Johnson, D. Mortlock and H. Peiris, 2012, **Phys. Rev. Lett.**, 108, 241301 (arXiv:1203.1928 [astro-ph.CO])

“*Optimal Filters for Detecting Cosmic Bubble Collisions*”, J. McEwen, **S. Feeney**, M. Johnson and H. Peiris, 2012, **Phys. Rev. D**, 85, 103502 (arXiv:1202.2861 [astro-ph.CO])

“*Avoiding Bias in Reconstructing the Largest Observable Scales from Partial-Sky Data*”, **S. Feeney**, H. Peiris and A. Pontzen, 2011, **Phys. Rev. D**, 84, 103002 (arXiv:1107.5466 [astro-ph.CO])

“*First Observational Tests of Eternal Inflation: Analysis Methods and WMAP 7-Year Results*”, **S. Feeney**, M. Johnson, D. Mortlock and H. Peiris, 2011, **Phys. Rev. D**, 84, 043507 (arXiv:1012.3667 [astro-ph.CO])

“*First Observational Tests of Eternal Inflation*”, **S. Feeney**, M. Johnson, D. Mortlock and H. Peiris, 2011, **Phys. Rev. Lett.**, 107, 071301 (arXiv:1012.1995 [astro-ph.CO])

“*Automated Detection of Classical Novae with Neural Networks*”, **S. Feeney**, V. Belokurov, N. W. Evans et al., 2005, **Astron. J.**, 130, 84-94 (astro-ph/0504236)

In Review

“*Optimal Proposals for Approximate Bayesian Computation*”, J. Alsing, B. Wandelt and **S. Feeney**, 2018, in review with **Bayesian Anal.** (arXiv:1808.06040 [math.ST])

“*The EBEX Balloon Borne Experiment - Detectors and Readout*”, EBEX Collaboration (inc. **S. Feeney**), 2018, in review with **Astrophys. J. Supp. Ser.** (arXiv:1803.01018 [astro-ph.CO])

“*Prospects for Resolving the Hubble Constant Tension with Standard Sirens*”, **S. Feeney**, H. Peiris, A. Williamson, S. Nissanke, D. Mortlock, J. Alsing and D. Scolnic, 2018, in review with **Phys. Rev. Lett.** (arXiv:1802.03404 [astro-ph.CO])

White Papers and Pre-Prints

“*The Simons Observatory: Science Goals and Forecasts*”, Simons Observatory Collaboration (inc. **S. Feeney**), 2018, (arXiv:1808.07445 [astro-ph.CO])

“*CMB-S4 Science Book, First Edition*”, K. Abazajian, . . . , **S. Feeney (27/86)**, . . . and K. Wu, 2016, (arXiv:1610.02743 [astro-ph.CO])

Invited Conference and Seminar Presentations

29 October 2018: Stony Brook University, Astronomy Seminar

4 October 2018: “The Future of H_0 : Crisis or Concordance” Workshop, Kavli Institute for Cosmological Physics, Chicago, introduction talk

15 April 2018: American Physical Society April Meeting, Columbus, “Crisis in Cosmology” session, invited talk

21 November 2017: American Museum of Natural History, New York, Astrophysics Seminar

10 November 2017: Kavli Institute for Cosmological Physics, Chicago, Friday Lunch Seminar

9 May 2014: Royal Astronomical Society, Annual General Meeting, invited talk

7 June 2013: Istituto Nazionale di Alta Matematica, Università di Roma La Sapienza, “Probabilistic and Statistical Techniques for Cosmological Applications” Meeting, invited talk

12 November 2013: Perimeter Institute for Theoretical Physics, Cosmology & Gravitation Seminar

10 May 2013: Centre for Astroparticle Physics and Cosmology, Imperial College London, CAPAC Cosmology Seminar

11 December 2012: Perimeter Institute for Theoretical Physics, special seminar

21 February 2011: Centre for Theoretical Cosmology, University of Cambridge, CTC / DAMTP Cosmology Lunch Talk

Referees

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