# Will Handley

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## Education

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|---|---|
| 2012–2016 | **University of Cambridge**, *PhD: Astrophysics*, Prof. A. Lasenby & Prof. M. Hobson. |
| 2008–2012 | **University of Cambridge**, *MSc, MA: Natural Sciences*, Gonville & Caius College. |
| 2001–2008 | **Alleyn's School**, *A levels, GCSEs*, London. |

## Research Experience

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| 2016–present | **Research fellow**, *Gonville & Caius College*, University of Cambridge. |
| Jul-Sep 2016 | **Postdoctoral research fellow**, *Prof. H. Peiris*, University College London. <br> Searching for features in the primordial power spectrum. |
| 2012–2016 | **PhD: Astrophysics**, *Prof. A. Lasenby & Prof. M. Hobson*, University of Cambridge. <br> Kinetic initial conditions for inflation: Theory, observations & methods. |
| 2011–2012 | **Part III Dissertation**, *Prof. P. Alexander*, University of Cambridge. <br> Investigating the origins of cosmic magnetism. |
| Summer 2011 | **Summer Research Student**, *Prof. M. Faulkes & Dr. J. Spencer*, Imperial College. <br> Folded spectrum full configuration interaction quantum Monte Carlo. |
| Summer 2011 | **Summer Research Student**, *Dr. R. Blumenfeld*, University of Cambridge. <br> Geometry and field equations of granular systems. |
| 2010–2011 | **Research Review**, *Prof. S. Gull*, University of Cambridge. <br> Literature Survey of the Physics-Philosophy crossover field of measurement theory. |
| Summer 2010 | **iGEM Team Physicist**, *Dr. J. Haseloff*, University of Cambridge. <br> E-glowli 2010 iGEM team (placed in final 6) http://2010.igem.org/Team:Cambridge |

## Awards & Prizes

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| July. 2019 | Guiseppe and Vanna Cocconi Prize (shared with WMAP and Planck) | *EPS-HEPP Division* |
| Jun. 2018 | Gruber Prize (shared with Planck) | *Gruber Foundation* |
| Dec. 2013 | Best presentation | *Cavendish grad. students conference* |
| Jun. 2012 | Best theoretical part III project | *University of Cambridge* |
| | Physics prize | *Gonville & Caius College* |
| Summer 2011 | Undergraduate Research Bursary | *Nuffield Foundation* |
| | UROP Studentship | *Imperial College* |
| Summer 2010 | iGEM Studentship | *Wellcome Trust* |
| 2009–12 | Junior and Senior Scholarships | *Gonville & Caius College* |

## Teaching

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|---|---|---|
| 2017-present | Bayesian Statistics | *Graduate lecture course* |
| 2013–2018 | Part II Physics: General relativity | *Supervising* |
| 2012–2017 | Part IA Mathematics for NatSci | *Supervising, Tripos classes* |

| 2013 | Part II Theoretical Physics 1 & 2 | *Demonstrating* |
| 2006–2012 | Maths and Science Tuition | *Individual coaching, key stage 1 — STEP* |

## Supervision of graduate students and postdoctoral fellows

| Postdoc | Kamran Javid | *2018-present* |
| PhD | Ed Higson, Lukas Hergt, Fruzsina Agocs, Will Barker | *2016-present* |
| Masters | Deaglan Bartlet, Jamie Bamber | *2018-present* |
| | Ward Haddadin, Jessica Rigley, Panagiotis Mavrogiannis | *2017-2018* |
| | Fruzsina Agocs, Robert Knighton, Stephen Pickman, Daniel Manela | *2016–2017* |
| Summer | Denis Werth, Maxime Jabarian, Liam Lau | *2019* |
| | Elizabeth Guest, Ward Haddadin, Shu-Fan Chen | *2018* |

## Grants won

| £25,000 | **STFC IAA 2016**, *Interfacing PolyChord 2.0.* |
| £2,000 | **KICC visitors 2017**, *Class and MontePython workshop.* |
| £42,000 | **STFC IAA 2018**, *PolyChord and Bayesian Neural network facial recognition.* |
| £1,500 | **King's + Kavli**, *Summer student funding.* |
| £15,000 | **KICC Workshop 2019**, *AstroHack week 2019.* |
| £2,000 | **KICC visitors 2019**, *Likelihood free inference workshop.* |

## Academic Talks

| Mar. 2019 | **Compromise-free Bayesian sparse reconstruction**, *LFI workshop*, Flatiron institute, US. |
| Dec. 2018 | **Inflation, curvature and kinetic dominance**, *Future uses of Planck data*, ESAC, Spain. |
| Nov. 2018 | **BAMBI Resurrection: Blind Accelerated Multimodal Bayesian Inference**, *Dark Machines*, Worldwide. |
| Nov. 2018 | **Nested Sampling: an efficient and robust Bayesian inference tool for cosmology and particle physics**, *Dark Machines*, Worldwide. |
| Oct. 2018 | **Bayesian Statistics**, *Third Asterics-Obelics workshop*, Cambridge, UK. |
| May. 2018 | **Planck, inflation and the future of inflationary constraints**, *Consistency of Cosmological Datasets*, Cambridge, UK. |
| May. 2018 | **MaxEnt priors with derived parameters in a specified distribution**, Cambridge, UK. |
| May. 2018 | **Nested Sampling: an efficient and robust Bayesian inference tool for astrophysics and cosmology**, ICIC, UK. |
| April. 2018 | **Introduction to statistics**, *CosmoTools 18*, RWTH Aachen, Germany. |
| Jan. 2018 | **Advances in Nested Sampling & astrophysical application**, Cambridge, UK. |
| Aug. 2017 | **PolyChord 2.0: Fast inference & nested sampling**, *Cosmo17*, Paris, France. |
| Jun. 2017 | **Modern Bayesian Inference: Theory and Practice**, RWTH Aachen, Germany. |
| Mar. 2017 | **Parameter estimation and Model comparison**, *CosmoTools 17*, Madrid, Spain. |
| Feb. 2017 | **PolyChord 2.0: Advances in Nested Sampling & astrophysical application**, Flatiron institute, US. |
| Sep. 2016 | **PolyChord 2.0 & the future of nested sampling**, University College London, UK. |
| May. 2016 | **PolyChord 2.0 & the future of nested sampling**, University of Sussex, UK. |
| Mar. 2016 | **PolyChord & the future of nested sampling**, Edinburgh, UK. |
| Dec. 2015 | **PolyChord: next generation nested sampling**, Max Planck Institute, Germany. |
| Feb. 2015 | **PolyChord: next generation nested sampling**, University of Sussex, UK. |

Dec. 2013    **Kinetic dominance in the pre-inflationary universe**, Cavendish grad. conference.

## Selected Outreach

Over the course of my career I have given 19 public outreach talks including:

May 2015    **Intro. to Astronomy: Beyond the Milky Way**, *IoA Public Talk*, Cambridge.

May 2015    **To infinity and beyond: Dark Energy**, *Pint of Science*, Cambridge Brewhouse.

Jan. 2014    **The first 3 yocto-pico seconds**, *Three minute wonder*, Cavendish Laboratory.

## Institutional responsibilities

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| 2017–present | Organiser of weekly group seminars | *Cavendish astrophysics group* |
| 2019–present | Gonville & Caius college council | *Gonville & Caius college* |
| 2018–present | Investments committee | *Gonville & Caius college* |
| 2018–present | Education and research committee | *Gonville & Caius college* |
| 2016–present | Undergraduate Admissions | *Gonville & Caius college* |

## Organisation of scientific meetings

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| 2018 | Secured funding for and organised CLASS+MontePython software workshop | *KICC* |
| 2019 | Helped secure funding for AstroHack week 2019 (currently helping organise) | *KICC* |
| 2019 | Secured funding for Likelihood free inference workshop (currently organising) | *KICC* |

## Collaborations

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| 2018–present | REACH | *www.mrao.cam.ac.uk/research/research-projects/reach* |
| 2018–present | GAMBIT | *gambit.hepforge.org* |
| 2018–present | DarkMachines | *darkmachines.org* |
| 2017–present | Terra Hunter Experiment | *terrahunting.org* |
| 2016–2017 | CORE | *core-mission.org* |
| 2015–2016 | AMI | *www.mrao.cam.ac.uk/research/research-projects/AMI* |
| 2015–2018 | Planck | *cosmos.esa.int/web/planck* |

## Software

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| PolyChord | Sole author and maintainer: github.com/PolyChord/PolyChordLite |
| pyBAMBI | Team maintainer: github.com/DarkMachines/pyBAMBI |
| anesthetic | Sole author and maintainer: github.com/williamjameshandley/anesthetic |
| fgivenx | Sole author and maintainer: github.com/williamjameshandley/fgivenx |
| primordial | Sole author and maintainer: github.com/williamjameshandley/primordial |
| ModeCode | Maintainer: modecode.org |
| MultiNest | Maintainer: github.com/farhanferoz/MultiNest |
| Open source | scipy: Weighted kernel density estimation in scipy.stats.gaussian_kde |
| | matplotlib: Vertical slider in matplotlib.widgets.Slider |

## Interaction with industry

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| PolyChord | Founded start-up company PolyChord Ltd. to bring Bayesian methods & tools from cosmology to Machine Learning & Biotech industries: polychord.co.uk |
| Shell | Work with department postdocs in the department applying nested sampling to geophysics |
| CMAM | Consult for local finance company on Bayesian algorithmic trading |

## Computer skills

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| Programming | MPI parallelisation, C++, FORTRAN, Mathematica, Maple, Python |
| Computing | Unix, Bash, zsh, vim, git, svn, LaTeX, TikZ, VMs, CI |
| OS | Arch Linux & HPC supercomputing (Experienced), Windows & OSX (Familiar) |

## References

Prof. Anthony Lasenby, +44 (0)1223 337293/4, a.n.lasenby@mrao.cam.ac.uk,
Prof. Mike Hobson, +44 (0)1223 339992, mph@mrao.cam.ac.uk
Prof. Hiranya Peiris, +44 (0)203 5495831, h.peiris@ucl.ac.uk
Prof. Alan Heavens, +44 (0)207 5942930, a.heavens@imperial.ac.uk

## Publications

### First Author Publications

[1]   **Will Handley** and Pablo Lemos. Quantifying dimensionality: Bayesian cosmological model complexities. *arXiv e-prints*, page arXiv:1903.06682, Mar 2019.

[2]   **Will Handley** and Pablo Lemos. Quantifying tension: interpreting the DES evidence ratio. *arXiv e-prints*, page arXiv:1902.04029, Feb 2019.

[3]   **Will Handley**, Anthony Lasenby, and Mike Hobson. Kinetically dominated curved universes: Logolinear series expansions. *arXiv e-prints*, page arXiv:1901.07540, Jan 2019.

[4]   **Will Handley** and Marius Millea. Maximum-Entropy Priors with Derived Parameters in a Specified Distribution. *Entropy*, 21(3):272, Mar 2019.

[5]   **Will Handley**. fgivenx: A Python package for functional posterior plotting. *JOSS*, 3(28):849, Aug 2018.

[6]   **W. J. Handley**, A. N. Lasenby, and M. P. Hobson. The Runge-Kutta-Wentzel-Kramers-Brillouin Method. *arXiv e-prints*, page arXiv:1612.02288, Dec 2016.

[7]   **W. J. Handley**, A. N. Lasenby, and M. P. Hobson. Novel quantum initial conditions for inflation. *PRD*, 94(2):024041, Jul 2016.

[8]   **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. POLYCHORD: next-generation nested sampling. *MNRAS*, 453(4):4384–4398, Nov 2015.

[9]   **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. polychord: nested sampling for cosmology. *MNRAS*, 450:L61–L65, Jun 2015.

[10]  **W. J. Handley**, S. D. Brechet, A. N. Lasenby, and M. P. Hobson. Kinetic initial conditions for inflation. *PRD*, 89(6):063505, Mar 2014.

### Supervised Student Publications

[11]  L. T. Hergt, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. Constraining the kinetically dominated Universe. *arXiv e-prints*, page arXiv:1809.07737, Sep 2018.

[12]  L. T. Hergt, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. A case for kinetically dominated initial conditions for inflation. *arXiv e-prints*, page arXiv:1809.07185, Sep 2018.

[13]  William E V Barker, Anthony N Lasenby, Michael P Hobson, and **William J Handley**. Static energetics in gravity. *arXiv e-prints*, page arXiv:1811.09844, Nov 2018.

[14]  W. I. J. Haddadin and **W. J. Handley**. Rapid numerical solutions for the Mukhanov-Sazaki equation. *arXiv e-prints*, page arXiv:1809.11095, Sep 2018.

[15]  Edward Higson, **Will Handley**, Michael Hobson, and Anthony Lasenby. Bayesian sparse reconstruction: a brute-force approach to astronomical imaging and machine learning. *MNRAS*, 483(4):4828–4846, Mar 2019.

[16]  Edward Higson, **Will Handley**, Michael Hobson, and Anthony Lasenby. NESTCHECK: diagnostic tests for nested sampling calculations. *MNRAS*, 483(2):2044–2056, Feb 2019.

[17]  Edward Higson, **Will Handley**, Mike Hobson, and Anthony Lasenby. Dynamic nested sampling: an improved algorithm for parameter estimation and evidence calculation. *arXiv e-prints*, page arXiv:1704.03459, Apr 2017.

[18]  Edward Higson, **Will Handley**, Mike Hobson, and Anthony Lasenby. Sampling Errors in Nested Sampling Parameter Estimation. *arXiv e-prints*, page arXiv:1703.09701, Mar 2017.

[19]  S. Hee, J. A. Vázquez, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. Constraining the dark energy equation of state using Bayes theorem and the Kullback-Leibler divergence. *MNRAS*, 466(1):369–377, Apr 2017.

[20]  S. Hee, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. Bayesian model selection without evidences: application to the dark energy equation-of-state. *MNRAS*, 455(3):2461–2473, Jan 2016.

### Collaboration Publications

[21]  Richard D. Hall, Samantha J. Thompson, **Will Handley**, and Didier Queloz. On the Feasibility of Intense Radial Velocity Surveys for Earth-Twin Discoveries. *MNRAS*, 479(3):2968–2987, Sep 2018.

[22]  A. J. K. Chua, S. Hee, **W. J. Handley**, E. Higson, C. J. Moore, J. R. Gair, M. P. Hobson, and A. N. Lasenby. Towards a framework for testing general relativity with extreme-mass-ratio-inspiral observations. *MNRAS*, 478(1):28–40, Jul 2018.

[23] Gong-Bo Zhao, Marco Raveri, Levon Pogosian, Yuting Wang, Robert G. Crittenden, **Will J. Handley**, Will J. Percival, Florian Beutler, Jonathan Brinkmann, Chia-Hsun Chuang, Antonio J. Cuesta, Daniel J. Eisenstein, Francisco-Shu Kitaura, Kazuya Koyama, Benjamin L'Huillier, Robert C. Nichol, Matthew M. Pieri, Sergio Rodriguez-Torres, Ashley J. Ross, Graziano Rossi, Ariel G. Sánchez, Arman Shafieloo, Jeremy L. Tinker, Rita Tojeiro, Jose A. Vazquez, and Hanyu Zhang. Dynamical dark energy in light of the latest observations. *Nature Astronomy*, 1:627–632, Aug 2017.

[24] Clare Rumsey, Malak Olamaie, Yvette C. Perrott, Helen R. Russell, Farhan Feroz, Keith J. B. Grainge, **Will J. Handley**, Michael P. Hobson, Richard D. E. Saunders, and Michel P. Schammel. AMI observations of 10 CLASH galaxy clusters: SZ and X-ray data used together to determine cluster dynamical states. *MNRAS*, 460(1):569–589, Jul 2016.

[25] James S. Spencer, Nick S. Blunt, Seonghoon Choi, Jiri Etrych, Maria-Andreea Filip, W. M. C. Foulkes, Ruth S. T. Franklin, **Will J. Handley**, Fionn D. Malone, Verena A. Neufeld, Roberto Di Remigio, Thomas W. Rogers, Charles J. C. Scott, James J. Shepherd, William A. Vigor, Joseph Weston, RuQing Xu, and Alex J. W. Thom. The HANDE-QMC project: open-source stochastic quantum chemistry from the ground state up. *arXiv e-prints*, page arXiv:1811.11679, Nov 2018.

## CORE Collaboration

[26] Exploring cosmic origins with CORE: Survey requirements and mission design. *JCAP*, 2018(4):014, Apr 2018.
[27] Exploring cosmic origins with CORE: The instrument. *JCAP*, 2018(4):015, Apr 2018.
[28] Exploring cosmic origins with CORE: Inflation. *JCAP*, 2018(4):016, Apr 2018.
[29] Exploring cosmic origins with CORE: Cosmological parameters. *JCAP*, 2018(4):017, Apr 2018.
[30] Exploring cosmic origins with CORE: Gravitational lensing of the CMB. *JCAP*, 2018(4):018, Apr 2018.
[31] Exploring cosmic origins with CORE: Cluster science. *JCAP*, 2018(4):019, Apr 2018.
[32] Exploring cosmic origins with CORE: Extragalactic sources in cosmic microwave background maps. *JCAP*, 2018(4):020, Apr 2018.
[33] Exploring cosmic origins with CORE: Effects of observer peculiar motion. *JCAP*, 2018(4):021, Apr 2018.
[34] Exploring cosmic origins with CORE: Mitigation of systematic effects. *JCAP*, 2018(4):022, Apr 2018.
[35] Exploring cosmic origins with CORE: B-mode component separation. *JCAP*, 2018(4):023, Apr 2018.

## Planck Collaboration

[36] Planck 2018 results. I. Overview and the cosmological legacy of Planck. *arXiv e-prints*, page arXiv:1807.06205, Jul 2018.
[37] Planck 2018 results. II. Low Frequency Instrument data processing. *arXiv e-prints*, page arXiv:1807.06206, Jul 2018.
[38] Planck 2018 results. III. High Frequency Instrument data processing and frequency maps. *arXiv e-prints*, page arXiv:1807.06207, Jul 2018.
[39] Planck 2018 results. IV. Diffuse component separation. *arXiv e-prints*, page arXiv:1807.06208, Jul 2018.
[40] Planck 2018 results. VI. Cosmological parameters. *arXiv e-prints*, page arXiv:1807.06209, Jul 2018.
[41] Planck 2018 results. VIII. Gravitational lensing. *arXiv e-prints*, page arXiv:1807.06210, Jul 2018.
[42] Planck 2018 results. X. Constraints on inflation. *arXiv e-prints*, page arXiv:1807.06211, Jul 2018.
[43] Planck 2018 results. XI. Polarized dust foregrounds. *arXiv e-prints*, page arXiv:1801.04945, Jan 2018.
[44] Planck 2018 results. XII. Galactic astrophysics using polarized dust emission. *arXiv e-prints*, page arXiv:1807.06212, Jul 2018.
[45] Planck intermediate results. LIII. Detection of velocity dispersion from the kinetic Sunyaev-Zeldovich effect. *A&A*, 617:A48, Sep 2018.
[46] Planck intermediate results. LIV. The Planck multi-frequency catalogue of non-thermal sources. *A&A*, 619:A94, Nov 2018.
[47] Planck 2015 results. I. Overview of products and scientific results. *A&A*, 594:A1, Sep 2016.
[48] Planck 2015 results. XX. Constraints on inflation. *A&A*, 594:A20, Sep 2016.