

# Will Handley

Gonville & Caius College  
Cambridge, UK, CB2 1TA

+44 (0) 7718 622713

+44 (0) 1223 764042

✉ wh260@cam.ac.uk

🌐 www.willhandley.co.uk

orcid.org/0000-0002-5866-0445

## Education

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

## Employment

- Oct 2020– **Royal Society University Research Fellow**, *Cavendish Lab*, University of Cambridge  
Bayesian machine learning and tensions in cosmology
- Oct 2021– **Turing Fellow**, *Alan Turing Institute*
- May 2021– **Fellow & College Lecturer**, *Gonville & Caius College*, University of Cambridge
- 2016–2020 **Research fellow**, *Gonville & Caius College*, University of Cambridge  
Funded by Gonville & Caius College and an STFC IPS grant.
- Jul-Sep 2016 **Postdoctoral researcher**, *Prof. H. Peiris*, University College London  
Searching for features in the primordial power spectrum.
- 2012–2016 **Ph.D. Astrophysics**, *Prof. A. Lasenby & Prof. M. Hobson*, University of Cambridge  
Kinetic initial conditions for inflation: Theory, observations & methods.
- 2011–2012 **Part III Dissertation**, *Prof. P. Alexander*, University of Cambridge  
Investigating the origins of cosmic magnetism.
- Summer 2011 **Summer Research Student**, *Prof. M. Faulkes & Dr. J. Spencer*, Imperial College  
Folded spectrum full configuration interaction quantum Monte Carlo.
- Summer 2011 **Summer Research Student**, *Dr. R. Blumenfeld*, University of Cambridge  
Geometry and field equations of granular systems.
- 2010–2011 **Research Review**, *Prof. S. Gull*, University of Cambridge  
Literature Survey of the Physics-Philosophy crossover field of measurement theory.
- Summer 2010 **iGEM Team Physicist**, *Dr. J. Haseloff*, University of Cambridge  
E-glowli 2010 iGEM team (placed in final 6) <http://2010.igem.org/Team:Cambridge>

## Grants won (£2.8m)

- £1.3m **ERC starting grant** ⇒ **UKRI frontier research**, *Resolving cosmological tensions with diverse data, novel theories and Bayesian machine learning*, Horizon Europe ERC STG 2021, invited for grant preparation, converted to UKRI frontier research guarantee, Start date: October 2023
- £170k **Royal Society Enhancement**, *Likelihood-free inference and Bayesian neural networks*
- 30MCPUh **DiRAC Resource Allocation Committee 13<sup>th</sup> call 2020**,  
≡ £300k *Next generation cosmological analysis with nested sampling*
- £723k **Royal Society URF 2020**, *Bayesian machine learning and tensions in cosmology*
- 2MCPUh **DiRAC directors discretionary award 2020**,  
≡ £20k *Bayesian model comparison of inflation and spatial curvature*

£225k **STFC IPS 2019**, *PolyChord and Bayesian sparse facial recognition*  
 £42k **STFC IAA 2018**, *PolyChord and Bayesian neural network facial recognition*  
 £25k **STFC IAA 2016**, *Interfacing PolyChord 2.0*  
 £15k **KICC Workshop 2019**, *AstroHackWeek 2019*  
 \$6k **George Southgate Visiting Fellowship 2020**, *GAMBIT visit*  
 £2k **KICC visitors 2019**, *Likelihood free inference workshop*  
 £2k **KICC visitors 2017**, *Class and MontePython workshop*  
 £1.8k **Caius + Kavli**, *Summer 2019 student funding*  
 £1.5k **King's + Kavli**, *Summer 2018 student funding*

## Awards & Prizes

Jul. 2022	Pacific Institute of Theoretical Physics visitor	<i>University of British Columbia</i>
Feb. 2020	George Southgate visiting Fellow	<i>University of Adelaide</i>
Jul. 2019	Guiseppe and Vanna Cocconi Prize (WMAP and Planck)	<i>EPS-HEPP Division</i>
Jun. 2018	Gruber Prize (Planck)	<i>Gruber Foundation</i>
Dec. 2013	Best presentation	<i>Cavendish grad. students conference</i>
Jun. 2012	Best theoretical part III project	<i>University of Cambridge</i>
	Physics prize	<i>Gonville &amp; Caius College</i>
Summer 2011	Undergraduate Research Bursary	<i>Nuffield Foundation</i>
	UROP Studentship	<i>Imperial College</i>
Summer 2010	iGEM Studentship	<i>Wellcome Trust</i>
2009–12	Junior and Senior Scholarships	<i>Gonville &amp; Caius College</i>

## Students & postdocs

[willhandley.co.uk/students](http://willhandley.co.uk/students)

Postdoc	David Yallup	<i>2021-present</i>
	Jianghui Lui	<i>2020</i>
	Kamran Javid	<i>2018-19</i>
Ph.D.	Metha Prathaban, Wei-Ning Deng	<i>2021-present</i>
	Ayngaran Thavanesan, Adam Ormondroyd	<i>2021-present</i>
	George Carter, Kilian Scheutwinkel, Thomas Gessey-Jones	<i>2020-present</i>
	Thomas McAloone	<i>2020-21</i>
	Isidro Gómez Vargas	<i>2020</i>
	Ian Roque, Harry Bevins	<i>2019-present</i>
	Dominic Anstey	<i>2018-2022</i>
	Fruzsina Agocs, Will Barker	<i>2017-21</i>
	Lukas Hergt	<i>2017-20</i>
	Ed Higson	<i>2016-17</i>
Masters	Danielle Dineen, Sam Leeney	<i>2022-</i>
	Allahyar Sahibzada, Yoann Launay, Oliver Normand, Xy Wang, Carola Zanoletti	<i>2021-22</i>
	Yi Jer Loh, Metha Prathaban	<i>2020-21</i>
	Thomas Gessey-Jones, Aleks Petrosyan, Ayngaran Thavanesan, Emma Shen	<i>2019-20</i>
	Deaglan Bartlet, Jamie Bamber, Ian Roque	<i>2018-19</i>
	Ward Haddadin, Jessica Rigley, Panagiotis Mavrogiannis	<i>2017-18</i>
	Fruzsina Agocs, Robert Knighton, Stephen Pickman, Daniel Manela	<i>2016-17</i>
Summer	Mary Letey, Beichen Xu, Artyom Baryshnikov	<i>2022</i>

Zak Shumaylov, Mattia Varrone	2021
Denis Werth, Maxime Jabarian, Liam Lau	2019
Elizabeth Guest, Ward Haddadin, Shu-Fan Chen	2018

## Lecturing

2021-present	Part III Physics: Relativistic Astrophysics & Cosmology	<i>MSci 24 lecture course</i>
2017-present	Bayesian Statistics	<i>Graduate 2 lecture course</i>

## Workshops

- 2022 **ICCS**, *Training Machine Learning models*, Cambridge, UK  
[github.com/handley-lab/2022-cambridge-iccs](https://github.com/handley-lab/2022-cambridge-iccs)
- 2018 **CosmoTools**, *Introduction to Statistics*, Aachen, Germany  
[indico.cern.ch/e/CosmoTools2018](https://indico.cern.ch/e/CosmoTools2018)
- 2017 **CosmoTools**, *Cosmological statistics & sampling*, IFT Madrid, Spain  
[workshops.ift.uam-csic.es/cosmotools2017](https://workshops.ift.uam-csic.es/cosmotools2017)

## Small group teaching

2020–present	Part III Physics: Relativistic Astrophysics and Cosmology	<i>Supervising (24 hours)</i>
2013–2018, 2021–present	Part II Physics: General relativity	<i>Supervising (136 hours)</i>
2012–2017	Part IA Mathematics for NatSci	<i>Tripes classes (20 hours), Supervising (580 hours)</i>
2015–2016	Part IA Physics	<i>Supervising (20 hours)</i>
2013	Part II Theoretical Physics 1 & 2	<i>Demonstrating (8 hours)</i>
2006–2012	Maths and Science Tuition	<i>Individual coaching, key stage 1 – STEP</i>

## Academic Talks [github.com/williamjameshandley/talks](https://github.com/williamjameshandley/talks) † = remote

- Sep. 2022 **Next generation cosmological analysis with nested sampling**, *KICC Symposium*, Cambridge, UK
- Sep. 2022 **Next generation cosmological analysis with nested sampling**, *Corfu2022: Tensions in Cosmology*, Corfu, Greece
- Aug. 2022 **Dark matter, cosmology and likelihood-free Inference**, *GAMBIT XIV*, Kelowna, Canada
- Jul. 2022 **Nested Sampling: An efficient and robust Bayesian inference tool for particle physics and cosmology**, *TRIUMF & UBC*, Vancouver, Canada
- Jul. 2022 **Frontiers of Nested Sampling**, *MaxEnt 2022*, Paris, France
- Apr. 2022 **Nested Sampling and Likelihood-free inference**, *Likelihood-free in Paris*, Paris, France
- Apr. 2022 **Statistical methods in Cosmology**, *Obs. and Theor. 21-cm Cosmology*, Cambridge, UK
- Jan. 2022 **PolyChord: Next generation nested sampling**, *UK Atomic Energy Authority*, UK<sup>†</sup>
- Nov. 2021 **Review on Statistical Tools and Samplers**, *TOOLS 2021*, IP2I, Lyon, France<sup>†</sup>
- Jul. 2021 **Success Story 2 — Optimum Sensor Placement**, *Mathematical Challenges in the Electromagnetic Environment*, Isaac Newton Institute, Cambridge, UK
- Jul. 2021 **Success Story 1 — Detecting Illicit Mesh Networks**, *Mathematical Challenges in the Electromagnetic Environment*, Isaac Newton Institute, Cambridge, UK
- Mar. 2021 **PolyChord: Novel Bayesian Machine Learning**, *Cambridge Data Science Fair*, UK<sup>†</sup>
- Feb. 2021 **Bayesian methods for quantifying global parameter tensions between cosmological datasets**, *Tehran meeting on cosmology at the crossroads*, Tehran, Iran<sup>†</sup>

- Jan. 2021 **Bayesian information fusion**, *Mathematical Challenges in the Electromagnetic Environment*, Isaac Newton Institute, Cambridge, UK<sup>†</sup>
- Oct. 2020 **Nested Sampling: an efficient and robust Bayesian inference tool for 21cm cosmology**, *3rd Global 21-cm Workshop*, Cambridge, UK<sup>†</sup>
- Sep. 2020 **Nested Sampling for optimising sensor location**, *Mathematical Challenges in the Electromagnetic Environment*, Isaac Newton Institute, Cambridge, UK<sup>†</sup>
- Feb. 2020 **Nested Sampling: an efficient and robust Bayesian inference tool for physics and machine learning**, *Physics Colloquium*, Adelaide, Australia
- Jan. 2020 **Nested Sampling: an efficient and robust Bayesian inference tool for astrophysics and cosmology**, Oxford, UK
- Jan. 2020 **PolyChord: next generation nested sampling**, *Mathematical Challenges in the Electromagnetic Environment*, Isaac Newton Institute, Cambridge, UK
- Dec. 2019 **Quantised primordial power spectra**, *Texas 2019*, Portsmouth, UK
- Nov. 2019 **Nested Sampling: an efficient and robust Bayesian inference tool for Machine Learning and Data Science**, *CDT talk*, Cambridge, UK
- Aug. 2019 **Curvature tension: evidence for a closed universe(?)**, ICG Portsmouth, UK
- Jul. 2019 **Quantifying cosmological tensions**, University College London, UK
- Jun. 2019 **Likelihood free inference**, *GAMBIT X*, Germany
- 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<sup>†</sup>
- Nov. 2018 **Nested Sampling: an efficient and robust Bayesian inference tool for cosmology and particle physics**, *Dark Machines*, Worldwide<sup>†</sup>
- 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
- Feb 2014 **The Physics of Juggling**, *CCPE*, Cavendish Laboratory
- Jan 2014 **The first 3 yocto-pico seconds**, *Three minute wonder*, Cavendish Laboratory

---

## Institutional responsibilities

2020–present	Convener of CosmoBit	<i>GAMBIT</i>
2020–present	Leader of data analysis team	<i>REACH</i>
2021–present	Center for data-driven discovery (C2D3) steering committee	<i>University of Cambridge</i>
2022–present	KICC Scientific Strategy Committee	<i>KICC</i>
2022–present	KICC Visitor and Lecturer committee	<i>KICC</i>
2019–present	Gonville & Caius College Council	<i>Gonville &amp; Caius college</i>
2018–present	Science Research Fellowships committee	<i>Gonville &amp; Caius college</i>
2018–present	Investments committee	<i>Gonville &amp; Caius college</i>
2016–present	Undergraduate Admissions	<i>Gonville &amp; Caius college</i>
2018–2020	Education and research committee	<i>Gonville &amp; Caius college</i>
2017–present	Organiser of weekly group seminars	<i>Cavendish astrophysics group</i>

---

## Examination

- Dec 2021 **High-resolution CMB bispectrum estimator**, *Wu Hyun Sohn*, Ph.D.
- Sep 2020 **Machine Learning Applied to Gaia and Other Survey Data: Applications Supporting a Polarisation Survey**, *Kyriakos Stylianiopoulos*, MPhil
- 2020– **Masters exam checking**, *Astrostatistics*, Part III Maths
- 2021–2022 **Exam setting**, *Relativistic Astrophysics and Cosmology*, Part III Physics

---

## Organisation of scientific meetings

2020	Scientific organising committee member of 3 <sup>rd</sup> Global 21-cm Workshop	<i>KICC</i>
2019	Local organising committee member of KICC 10 <sup>th</sup> anniversary symposium	<i>KICC</i>
2019	Secured funding for Likelihood free inference workshop (currently organising)	<i>KICC</i>
2019	Helped secure funding and organised AstroHack week 2019	<i>KICC</i>
2018	Secured funding for and organised CLASS+MontePython software workshop	<i>KICC</i>

---

## Peer review

Performed 70 reviews for journals including Physical Review D and Physical Review Letters;

<https://www.webofscience.com/wos/author/record/S-9134-2018>

PRD (32), MNRAS (6), JCAP (8), PRL (6), JOSS (2), APJ (2), EPJC (1), PLB (6), RASTI (1) Entropy (2), Astronomy & Computing (2), Physics of the Dark Universe (2)

Review for fellowship awards:

- 2022 C2D3 Early Career Researcher Seed Fund
- 2022 ABTA UK Doctoral Research Award
- 2022 Blavatnik fellowship
- 2021– Gonville & Caius Junior Research Fellowships

---

## Collaborations

2018–present	REACH	<a href="https://astro.phy.cam.ac.uk/research/research-projects/reach">astro.phy.cam.ac.uk/research/research-projects/reach</a>
2018–present	GAMBIT	<a href="https://gambit.hepforge.org">gambit.hepforge.org</a>
2018–present	DarkMachines	<a href="https://darkmachines.org">darkmachines.org</a>
2017–2018	Terra Hunter Experiment	<a href="https://terra hunting.org">terra hunting.org</a>
2016–2017	CORE	<a href="https://core-mission.org">core-mission.org</a>
2015–2016	AMI	<a href="https://astro.phy.cam.ac.uk/research/research-projects/AMI">astro.phy.cam.ac.uk/research/research-projects/AMI</a>
2015–2019	Planck	<a href="https://cosmos.esa.int/web/planck">cosmos.esa.int/web/planck</a>

---

## Software

PolyChord	Sole author and maintainer: <a href="https://github.com/PolyChord/PolyChordLite">github.com/PolyChord/PolyChordLite</a>
pyBAMBI	Team maintainer: <a href="https://github.com/DarkMachines/pyBAMBI">github.com/DarkMachines/pyBAMBI</a>
anesthetic	Principle author and maintainer: <a href="https://github.com/williamjameshandley/anesthetic">github.com/williamjameshandley/anesthetic</a>
fgivenx	Sole author and maintainer: <a href="https://github.com/williamjameshandley/fgivenx">github.com/williamjameshandley/fgivenx</a>
primordial	Sole author and maintainer: <a href="https://github.com/williamjameshandley/primordial">github.com/williamjameshandley/primordial</a>
ModeCode	Maintainer: <a href="https://modecode.org">modecode.org</a>
MultiNest	Maintainer: <a href="https://github.com/farhanferoz/MultiNest">github.com/farhanferoz/MultiNest</a>
Open source	scipy: Weighted kernel density estimation in <code>scipy.stats.gaussian_kde</code> matplotlib: Vertical slider in <code>matplotlib.widgets.Slider</code>

---

## Interaction with industry

PolyChord	Founded start-up company PolyChord Ltd. to bring Bayesian methods & tools from cosmology to Machine Learning & Biotech industries: <a href="https://polychord.co.uk">polychord.co.uk</a>
AnyVision	Working collaboratively as part of STFC grant to apply Bayesian sparse reconstruction to facial recognition
Shell	Work with department postdocs in the department applying nested sampling to geophysics
DSTL	Consult for government defence research using Bayesian inference
CMAM	Consult for local finance company on Bayesian algorithmic trading

---

## In the media

- 2022 **Cavendish Laboratory News**, *What can astrophysical data-intensive science do beyond the Universe?*, PolyChord, the next generation optimisation technology  
<https://www.phy.cam.ac.uk/news/what-can-astrophysical-data-intensive-science-do-beyond-universe-polychord-next-generation>
- 2022 **BBC Radio 4**, *The Third Degree*, Astrophysics Don  
“Students vs Dons” BBC radio quiz aired July 2022
- 2020 **Quanta Magazine**, *Modified gravity in cosmology led by Will Barker*  
[quantamagazine.org/why-is-the-universe-expanding-so-fast-20200427/](https://quantamagazine.org/why-is-the-universe-expanding-so-fast-20200427/)
- 2019 **KICC annual report**, *Compromise-free Bayesian cosmology & AstroHack week*  
[kicc.cam.ac.uk/aboutus/kicc-annual-report-2019](https://kicc.cam.ac.uk/aboutus/kicc-annual-report-2019)

---

## Computer skills

Programming	MPI parallelisation, C++, FORTRAN, Mathematica, Maple, Python
Computing	Unix, Bash, zsh, vim, git, svn, L <sup>A</sup> T <sub>E</sub> X, 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. Ofer Lahav, +44 (0)203 5495813, o.lahav@ucl.ac.uk  
Prof. Alan Heavens, +44 (0)207 5942930, a.heavens@imperial.ac.uk  
Prof. Hiranya Peiris, +44 (0)203 5495831, h.peiris@ucl.ac.uk  
Prof. Julien Lesgourgues, +49 241 80 25724, lesgourg@physik.rwth-aachen.de

---

## Publications:

[arxiv.org/a/handley\\_w\\_1](https://arxiv.org/a/handley_w_1)

### First Author Publications

- [1] **Will Handley** and Pablo Lemos. Quantifying the global parameter tensions between ACT, SPT, and Planck. *PRD*, 103(6):063529, March 2021.
- [2] **Will Handley**. Curvature tension: Evidence for a closed universe. *PRD*, 103(4):L041301, February 2021.
- [3] **Will Handley**. Primordial power spectra for curved inflating universes. *PRD*, 100(12):123517, July 2019.
- [4] **Will Handley** and Pablo Lemos. Quantifying tensions in cosmological parameters: Interpreting the DES evidence ratio. *PRD*, 100(4):043504, August 2019.
- [5] **Will Handley** and Pablo Lemos. Quantifying dimensionality: Bayesian cosmological model complexities. *PRD*, 100(2):023512, July 2019.
- [6] **Will Handley**, Anthony Lasenby, and Mike Hobson. Logolinear series expansions with applications to primordial cosmology. *PRD*, 99(12):123512, June 2019.
- [7] **Will Handley**. anesthetic: nested sampling visualisation. *JOSS*, 4:1414, May 2019.
- [8] **Will Handley** and Marius Millea. Maximum-Entropy Priors with Derived Parameters in a Specified Distribution. *Entropy*, 21(3):272, March 2019.
- [9] **Will J. Handley**, Anthony N. Lasenby, Hiranya V. Peiris, and Michael P. Hobson. Bayesian inflationary reconstructions from Planck 2018 data. *PRD*, 100(10):103511, November 2019.
- [10] **Will Handley**. fgivenx: A Python package for functional posterior plotting. *JOSS*, 3(28):849, August 2018.
- [11] **W. J. Handley**, A. N. Lasenby, and M. P. Hobson. Novel quantum initial conditions for inflation. *PRD*, 94(2):024041, July 2016.
- [12] **W. J. Handley**, A. N. Lasenby, and M. P. Hobson. The Runge-Kutta-Wentzel-Kramers-Brillouin Method. *arXiv*, 1612.02288, December 2016.
- [13] **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. POLYCHORD: next-generation nested sampling. *MNRAS*, 453(4):4384–4398, November 2015.
- [14] **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. polychord: nested sampling for cosmology. *MNRAS*, 450:L61–L65, June 2015.
- [15] **W. J. Handley**, S. D. Brechet, A. N. Lasenby, and M. P. Hobson. Kinetic initial conditions for inflation. *PRD*, 89(6):063505, March 2014.

### Other publications

- [16] Harry Bevis, Stefan Heimersheim, Irene Abril-Cabezas, Anastasia Fialkov, Eloy de Lera Acedo, **Will Handley**, Saurabh Singh, and Ravi Barkana. Constraints on the Physics of the Infant Universe with Joint Multi-wavelengths and Multi-scale Data Analysis. *Nature Astronomy (in press)*, September 2022.
- [17] Greg Ashton, Noam Bernstein, Johannes Buchner, Xi Chen, Gábor Csányi, Andrew Fowlie, Farhan Feroz, Matthew Griffiths, **Will Handley**, Michael Habeck, Edward Higson, Michael Hobson, Anthony Lasenby, David Parkinson, Livia B. Pártay, Matthew Pitkin, Doris Schneider, Joshua S. Speagle, Leah South, John Veitch, Philipp Wacker, David J. Wales, and David Yallup. Nested sampling for physical scientists. *Nature Reviews Methods Primers*, 2(1):39, May 2022.
- [18] REACH Collaboration. The REACH radiometer for detecting the 21-cm hydrogen signal from redshift  $z \approx 7.5$ –28. *Nature Astronomy*, 6:984–998, July 2022.
- [19] Andrew Fowlie, Sebastian Hoof, and **Will Handley**. Nested Sampling for Frequentist Computation: Fast Estimation of Small p -Values. *PRL*, 128(2):021801, January 2022.
- [20] Gong-Bo Zhao, Marco Raveri, Levon Pogosian, Yuting Wang, Robert G. Crittenden, **Will J. Handley**, and et al. Dynamical dark energy in light of the latest observations. *Nature Astronomy*, 1:627–632, August 2017.
- [21] David Yallup, **Will Handley**, Mike Hobson, Anthony Lasenby, and Pablo Lemos. Split personalities in Bayesian Neural Networks: the case for full marginalisation. *arXiv*, 2205.11151, May 2022.
- [22] David Yallup, Timo Janßen, Steffen Schumann, and **Will Handley**. Exploring phase space with nested sampling. *European Physical Journal C*, 82(8):678, August 2022.
- [23] Aleksandr Petrosyan and **Will Handley**. SuperNest: accelerated nested sampling applied to astrophysics and cosmology. *Entropy (in press)*, 2022.
- [24] A. N. Lasenby, **W. J. Handley**, D. J. Bartlett, and C. S. Negreanu. Perturbations and the future conformal boundary. *PRD*, 105(8):083514, April 2022.
- [25] D. J. Bartlett, **W. J. Handley**, and A. N. Lasenby. Improved cosmological fits with quantized primordial power spectra. *PRD*, 105(8):083515, April 2022.

- [26] Metha Prathaban and **Will Handley**. Rescuing palindromic universes with improved recombination modeling. *PRD*, 105(12):123508, June 2022.
- [27] F. J. Agocs, M. P. Hobson, **W. J. Handley**, and A. N. Lasenby. Dense output for highly oscillatory numerical solutions. *arXiv*, 2007.05013, July 2020.
- [28] F. J. Agocs, **W. J. Handley**, A. N. Lasenby, and M. P. Hobson. Efficient method for solving highly oscillatory ordinary differential equations with applications to physical systems. *Physical Review Research*, 2(1):013030, January 2020.
- [29] F. J. Agocs, L. T. Hergt, **W. J. Handley**, A. N. Lasenby, and M. P. Hobson. Quantum initial conditions for inflation and canonical invariance. *PRD*, 102(2):023507, July 2020.
- [30] Lukas T. Hergt, Fruzsina J. Agocs, **Will J. Handley**, Michael P. Hobson, and Anthony N. Lasenby. Finite inflation in curved space. *arXiv*, 2205.07374, May 2022.
- [31] L. T. Hergt, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. Bayesian evidence for the tensor-to-scalar ratio  $r$  and neutrino masses  $m_\nu$ : Effects of uniform versus logarithmic priors. *PRD*, 103(12):123511, June 2021.
- [32] L. T. Hergt, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. Case for kinetically dominated initial conditions for inflation. *PRD*, 100(2):023502, July 2019.
- [33] L. T. Hergt, **W. J. Handley**, M. P. Hobson, and A. N. Lasenby. Constraining the kinetically dominated universe. *PRD*, 100(2):023501, July 2019.
- [34] Ayngaran Thavanesan, Denis Werth, and **Will Handley**. Analytical approximations for curved primordial power spectra. *PRD*, 103(2):023519, January 2021.
- [35] Zakhar Shumaylov and **Will Handley**. Primordial power spectra from  $k$ -inflation with curvature. *PRD*, 105(12):123532, June 2022.
- [36] T. Gessey-Jones and **W. J. Handley**. Constraining quantum initial conditions before inflation. *PRD*, 104(6):063532, September 2021.
- [37] Jamie Bamber and **Will Handley**. Beyond the Runge-Kutta-Wentzel-Kramers-Brillouin method. *PRD*, 101(4):043517, February 2020.
- [38] W. I. J. Haddadin and **W. J. Handley**. Rapid numerical solutions for the Mukhanov-Sasaki equation. *PRD*, 103(12):123513, June 2021.
- [39] W. E. V. Barker, A. N. Lasenby, M. P. Hobson, and **W. J. Handley**. Nonlinear Hamiltonian analysis of new quadratic torsion theories: Cases with curvature-free constraints. *PRD*, 104(8):084036, October 2021.
- [40] W. E. V. Barker, A. N. Lasenby, M. P. Hobson, and **W. J. Handley**. Systematic study of background cosmology in unitary Poincaré gauge theories with application to emergent dark radiation and  $H_0$  tension. *PRD*, 102(2):024048, July 2020.
- [41] W. E. V. Barker, A. N. Lasenby, M. P. Hobson, and **W. J. Handley**. Mapping Poincaré gauge cosmology to Horndeski theory for emergent dark energy. *PRD*, 102(8):084002, October 2020.
- [42] W. E. V. Barker, A. N. Lasenby, M. P. Hobson, and **W. J. Handley**. Static energetics in gravity. *JMAP*, 60(5):052504, May 2019.
- [43] REACH Collaboration. Radio Antenna Design for Sky-Averaged 21cm Cosmology Experiments: The REACH Case. *Journal of Astronomical Instrumentation*, 11(1):2250001–2058, January 2022.
- [44] H. T. J. Bevins, E. de Lera Acedo, A. Fialkov, **W. J. Handley**, S. Singh, R. Subrahmanyan, and R. Barkana. A comprehensive Bayesian reanalysis of the SARAS2 data from the epoch of reionization. *MNRAS*, 513(3):4507–4526, July 2022.
- [45] Harry Bevins, **Will Handley**, Pablo Lemos, Peter Sims, Eloy de Lera Acedo, and Anastasia Fialkov. Marginal Bayesian Statistics Using Masked Autoregressive Flows and Kernel Density Estimators with Examples in Cosmology. *arXiv*, 2207.11457, July 2022.
- [46] Harry T. J. Bevins, **William J. Handley**, Pablo Lemos, Peter H. Sims, Eloy de Lera Acedo, Anastasia Fialkov, and Justin Alsing. Removing the fat from your posterior samples with margarine. *arXiv*, 2205.12841, May 2022.
- [47] H. T. J. Bevins, **W. J. Handley**, A. Fialkov, E. de Lera Acedo, L. J. Greenhill, and D. C. Price. MAXSMOOTH: rapid maximally smooth function fitting with applications in Global 21-cm cosmology. *MNRAS*, 502(3):4405–4425, April 2021.
- [48] H. T. J. Bevins, **W. J. Handley**, A. Fialkov, E. de Lera Acedo, and K. Javid. GLOBALEMU: a novel and robust approach for emulating the sky-averaged 21-cm signal from the cosmic dawn and epoch of reionization. *MNRAS*, 508(2):2923–2936, December 2021.
- [49] K. H. Scheutwinkel, E. de Lera Acedo, and **W. Handley**. Bayesian evidence-driven diagnosis of instrumental systematics for sky-averaged 21-cm cosmology experiments. *arXiv*, 2204.04445, April 2022.
- [50] K. H. Scheutwinkel, **W. Handley**, and E. de Lera Acedo. Bayesian evidence-driven likelihood selection for sky-averaged 21-cm signal extraction. *arXiv*, 2204.04491, April 2022.
- [51] Emma Shen, Dominic Anstey, Eloy de Lera Acedo, Anastasia Fialkov, and **Will Handley**. Quantifying ionospheric effects on global 21-cm observations. *MNRAS*, 503(1):344–353, May 2021.
- [52] I. L. V. Roque, **W. J. Handley**, and N. Razavi-Ghods. Bayesian noise wave calibration for 21-cm global experiments. *MNRAS*, 505(2):2638–2646, August 2021.
- [53] Dominic Anstey, Eloy de Lera Acedo, and **Will Handley**. A general Bayesian framework for foreground modelling and chromaticity correction for global 21 cm experiments. *MNRAS*, 506(2):2041–2058, September 2021.
- [54] Dominic Anstey, John Cumner, Eloy de Lera Acedo, and **Will Handley**. Informing antenna design for sky-averaged 21-cm experiments using a simulated Bayesian data analysis pipeline. *MNRAS*, 509(4):4679–4693, February 2022.



- [55] T. Gessey-Jones, N. S. Sartorio, A. Fialkov, G. M. Mirouh, M. Magg, R. G. Izzard, E. de Lera Acedo, **W. J. Handley**, and R. Barkana. Impact of the Primordial Stellar Initial Mass Function on the 21-cm Signal. *MNRAS*, July 2022.
- [56] Pablo Lemos, Fabian Köhlinger, **Will Handley**, Benjamin Joachimi, Lorne Whiteway, and Ofer Lahav. Quantifying Suspiciousness within correlated data sets. *MNRAS*, 496(4):4647–4653, August 2020.
- [57] B. Joachimi, F. Köhlinger, **W. Handley**, and P. Lemos. When tension is just a fluctuation. How noisy data affect model comparison. *A&A*, 647:L5, March 2021.
- [58] Peter Athron, Neal Avis Kozar, Csaba Balázs, Ankit Beniwal, Sanjay Bloor, Torsten Bringmann, Joachim Brod, Christopher Chang, Jonathan M. Cornell, Ben Farmer, Andrew Fowlie, Tomás E. Gonzalo, **Will Handley**, Felix Kahlhoefer, Anders Kvellestad, Farvah Mahmoudi, Markus T. Prim, Are Raklev, Janina J. Renk, Andre Scaffidi, Pat Scott, Patrick Stöcker, Aaron C. Vincent, Martin White, Sebastian Wild, Jure Zupan, and Gambit Collaboration. Thermal WIMPs and the scale of new physics: global fits of Dirac dark matter effective field theories. *European Physical Journal C*, 81(11):992, November 2021.
- [59] Gambit Cosmology Workgroup. Strengthening the bound on the mass of the lightest neutrino with terrestrial and cosmological experiments. *PRD*, 103(12):123508, June 2021.
- [60] GAMBIT Cosmology Workgroup. CosmoBit: a GAMBIT module for computing cosmological observables and likelihoods. *JCAP*, 2021(2):022, February 2021.
- [61] Shehu S. AbdusSalam, Fruzsina J. Agocs, Benjamin C. Allanach, Peter Athron, Csaba Balázs, Emanuele Bagnaschi, Philip Bechtle, Oliver Buchmueller, Ankit Beniwal, Jihyun Bhom, Sanjay Bloor, Torsten Bringmann, Andy Buckley, Anja Butter, José Eliel Camargo-Molina, Marcin Chruszcz, Jan Conrad, Jonathan M. Cornell, Matthias Danninger, Jorge de Blas, Albert De Roeck, Klaus Desch, Matthew Dolan, Herbert Dreiner, Otto Eberhardt, John Ellis, Ben Farmer, Marco Fedele, Henning Flücher, Andrew Fowlie, Tomás E. Gonzalo, Philip Grace, Matthias Hamer, **Will Handley**, Julia Harz, Sven Heinemeyer, Sebastian Hoof, Selim Hotinli, Paul Jackson, Felix Kahlhoefer, Kamila Kowalska, Michael Krämer, Anders Kvellestad, Miriam Lucio Martinez, Farvah Mahmoudi, Diego Martinez Santos, Gregory D. Martinez, Satoshi Mishima, Keith Olive, Ayan Paul, Markus Tobias Prim, Werner Porod, Are Raklev, Janina J. Renk, Christopher Rogan, Leszek Roszkowski, Roberto Ruiz de Austri, Kazuki Sakurai, Andre Scaffidi, Pat Scott, Enrico Maria Sessolo, Tim Stefaniak, Patrick Stöcker, Wei Su, Sebastian Trojanowski, Roberto Trotta, Yue-Lin Sming Tsai, Jeriek Van den Abeele, Mauro Valli, Aaron C. Vincent, Georg Weiglein, Martin White, Peter Wienemann, Lei Wu, and Yang Zhang. Simple and statistically sound recommendations for analysing physical theories. *Reports on Progress in Physics*, 85(5):052201, May 2022.
- [62] Csaba Balázs, Sanjay Bloor, Tomás E. Gonzalo, **Will Handley**, Sebastian Hoof, Felix Kahlhoefer, Marie Lecoq, David J. E. Marsh, Janina J. Renk, Pat Scott, and Patrick Stöcker. Cosmological constraints on decaying axion-like particles: a global analysis. *arXiv*, 2205.13549, May 2022.
- [63] Andrew Fowlie, **Will Handley**, and Liangliang Su. Nested sampling with plateaus. *MNRAS*, 503(1):1199–1205, May 2021.
- [64] Andrew Fowlie, **Will Handley**, and Liangliang Su. Nested sampling cross-checks using order statistics. *MNRAS*, 497(4):5256–5263, October 2020.
- [65] Justin Alsing and **Will Handley**. Nested sampling with any prior you like. *MNRAS*, 505(1):L95–L99, July 2021.
- [66] Kamran Javid, **Will Handley**, Mike Hobson, and Anthony Lasenby. Compromise-free Bayesian neural networks. *arXiv*, 2004.12211, April 2020.
- [67] Edward Higson, **Will Handley**, Mike Hobson, and Anthony Lasenby. Dynamic nested sampling: an improved algorithm for parameter estimation and evidence calculation. *Statistics and Computing*, 29(5):891–913, September 2019.
- [68] 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, March 2019.
- [69] Edward Higson, **Will Handley**, Michael Hobson, and Anthony Lasenby. NESTCHECK: diagnostic tests for nested sampling calculations. *MNRAS*, 483(2):2044–2056, February 2019.
- [70] Edward Higson, **Will Handley**, Mike Hobson, and Anthony Lasenby. Sampling Errors in Nested Sampling Parameter Estimation. *Bayesian Analysis*, 13(3):873–896, March 2018.
- [71] E. Ahrer, D. Queloz, V. M. Rajpaul, D. Ségransan, F. Bouchy, R. Hall, **W. Handley**, C. Lovis, M. Mayor, A. Mortier, F. Pepe, S. Thompson, S. Udry, and N. Unger. The HARPS search for southern extra-solar planets - XLV. Two Neptune mass planets orbiting HD 13808: a study of stellar activity modelling’s impact on planet detection. *MNRAS*, 503(1):1248–1263, May 2021.
- [72] F. Lienhard, D. Queloz, M. Gillon, A. Burdanov, L. Delrez, E. Ducrot, **W. Handley**, E. Jehin, C. A. Murray, A. H. M. J. Triaud, E. Gillen, A. Mortier, and B. V. Rackham. Global analysis of the TRAPPIST Ultra-Cool Dwarf Transit Survey. *MNRAS*, 497(3):3790–3808, September 2020.
- [73] 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, September 2018.
- [74] The DarkMachines High Dimensional Sampling Group. A comparison of optimisation algorithms for high-dimensional particle and astrophysics applications. *Journal of High Energy Physics*, 2021(5):108, May 2021.
- [75] Ethan Carragher, **Will Handley**, Daniel Murnane, Peter Stangl, Wei Su, Martin White, and Anthony G. Williams. Convergent Bayesian global fits of 4D composite Higgs models. *Journal of High Energy Physics*, 2021(5):237, May 2021.

- [76] 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, July 2018.
- [77] 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, April 2017.
- [78] 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, January 2016.
- [79] 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, July 2016.
- [80] 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. *Journal of Chemical Theory and Computation*, 15(3):1728–1742, January 2019.

## CORE Collaboration

- [81] Exploring cosmic origins with CORE: B-mode component separation. *JCAP*, 2018(4):023, April 2018.
- [82] Exploring cosmic origins with CORE: Mitigation of systematic effects. *JCAP*, 2018(4):022, April 2018.
- [83] Exploring cosmic origins with CORE: Effects of observer peculiar motion. *JCAP*, 2018(4):021, April 2018.
- [84] Exploring cosmic origins with CORE: Extragalactic sources in cosmic microwave background maps. *JCAP*, 2018(4):020, April 2018.
- [85] Exploring cosmic origins with CORE: Cluster science. *JCAP*, 2018(4):019, April 2018.
- [86] Exploring cosmic origins with CORE: Gravitational lensing of the CMB. *JCAP*, 2018(4):018, April 2018.
- [87] Exploring cosmic origins with CORE: Cosmological parameters. *JCAP*, 2018(4):017, April 2018.
- [88] Exploring cosmic origins with CORE: Inflation. *JCAP*, 2018(4):016, April 2018.
- [89] Exploring cosmic origins with CORE: The instrument. *JCAP*, 2018(4):015, April 2018.
- [90] Exploring cosmic origins with CORE: Survey requirements and mission design. *JCAP*, 2018(4):014, April 2018.

## Planck Collaboration

- [91] Planck 2018 results. XII. Galactic astrophysics using polarized dust emission. *A&A*, 641:A12, September 2020.
- [92] Planck 2018 results. XI. Polarized dust foregrounds. *A&A*, 641:A11, September 2020.
- [93] Planck 2018 results. X. Constraints on inflation. *A&A*, 641:A10, September 2020.
- [94] Planck 2018 results. IX. Constraints on primordial non-Gaussianity. *A&A*, 641:A9, September 2020.
- [95] Planck 2018 results. VIII. Gravitational lensing. *A&A*, 641:A8, September 2020.
- [96] Planck 2018 results. VII. Isotropy and statistics of the CMB. *A&A*, 641:A7, September 2020.
- [97] Planck 2018 results. VI. Cosmological parameters. *A&A*, 641:A6, September 2020.
- [98] Planck 2018 results. V. CMB power spectra and likelihoods. *A&A*, 641:A5, September 2020.
- [99] Planck 2018 results. IV. Diffuse component separation. *A&A*, 641:A4, September 2020.
- [100] Planck 2018 results. III. High Frequency Instrument data processing and frequency maps. *A&A*, 641:A3, September 2020.
- [101] Planck 2018 results. II. Low Frequency Instrument data processing. *A&A*, 641:A2, September 2020.
- [102] Planck 2018 results. I. Overview and the cosmological legacy of Planck. *A&A*, 641:A1, September 2020.
- [103] Planck intermediate results. LVII. Joint Planck LFI and HFI data processing. *A&A*, 643:A42, November 2020.
- [104] Planck intermediate results. LVI. Detection of the CMB dipole through modulation of the thermal Sunyaev-Zeldovich effect: Eppur si muove II. *A&A*, 644:A100, December 2020.
- [105] Planck intermediate results. LV. Reliability and thermal properties of high-frequency sources in the Second Planck Catalogue of Compact Sources. *A&A*, 644:A99, December 2020.
- [106] Planck intermediate results. LIV. The Planck multi-frequency catalogue of non-thermal sources. *A&A*, 619:A94, November 2018.
- [107] Planck intermediate results. LIII. Detection of velocity dispersion from the kinetic Sunyaev-Zeldovich effect. *A&A*, 617:A48, September 2018.
- [108] Planck 2015 results. XX. Constraints on inflation. *A&A*, 594:A20, September 2016.
- [109] Planck 2015 results. I. Overview of products and scientific results. *A&A*, 594:A1, September 2016.