Philip James Bull

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Date of Birth: 30th Nov 1987 // Nationality: British

Research positions

10/2018 – onwards	**Lecturer in Cosmology,** Queen Mary University of London
10/2017 – current	**Postdoctoral Fellow**, University of California at Berkeley
10/2015 – 10/2017	**NASA Postdoctoral Fellow (NPP)**, Jet Propulsion Lab / Caltech
05/2013 – 10/2015	**Postdoctoral Fellow,** Inst. Theoretical Astrophysics, University of Oslo

Education and qualifications

10/2010 – 04/2013	**DPhil Astrophysics, University of Oxford** Theoretical cosmology, supervised by Pedro Ferreira and Tim Clifton.
09/2006 – 07/2010	**MPhys Physics with Astrophysics, University of Manchester** First class honours, top of class. Specialised in astrophysics/theory.

Awards and scholarships

2016	Elected Affiliate Lecturer at the University of Malta (ISSA)
2012	Pollard Fund travel grant (Wadham College, University of Oxford)
2010	Outstanding Academic Achievement Award (University of Manchester)
2010	Samuel Bright Research Scholarship in Physical Sciences (U. Manchester)
2006 – 2010	President's Award (University of Manchester)
2006 – 2010	Foresters Scholarship
2009	Hatfield-Heginbottom Scholarship (University of Manchester)
2008	Hatfield Scholarship (University of Manchester)
2004	Award for Academic Achievement (Staffordshire University)

Professional activities and collaborations

2018 onwards	HERA Statistics working group coordinator
2018 onwards	LSST DESC Theory and Joint Probes working group co-convener
2017 onwards	Member of the HERA collaboration
2016 onwards	LSST Dark Energy Science Collaboration (full member from 2017)
2016	Reviewer, NASA ROSES 2016 review panel
2016 – 2017	JPL Astrophysics Diversity and Best Practices advisory panel
2016 onwards	SKA Cosmology SWG work package lead: HI galaxy surveys
2013 onwards	Member of the SKA Cosmology Science Working Group (Core Team)
2013 – 2015	Member of the Planck Collaboration (LFI Core team)
2012 onwards	Regular referee for ApJ, JCAP, MNRAS, PRD, and PRL

Grants awarded

2018 – 2019	DiRAC 10th Call supercomputer allocation (0.3M CPU-hours)
2016	NASA Innovative Advanced Concepts, Phase I Step B study: "A direct probe of dark energy interactions with a Solar System laboratory", Co-I (up to $125,000)
2015 – 2017	NASA Postdoctoral Program Fellowship, Co-I ($127,000)

Research

My research covers the intersection of theoretical and observational cosmology. I am interested in what inhomogeneities can tell us about dark energy, and how novel observables and statistical tools can be used to make inferences about the cosmos on the largest scales. Research topics include:

- Cosmology with multiple tracers, including optical and radio (21cm) surveys
- Secondary anisotropies and spectral distortions of the CMB as cosmological probes
- General Relativistic effects on matter inhomogeneities and light propagation
- Bayesian inference, stochastic processes, and computational physics

Journal articles (published/submitted)

2018

28. Mitigating complex dust foregrounds in future CMB polarization experiments
    B. Hensley, **P. Bull**, ApJ 853, 127 (2018)

2017

27. Model-independent curvature determination with 21cm intensity mapping experiments
    A. Witzemann, **P. Bull**, C. Clarkson, M. G. Santos, M. Spinelli, A. Weltman, accepted [1711.02179]
26. Line-Intensity Mapping: 2017 Status Report
    E. Kovetz et al., Phys. Reports submitted [1709.09066]
25. MeerKLASS: MeerKAT Large Area Synoptic Survey
    M. Santos (Ed.) et al. [1709.06099]
24. Priors on the effective Dark Energy equation of state in scalar-tensor theories
    M. Raveri, **P. Bull**, A. Silvestri, L. Pogosian, Phys. Rev. D 96, 083509 (2017)
23. Dipolar modulation in the size of galaxies: The effect of Doppler magnification
    C. Bonvin, …, **P. Bull**, MNRAS 472, 4 (2017)
22. A Galaxy-Halo Model for Multiple Cosmological Tracers
    P. Bull, MNRAS 471, 12 (2017)

2016

21. Science Impacts of the SPHEREx All-Sky Optical to Near-Infrared Spectral Survey
    O. Doré, M. W. Werner (Eds.) et al. [1606.07039]
20. Spatial curvature endgame: Reaching the limit of curvature determination
    C. D. Leonard, **P. Bull**, R. Allison, Phys. Rev. D 94, 023502 (2016)
19. Reconstructing cosmic growth with kSZ observations in the era of Stage IV experiments
    D. Alonso, T. Louis, **P. Bull**, P. G. Ferreira, Phys. Rev. D 94, 043522 (2016)
18. Distinguishing screening mechanisms with environment-dependent velocity statistics
    M. F. Ivarsen, **P. Bull**, C. Llinares, D. F. Mota, A&A 595 (2016) A40
17. Beyond ΛCDM: Problems, solutions, and the road ahead [review]
    P. Bull, Y. Akrami (Eds.) et al., Phys. Dark. Univ. 12, 56 (2016)
16. Extending cosmological tests of General Relativity with the Square Kilometre Array
    P. Bull, ApJ 817, 26 (2016)

2015

15. Weighing neutrinos with cosmic neutral hydrogen
    F. Villaescusa-Navarro, **P. Bull**, M. Viel, ApJ 814, 146 (2015)
14. A systematic study of Ly-α transfer through outflowing shells: Model parameter estimation
    M. Gronke, **P. Bull**, M. Dijkstra, ApJ 812, 123 (2015)
13. Observational signatures of modified gravity on ultra-large scales
    T. Baker, **P. Bull**, ApJ 811, 2 (2015)
12. Ultra-large scale cosmology with next-generation experiments
    D. Alonso, **P. Bull**, P. G. Ferreira, R. Maartens, M. G. Santos, ApJ 814, 145 (2015)
11. Cosmological performance of SKA HI galaxy surveys
    S. Yahya, **P. Bull**, M. G. Santos, M. Silva et al., MNRAS 450, 2251 (2015)

10. Cross-correlating 21cm intensity maps with LBGs in the post-reionization era
    F. Villaescusa-Navarro, …, **P. Bull** et al., JCAP 03, 034 (2015)
9. A CMB Gibbs sampler for localized secondary anisotropies
    P. Bull, I. K. Wehus, H. K. Eriksen, P. G. Ferreira et al., ApJS 219, 10 (2015)
8. Blind foreground subtraction for intensity mapping experiments
    D. Alonso, **P. Bull**, P. G. Ferreira, M. G. Santos, MNRAS 447, 400 (2015)
7. Late-time cosmology with 21cm intensity mapping experiments
    P. Bull, P. G. Ferreira, P. Patel, M. G. Santos, ApJ 803, 21 (2015)

2014

6. Quintessence in a quandary: On prior dependence in dark energy models
    D. J. E. Marsh, **P. Bull**, P. G. Ferreira, A. Pontzen, Phys. Rev. D 90, 105023 (2014)
5. A multi-level solver for Gaussian constrained CMB realizations
    D. S. Seljebotn, …, **P. Bull**, ApJS 210, 24 (2014)

2013

4. What if Planck's Universe isn't flat?
    P. Bull, M. Kamionkowski, Phys. Rev. D 87, 081301(R) (2013)

2012

3. Local and nonlocal measures of acceleration in cosmology
    P. Bull, T. Clifton, Phys. Rev. D 85, 103512 (2012)
2. The isotropic blackbody CMB as evidence for a homogeneous universe
    T. Clifton, C. Clarkson, **P. Bull**, Phys. Rev. Lett. 109, 051303 (2012)
1. The KSZ effect as a test of general radial inhomogeneity in LTB cosmology
    P. Bull, T. Clifton & P. G. Ferreira, Phys. Rev. D 85, 024002 (2012)

Conference proceedings

12. Weak gravitational lensing with CO galaxies
    P. Bull, I. Harrison, E. Huff, ASP Conf. 7, “Science with a Next-Generation Very Large Array” (2018)
11. Cosmology from HI galaxy surveys with the SKA
    F. B. Abdalla, **P. Bull**, S. Camera et al., PoS AASKA14 (2015) 017
10. Cosmology from a SKA HI intensity mapping survey
    M. Santos, **P. Bull**, D. Alonso et al., PoS AASKA14 (2015) 019
9. Cross correlation surveys with the Square Kilometre Array
    D. Kirk, F. B. Abdalla, A. Benoit-Levy et al., PoS AASKA14 (2015) 020
8. HI galaxy simulations for the SKA: number counts and bias
    M. Santos, D. Alonso, **P. Bull** et al., PoS AASKA14 (2015) 021
7. Measuring baryon acoustic oscillations with future SKA surveys
    P. Bull, S. Camera, A. Raccanelli et al., PoS AASKA14 (2015) 024
6. Cosmology on the Largest Scales with the SKA
    S. Camera, A. Raccanelli, **P. Bull** et al., PoS AASKA14 (2015) 025
5. Measuring redshift-space distortion with future SKA surveys
    A. Raccanelli, **P. Bull**, S. Camera et al., PoS AASKA14 (2015) 031
4. Foreground Subtraction in Intensity Mapping with the SKA
    L. Wolz, F. B. Abdalla, D. Alonso, et al., PoS AASKA14 (2015) 035
3. Synergy between the Large Synoptic Survey Telescope and the Square Kilometre Array
    D. Bacon, S. Bridle, F. B. Abdalla et al., PoS AASKA14 (2015) 145
2. Euclid & SKA Synergies
    T. Kitching, D. Bacon, M. Brown, **P. Bull** et al., PoS AASKA14 (2015) 146
1. 21cm Cosmology
    M. G. Santos, D. Alonso, **P. Bull** et al., Proc. IAU 306, CUP (2015)

Teaching experience

2018	Masters student supervision: R. O. Fauli; M. F. Ivarsen (U. Oslo); Lisa McBride (SFSU)
2016 – 2018	Summer student supervision: A. Brown (Princeton U.); L. Penafiel (UC Riverside); E. Kimura (Santa Monica); S. Modak, J. Tan (UC Berkeley); D. Rocha (Harvey Mudd)
2016	3x lectures on radio cosmology, INAF Lucchin summer school (Naples, Italy)
2015 – 2016	PhD student supervision: M. B. Steen (University of Oslo)
2011 – 2013	Tutor, "Symmetry and Relativity", 3rd year physics (St. Edmund Hall, Oxford)
2011 – 2012	Short-course lecturer, "Python for Astrophysicists", Oxford Astro. Grad. course

Talks and seminars

2018	Invited talks (3): Berkeley extragalactic modelling workshop (Berkeley, USA); Direct detection of Dark Energy workshop (Caltech, USA); Tremendous Radio Arrays (Brookhaven, USA)
	Departmental/group seminars (1): Perimeter Institute (Canada)
2017	Invited plenary talk: Fundamental Physics with the SKA conference (Mauritius)
	Invited colloquia (2): UC Berkeley, Stanford SITP (USA)
	Invited talks (4): Berkeley Neutral Hydrogen workshop, Johns Hopkins Intensity Mapping workshop, LBNL Cosmic Visions workshop, JPL DES Modified Gravity workshop (USA)
	Departmental/group seminars (3): Carnegie Mellon, Stanford, USC (USA)
2016	Departmental/group seminars (6): Heidelberg (Germany); Caltech, CCA, JPL, U. Penn, Princeton, IAS (USA)
	Invited talks (3): LSST DESC meeting (Stanford, USA); Future Cosmic Surveys workshop (Chicago, USA); Science for the SKA Generation (Goa, India)
	Contributed talks (2): Statistical sampling and non-sampling methods in cosmology workshop (Berkeley, USA); Pasadena annual postdoc retreat (Los Angeles, USA)
2015	Invited colloquium: Oskar Klein Centre (Sweden)
	Departmental/group seminars (5): Caltech, JPL, Fermilab (USA); Heidelberg (Germany); Queen Mary (UK)
	Contributed talks (3): Building an Open UK SKA-Science Consortium (RAS, UK); Nordic Physics Days (Trondheim, Norway); NAM 2015 (RAS, UK)
2014	Invited talk: Radio intensity mapping as a new cosmological tool (RAS, UK)
	Invited colloquia (2): Oxford (UK); Oslo (Norway)
	Contributed talks (2): Advancing Astrophysics with the SKA (Sicily, Italy); Dark Energy Interactions (Stockholm, Sweden)
	Departmental/group seminars (6): Oslo (Norway); 2 x Perimeter Institute, U. British Columbia (Canada); INAF/OATS Trieste (Italy); LBNL Berkeley (USA)
2013	Contributed talk: Synergistic science with Euclid and the SKA (Oxford, UK)
	Departmental/group seminars (2): Johns Hopkins (USA); Manchester (UK)
2012	Contributed talk: National Astronomy Meeting 2012, Manchester (UK)
	Departmental/group seminars (10): Helsinki (Finland); Lyon (France); Heidelberg, Bielefeld (Germany); Oslo (Norway); Geneva (Switzerland); Queen Mary (UK); Pittsburgh, Stanford, Berkeley/LBL (USA)
2011	Contributed talk: Inhomogeneous Cosmologies Workshop, Jyväskylä (Finland)
	Departmental/group seminars (2): Dalhousie (Canada); Cape Town (S. Africa)

Public outreach and media

2015	Interviewed in series of five articles on the SKA in Norwegian (forskning.no)
	Quoted in articles on BICEP2 (Smithsonian), SKA (CBS, Astronomy Now)
2013	Interview: The Register (news website)
	Public lectures: BBC Stargazing Live Newbury; Wadham grad. research forum
2012 – 2013	STEM Ambassador (STEMNET/University of Oxford)
2012 – 2013	Co-organiser: Stargazing Oxford space science festival
2012	Interviews: PBS Nova Physics Blog; JodCast (astronomy podcast)
2011 – 2012	Public outreach coordinator for Astrophysics (University of Oxford)

Public scientific code

I make much of my scientific computer code publicly-available, for the sake of transparency, reproducibility, and to enable others to re-use and build on my work. Recent projects include:

- **HERA Power Spectrum library (Python)**
  Library to calculate optimal quadratic power spectrum estimates from visibility data (core developer).
- **LSST Core Cosmology Library (C/Python)**
  Validated library for theoretical computation of LSST observables (core contributor).
- **ghost (Python)**
  Analytic, probabilistic galaxy-halo model, with mock galaxy catalogue generator.
- **Commander 2 (Python/C/Fortran)** and **FIST (Python)**
  CMB component separation codes; Commander 2 performs full-sky constrained realisations; FIST is a Gibbs sampling code tailored for localised signals (e.g. SZ clusters) on the flat sky.
- **RadioFisher (Python)**
  General, fully-featured Fisher-forecasting code for 21cm intensity mapping experiments.
- **Bubble (C++/Python)**
  Background solver and ray-tracer for spherically-symmetric inhomogeneous spacetimes.

See www.philbull.com/code.html for more.

Technical computing skills

- Experienced Python, C/C++, and Fortran 90 programmer. Experience with JavaScript and SQL.
- Experienced HPC user and developer, including work on complex hybrid MPI and OpenMP codes.
- Extensive experience of writing multi-language wrappers.
- Expert in plotting/visualisation with Matplotlib (Python).

Open source projects

I was involved in the open source software movement for a decade. This has exposed me to a variety of interesting ideas and experiences that I often find useful in my scientific work, and has given me valuable experience in working across disciplinary boundaries.

- **GNOME Documentation Project**
  Contributor/member of steering committee. Responsible for designing, writing, and editing end user and developer documentation. Designed terminology and style guidelines. Coordinated major rewrite in Mallard XML with the introduction of GNOME 3.
- **Books on Ubuntu Linux**
  Co-author of two (related) books on Ubuntu Linux: *Ubuntu for Non Geeks 4th Ed.* (ISBN 978-1593272579) and *Ubuntu Made Easy* (ISBN 978-1593274252), No Starch Press.
- **GNOME Outreach Programme for Women**
  Mentor for two rounds of the outreach programme. Responsible for designing and coordinating documentation projects, and training and pastoral care of students.