Office K34, Kavli Institute for Cosmology (KICC)
Institute of Astronomy, University of Cambridge
Madingley Road, Cambridge CB3 0HA, United Kingdom
+44 (0) 7396 130513
+44 (0) 1223 746437
wb263@cam.ac.uk
www.astro.phy.cam.ac.uk/directory/william-barker
wevbarker
0000-0002-1501-3221
British Citizen

Will Barker
(威廉　巴克尔)

Education

2017

Ph.D. Physics (Theoretical Cosmology), *University of Cambridge, Cavendish Astrophysics Group, Kavli Institute for Cosmology, Cambridge.*

- Supervisors: Prof. A. N. Lasenby, Prof. M. P. Hobson & Dr. W. J. Handley
- Thesis: Gauge Theories of Gravity

2016
2017

M.Sc. Master of Natural Sciences, *University of Cambridge*, **First Class (4.0 GPA)**.

- Natural Science Tripos Part III: ▪ Quantum field theory ▪ Gauge field theory ▪ Particle physics ▪ Relativistic astrophysics & cosmology ▪ Formation of structure in the universe ▪ General physics
- Dissertation: Pushing electrons in one dimension

2013
2016

BA Bachelor of Arts, *University of Cambridge*, **First Class (4.0 GPA)**.

- Natural Science Tripos Part II: ▪ Theoretical physics 1 & 2 ▪ Relativity ▪ Thermal & statistical physics ▪ Advanced quantum physics ▪ Optics & electrodynamics ▪ Astrophysical fluid dynamics ▪ Particle & nuclear physics ▪ Quantum condensed matter physics ▪ Research review
- Natural Science Tripos Part IB: ▪ Physics A ▪ Physics B ▪ Mathematics
- Natural Science Tripos Part IA: ▪ Mathematics ▪ Physics ▪ Materials science ▪ Earth science

2011
2013

School, *Truro and Penwith College*, **A-Level: 3A*, As-Level: 4A, GCSE: 10A***.

Publications

2020 **Barker, W. E. V.**, A. N. Lasenby, et al. (Oct. 2020a). "***Mapping Poincaré cosmology to Horndeski theory for emergent dark energy***". In: *Phys. Rev. D* 102.8, 084002. Featured in His Dark CMBlog, p. 084002. DOI: 10.1103/PhysRevD.102.084002. arXiv: 2006.03581 [gr-qc].

Barker, W. E. V., A. N. Lasenby, et al. (Dec. 2020b). "***Nonlinear Hamiltonian analysis of the new quadratic torsion theories Part I. Cases with curvature-free constraints***". In: Phys. Rev. D *in prep.* (see preprint). DOI: 10.5281/zenodo.4361667.

Barker, W. E. V., A. N. Lasenby, et al. (July 2020c). "***Systematic study of background cosmology in unitary Poincaré gauge theories with application to emergent dark radiation and H_0 tension***". In: *Physical Review D* 102.2, 024048. Featured in Quanta, p. 024048. DOI: 10.1103/PhysRevD.102.024048. arXiv: 2003.02690 [gr-qc].

2019 **Barker, W. E. V.**, A. N. Lasenby, et al. (May 2019). "***Static energetics in gravity***". In: *Journal of Mathematical Physics* 60.5, 052504, p. 052504. DOI: 10.1063/1.5082730. arXiv: 1811.09844 [gr-qc].

2017 **Barker, W. E. V.** (Aug. 2017). "***Effects of the circularly polarized beam of linearized gravitational waves***". In: *Classical and Quantum Gravity* 34.16, 167001, p. 167001. DOI: 10.1088/1361-6382/aa7da9. arXiv: 1612.00905 [gr-qc].

Barker, W. E. V., T. Ledvinka, et al. (Oct. 2017). "***Rotation of inertial frames by angular momentum of matter and waves***". In: *Classical and Quantum Gravity* 34.20, 205006, p. 205006. DOI: 10.1088/1361-6382/aa8a34. arXiv: 1710.10360 [gr-qc].

Awards and Funding

2020–2020 **Secured 400,000¥ funding**, *To collaborate with Hitoshi Hanami at Iwate University in Japan, on appliations of geometric algebra techniques to the field of transformation optics. On hold due to coronavirus pandemic.*

2016–2017 **Queens' College Cambridge Foundation Scholar**, *re-awarded.*

2015–2016 **Queens' College Cambridge Foundation Scholar**, *for high exam performance.*

Research Experience

2017– **Ph.D. Physics**, *Cavendish Astrophysics Group*, Prof. A. N. Lasenby.

2016–2017 **M.Sc. Dissertation**, *Cavendish Theory of Condensed Matter Group*, Prof. E. Artacho.
▪ Quantum description of fermionic fluid in quenched, one-dimensional systems ▪ A novel quantum description of shock and sound waves was developed ▪ Two-particle interactions included through Hartree–Fock/Luttinger liquid formalisms, implemented in C++

2016–2016 **Summer Student**, *Institute of Astronomy*, Prof. D. Lynden–Bell and Prof. J. Bičák.
Gravitoelectromagnetic proof that the graviton has spin-parity 2^+

2016–2016 **Summer Student**, *Institute of Astronomy*, Dr. T. Ledvinka, Prof. D. Lynden–Bell.
Addressing Mach's principle by gravitomagnetically rotating inertial frames

2016–2016 **Research Review**, *Cavendish Quantum Optics Group*, Prof. U. Schneider.
Literature review of the eigenstate thermalisation hypothesis

Seminars, Colloquia and Conference Talks

Talks

2020/12 ***Exorcism of Nonlinear Ghosts in Hamiltonian Gravity***.
▪ Invited speaker at Queen Mary London cosmology seminar (upcoming, 16th Dec.)

2020/12 ***Torsion cosmology and beyond***.
▪ Invited speaker at the Perimeter Institute cosmology seminar

2020/8 ***Dark Energy in the Novel Gauge Gravity Theories***.
▪ Invited speaker at CEICO cosmology seminar ▪ Parallel speaker for the Cosmology from Home 2020 conference (see YouTube or slides)

2020/2 ***Addressing Hubble Tension with Emergent Dark Radiation in Unitary Gravity***.
▪ Invited speaker at DAMTP GR Seminar Series ▪ Speaker at Battcock Wednesday Seminar Series ▪ Parallel speaker at 30th Texas Symposium on Relativistic Astrophysics

2019/3 ***Habitable Tordion Worlds***.
▪ Poster session at Strings, Cosmology & Gravity 2019 conference in Munich ▪ Flash talk/poster session at KICC 10th Anniversary Symposium

2018/1 ***Gravitational Fields of Massless Particles***.
Speaker at Battcock Wednesday Seminar Series (see slides)

2017/1 ***Pushing Electrons in One Dimension***.
Speaker at Theory of Condensed Matter Group Seminar

Conferences

2020/8 **Probing Effective Theories of Gravity in Strong Fields and Cosmology**.

2020/8 **Cosmology from Home 2020**.
Led seminar with over 50 participants *Theoretical Requirements of Modified Gravity*

2019/12 **30th Texas Symposium on Relativistic Astrophysics**.

2019/9 **KICC 10th Anniversary Symposium**.

2019/3 **Strings, Cosmology and Gravity Student Conference 2019**.

Press and Media

2020/6 — ***Top arXiv papers from week 24, 2020***, *His Dark CMBlog*.

2020/4 — ***Why is the Universe expanding so fast?***, *Quanta Magazine*.
Featured alongside work by Lisa Randall and Marc Kamionkowski

Academic Service, Teaching and Outreach

2020 — **Reviewer for Elsevier *Physics of the Dark Universe* (Impact Factor 4.473)**.

Undergraduate Teaching

2018 — **4th-year *Relativistic Astrophysics and Cosmology* (30 hours)**.

2017 — **3rd-year *Relativity* (70 hours)**.

2017–2018 — **1st-year *Mathematics B* (100 hours)**.
Also co-authored mock exam

Outreach

2019/6 — **REACH Summer School *Astronomy and Astrophysics* (40 hours)**.
- Designed and taught intensive two-week course for 14-18 year-olds from across the globe
- Re-invited in 2020, but cancelled due to coronavirus pandemic

2013/12 — ***Academic Life***, *Truro and Penwith College*.
Outreach talk for 18 year-olds on academic life of Cambridge undergraduates

Computing

Operating systems	▪ Arch Linux (preferred) ▪ Manjaro Linux ▪ CentOS Linux ▪ Ubuntu Linux
Languages	▪ `Wolfram` (see `HiGGS`) ▪ `Maple` (see `CLIo`) ▪ TEX (see `barxiv`) ▪ `Python` ▪ `C++` ▪ `Bash`
Tools	▪ `Mathematica` (particularly `xAct`) ▪ `Git` ▪ `Vi` ▪ `Tmux` ▪ `i3` ▪ `Gnuplot`

References

Prof. Anthony Lasenby
Cavendish Astrophysics Group, KICC
University of Cambridge
Cambridge, UK
✉ a.n.lasenby@mrao.cam.ac.uk
☎ +44-(0)1223-337293

Prof. Mike Hobson
Cavendish Astrophysics Group
University of Cambridge
Cambridge, UK
✉ mph@mrao.cam.ac.uk
☎ +44-(0)1223-339992

Prof. Jiří Bičák
Institute of Theoretical Physics
Charles University
V Holešovickách 2
180 00 Praha 8, Czech Republic
✉ bicak.troja@gmail.com
☎ +420-(0)221-912-499

Dr. Will Handley
Cavendish Astrophysics Group, KICC
University of Cambridge
Cambridge, UK
✉ wh260@cam.ac.uk
☎ +44-(0)7718-622713

Prof. Emilio Artacho
Cavendish Theory of Condensed Matter Group
University of Cambridge
Cambridge, UK
✉ ea245@cam.ac.uk
☎ +44-(0)1223-337461

Prof. Eugene Terentjev
Cavendish Biological and Soft Systems Group
University of Cambridge
Cambridge, UK
✉ emt1000@cam.ac.uk
☎ +44-(0)1223-337003