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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](https://doi.org/10.1103/PhysRevD.102.084002). arXiv: [2006.03581](https://arxiv.org/abs/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](https://doi.org/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](https://doi.org/10.1103/PhysRevD.102.024048). arXiv: [2003.02690](https://arxiv.org/abs/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](https://doi.org/10.1063/1.5082730). arXiv: [1811.09844](https://arxiv.org/abs/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](https://doi.org/10.1088/1361-6382/aa7da9). arXiv: [1612.00905](https://arxiv.org/abs/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](https://doi.org/10.1088/1361-6382/aa8a34). arXiv: [1710.10360](https://arxiv.org/abs/1710.10360) [gr-qc].

Awards and Funding

2020
2020

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

2016

2017

2015

2016

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

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

Academic Life, *Truro and Penwith College*.

Outreach talk for 18 year-olds on academic life of Cambridge undergraduates

2013/12

Computing

Operating systems

▪ Arch Linux (preferred) ▪ Manjaro Linux ▪ CentOS Linux ▪ Ubuntu Linux

Languages

▪ Wolfram (see [HiGGS](#)) ▪ Maple (see [CLIo](#)) ▪ T_EX (see [barxiv](#)) ▪ Python ▪ C++ ▪ Bash

Tools

▪ Mathematica (particularly xAct) ▪ Git ▪ Vi ▪ Tmux ▪ i3 ▪ Gnuplot

References

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Prof. Jiří Bičák

Institute of Theoretical Physics
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Prof. Emilio Artacho

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Prof. Mike Hobson

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Dr. Will Handley

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Prof. Eugene Terentjev

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