Benjamin M. Roberts – CV

Senior Lecturer (Amplify), School of Mathematics and Physics, University of Queensland, Brisbane, Australia b.roberts@uq.edu.au

My research lies at the intersection of theoretical atomic physics, particle phenomenology, and particle astrophysics. I develop and apply precision atomic theory to search for signatures of new physics, including dark matter, and to test the Standard Model at low energies. I lead the development of the open-source code *ampsci* for state-of-the-art atomic structure calculations in one- and two-valence heavy atomic systems, driving advances in both fundamental physics and quantum sensing applications. I supervise PhD, honours, masters, and undergraduate research students, and lecture across a wide range of courses, from first year to postgraduate.

broberts.io GitHub: benroberts999 ORCiD: 0002-0345-6375 Google Scholar Inspire: B.M.Roberts.1 arXiv: roberts_b_1

Academic Positions

2024 – **University of Queensland**, Australia, School of Mathematics and Physics
Senior Lecturer, Amplify (2024 – current; fixed-term two-year post-DECRA appointment)
ARC DECRA Fellow (2021 – 2024)
- High-impact research in high-precision atomic theory, particle phenomenology, and astroparticle physics
- Supervise PhD, masters, honours, and undergraduate students
- Lecture and coordinate courses; lead curriculum development
- Academic and discipline service, including committee roles, outreach, and public engagement

2019 – 2021 **University of Queensland**, Australia, School of Mathematics and Physics
Postdoctoral Researcher
- Working with Dr. Jacinda Ginges in high-precision atomic theory
- Supervise honours, and undergraduate students; lecture courses, aid in curriculum development

2018 – 2019 **SYRTE, Observatoire de Paris**, France
Postdoctoral Researcher
- Working with Prof. Peter Wolf and Dr. Pacome Delva in the Theory and Metrology group
- Developed methods for dark matter detection using networks of atomic clocks

2016 – 2018 **University of Nevada, Reno**, USA
Postdoctoral Fellow
- Working with Prof. Andrei Derevianko and Prof. Geoffrey Blewitt
- Using GPS atomic clock data to search for macroscopic dark matter candidates
- Assisted in student supervision; received an *Exceptional Postdoctoral Mentoring* award

Education

2013 – 2016 **Doctor of Philosophy in Physics**, UNSW, Sydney, Australia
- Supervisors: Prof. Victor Flambaum and Dr. Vladimir Dzuba
- Thesis: *Low-energy atomic phenomena: probing fundamental physics and searching for dark matter*
- Nominated by the NSW AIP branch for the *Bragg Gold Medal for Excellence in Physics*
- 9 first-author publications, including in *Physical Review Letters*
- Invited talk at *Mainz Institute for Theoretical Physics*, Germany, and Invited by Prof. Maxim Pospelov to the *Perimeter Institute for Theoretical Physics*, Canada, to collaborate

2009 – 2012 **Bachelor of Science (Advanced)**, Class 1 Honours in Physics, UNSW, Sydney, Australia
- Supervisors: Dr. Julian Berengut and Prof. Victor Flambaum
- Thesis: *Parity nonconservation in atomic transitions and tests of Unification Theories*
- 3 publications (1 first author), including in *Physical Review Letters*
- Received Spruson & Ferguson Award for Innovation in Science (2012)

Grants and Awards

2025 **DP** | Australian Research Council (ARC) Discovery Project – $566K (AUD)
- *Nuclear structure and precision tests of fundamental physics in atoms* (DP250103374, CI)
- With Dr. Jacinda Ginges (UQ), and Dr. Natalia Oreshkina (Max Planck Institute, Heidelberg)

2023 **BQI** | Big Questions Institute Fellowship – $15k
- *Are the laws of physics the same everywhere in the universe?* (sole investigator)

2023 **DP** | ARC Discovery Project – $415K
- *Probing new physics with atomic parity violation* (DP230101685, CI)
- With Dr. Jacinda Ginges (UQ), and Dr. Magdalena Kowalska (ISOLDE, CERN)

2021 **DECRA** | ARC Discovery Early Career Research Award – $440K
- *Atomic physics as a probe for fundamental physics and dark matter* (DE210101026, sole CI)

2017 Nominated for the *Bragg Gold Medal for Excellence in Physics*
- Nominated by UNSW, and the NSW branch of the Australian Institute of Physics

2013 Australian Postgraduate award (PhD scholarship) – $72K

2012 Spruson & Ferguson Award for Innovation in Science – $2K

Teaching

I lecture courses across a wide range of physics, computing, and general science disciplines, from first-year to postgraduate level. My experience includes course coordination, curriculum development, new course design, and diverse teaching styles. I consistently receive excellent student feedback.

2025 **Particle Physics and General Relativity**, University of Queensland, Australia
Course proposal and development
- Involved in proposal and design of a new course to fill gap in current curriculum
- Developing modules on particle phenomenology and nuclear physics

2024 – **Quantum Field Theory**, University of Queensland, Australia
Lecturer
- PHYS4040 – 4th year course (honours-level), classes of 30 students

2024 – **Theory & Practice in Science**, University of Queensland, Australia
Lecturer
- SCIE1000 – 1st year general science course, classes of 100+ students

2022 – **Frontiers in Astrophysics**, University of Queensland, Australia
Lecturer
- PHYS4080 – 4th year course (honours-level)
- Designed new particle astrophysics module and assessment

2021 – **Computational Physics**, University of Queensland, Australia
Course Coordinator and Lecturer
- PHYS4070 – 4th year course (honours-level), classes of 20 students
- Led curriculum development; designed new modules and assessments
- Developed modules on many-body atomic physics
- Coordinate and mentor junior lecturers and teaching assistants

2023 **Data Visualisation and Analysis**, University of Queensland, Australia
Lecturer
- COSC3000 – 3rd year computer science course, classes of 100+ students
- Updated all tutorials and examples to use modern python, developed new tutorials and lectures

2021 – 2023 **Advanced Quantum Field Theory**, University of Queensland, Australia
Lecturer
- PHYS6004 – *special topics* course, aimed at honours and postgraduate students
- Lectured first time course ran; designed module on quantum electrodynamics

2012 – 2015 **First-year physics**, UNSW, Australia
Teaching Assistant and Laboratory Demonstrator in Charge
- 1st year teaching laboratory *Demonstrator in Charge* (supervise 3 demonstrators and 45 students)
- Ran tutorial classes of 40 students for the *Physics Bridging Course*
- Involved in implementing *Mechanics: Motion, Forces, Energy and Gravity* MOOC

Research Supervision

2021 – **Postgraduate Supervision**, University of Queensland, Australia

- Current: primary supervisor for 3 PhD students, and co-supervisor for further 3
- Graduated: primary supervisor for one Masters student (jointly with *University of Vienna*)
- Excellent student outcomes: students have led first-author publications, presented at national and international conferences, and engaged in international collaborations and public outreach

2016 – **Undergraduate Supervision**, University of Queensland, Australia, and University of Nevada, Reno, USA

- Current: primary supervisor for 1 honours student
- Graduated: primary supervisor for 8 graduated honours students, and co-supervisor for further 9
- Supervised 20+ undergraduate research projects
- Excellent student outcomes: graduated students have positions in industry and prestigious Australian and international postgraduate programs; several undergraduates co-authored publications

Selected Publications

I have 35+ high-impact publications spanning atomic, nuclear, particle phenomenology, and astrophysics, including in *Nature Communications* and *Physical Review Letters* with several Editors' Suggestions.

Highlights include: probing fundamental physics near our galaxy's supermassive black hole in collaboration with 2020 Nobel Laureate Prof. Andrea Ghez; using the GPS constellation to search for dark matter, sparking numerous subsequent studies from groups around the world; performing high-precision atomic calculations enabling the most accurate low-energy test of electroweak theory to date; developing methods to combine nuclear and atomic theory for improved fundamental probes; and proposing new atomic signatures of dark matter, opening the door to a range of previously "invisible" models.

- *Ultralight Dark Matter Search with Space-Time Separated Atomic Clocks and Cavities*, M. Filzinger, A. Caddell, D. Jani, M. Steinel, L. Giani, N. Huntemann, and B. M. Roberts, Phys. Rev. Lett. **134**, 031001 (2025)
- *Empirical determination of the Bohr-Weisskopf effect in cesium and improved tests of precision atomic theory in searches for new physics*, G. Sanamyan, B. M. Roberts, and J. Ginges, Phys. Rev. Lett. **130**, 053001 (2023)
- *Variation of the Fine Structure Constant around the Supermassive Black Hole in Our Galactic Center*, A. Hees, T. Do, B. M. Roberts, Andrea M. Ghez, *et al.*, Phys. Rev. Lett. **124**, 081101 (2020)
- *Search for transient variations of the fine structure constant and dark matter using fiber-linked optical atomic clocks*, B. M. Roberts *et al.*, New J. Phys. **22**, 093010 (2020)
- *Nuclear magnetic moments of francium 207–213 from precision hyperfine comparisons*, B. M. Roberts and J. Ginges, Phys. Rev. Lett. **125**, 063002 (2020)
- *Search for domain wall dark matter with atomic clocks on board GPS satellites*, B. M. Roberts, G. Blewitt, C. Dailey, M. Murphy, M. Pospelov, A. Rollings, J. Sherman, W. Williams, and A. Derevianko, Nature Comm. **8**, 1195 (2017)
- *Ionization of Atoms by Slow Heavy Particles, Including Dark Matter*, B. M. Roberts, V. Flambaum, and G. Gribakin, Phys. Rev. Lett. **116**, 023201 (2016)
- *Parity and Time-Reversal Violation in Atomic Systems*, B. M. Roberts, V. Dzuba, and V. Flambaum, Annu. Rev. Nucl. Part. Sci. **65**, 63 (2015)
- *Limiting P-Odd Interactions of Cosmic Fields with Electrons, Protons, and Neutrons*, B. M. Roberts, Y. Stadnik, V. Dzuba, V. Flambaum, N. Leefer, and D. Budker, Phys. Rev. Lett. **113**, 081601 (2014)
- *Revisiting Parity Nonconservation in Cesium*, V. Dzuba, J. Berengut, V. Flambaum, and B. M. Roberts, Phys. Rev. Lett. **109**, 203003 (2012)
- *Full publication list included separately, and available online: broberts.io/publications/*

Selected Invited Talks

- *21st Rencontres du Vietnam: particle astrophysics and cosmology*, **ICISE**, Vietnam, 2025
- *Precision Physics and Fundamental Symmetries* seminar, **PTB**, Braunschweig, Germany, 2024
- CSIRO Space & Astronomy Colloquium, *A brief history of time (keeping)*, **CSIRO, Sydney**, Australia, 2024
- Lecture on *Atomic Parity Violation and Precision Low-Energy Physics*, **Les Houches**, France, 2023
- *Frontiers in Quantum Matter Workshop: Electric Dipole Moments*, **ANU**, Canberra, Australia, 2019
- *7th International Colloquium on Scientific and Fundamental Aspects of GNSS*, **ETH Zürich**, Switzerland, 2019
- *15th Marcel Grossmann Meeting*, **La Sapienza**, University of Rome, Italy, 2018

- *New Directions in Dark Matter and Neutrino Physics*, **Perimeter Institute for Theoretical Physics**, 2017
- *The Ultra-Light Frontier*, **Mainz Institute for Theoretical Physics**, Germany, 2015

Selected Coverage in Popular Press

- Cosmos, *Atomic clocks and lasers could help find dark matter*, I. Perfetto, 10 Feb 2025
- Brisbane Times, *'Unusual' atom helps search for dark matter*, S. Layt, 28 Feb 2023
- APS Physics Synopsis, *Constants Still Constant Near Black Hole*, M. Stephens, 26 Feb 2020
- Quanta, *Ultra-Accurate Clocks Lead Search for New Physics*, G. Popkin, 16 Apr 2018
- Cosmos, *GPS satellites "largest dark matter detector ever built"*, R. Lovett, 10 Nov 2017
- NBC News, *The search for dark matter just took a big step forward*, B. Bergan, 3 Nov 2017
- MIT Tech. Review, *Astrophysicists turn GPS satellite constellation into giant dark matter detector*, 4 May 2017
- Science, *Hunting dark matter with GPS data*, A. Cho, 30 Jan 2017

Academic Service & Leadership

2024 – **External Service**
Queensland Curriculum and Assessment Authority (QCAA)
- Panel member for the *2026 Physics external assessment academic review*
- Consulted on questions regarding year 12 physics syllabus

2023 – **Australian Institute of Physics**, Atomic and Molecular Physics (ATMOP) Topical Group Committee
ATMOP Vice Chair (2024 – current)
ATMOP Vice Secretary-Treasurer (2023 – 2024)
- Attend group meetings, plan invited sessions at AIP conferences

2022 – **School and Faculty service**, University of Queensland, Australia
Equity, Diversity and Inclusion Committee (2025 – current)
- Contribute to initiatives and policy development supporting equity, diversity, and inclusion

Big Questions Institute Fellowship panel (2024 – current)
- Assess applications for the UQ Fellowship of the *Big Questions Institute*

Colloquium Committee (2022 – 2025), *Acting Chair* (2025)
- Organise and run the weekly physics colloquium, host guest speakers

Higher-Degree Research panels (2022 – current)
- *Chair of Examiners* for PhD defence; Progress review panels for over a dozen PhD and Masters students
- Examined several honours theses and undergraduate research projects

2021 – **Conference organisation**
- Chaired several sessions at Australian and international conferences (2021 – current)
- Organised UQ hub for virtual ACAMAR particle astrophysics meeting 2022
- Organised the UQ leg of the 2022 Australian Institute of Physics Women in Physics lecture

2021 – **Computational Workshops**, University of Queensland, Australia
- Initiated and run a yearly *git and GitHub* workshop for the School of Mathematics and Physics
- Contribute to several high-performance computing workshops
- Run the *Computing Systems and Data Management* lecture for physics honours cohort each semester

2017 – **Outreach and Community Engagement**
- Several public talks, including *Pint of Science*, and *National Quantum and Dark Matter Roadshow*
- *Junior Physics Odyssey* program: lecture on relativity to year 10 students
- Provide expert comment for several science journalists

2014 – **Referee for peer-reviewed journals and grants**
Australian Research Council, detailed assessor (2022 – current)
- Referee for several ARC Discovery grants, including DP, DECRA, and LIEF

Peer-reviewed journal referee (2014 – current)
- Referee several journal articles per year, including *Nature Astronomy*, *Physical Review Letters*, and others