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. My work develops and applies 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. My work has led to highly cited publications, and sparked international collaborations with some of worlds leading experimental groups. I supervise PhD, honours, masters, and undergraduate research students, and lecture across the full spectrum of physics education, from first year to postgraduate levels.

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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
- *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 – 4^{th} year course (honours-level), classes of $\sim$ 30 students

2024 – **Theory & Practice in Science**, University of Queensland, Australia
Lecturer
- SCIE1000 – 1^{st} year general science course, classes of $\sim$ 200 students

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

2021 – **Computational Physics**, University of Queensland, Australia
Course Coordinator and Lecturer
- PHYS4070 – 4^{th} year course (honours-level), $\sim$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 – 3^{rd} year computer science course, classes of $\sim$ 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
- 1^{st} 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

- Currently primary supervisor for 2 PhD students; 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

- Currently 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, highly-cited 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; 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. 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
- *7^{th} International Colloquium on Scientific and Fundamental Aspects of GNSS*, **ETH Zürich**, Switzerland, 2019
- *15^{th} 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
- 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 & Discipline Service

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
- Successfully reinstated the colloquium series post-COVID

Higher-Degree Research panels (2022 – current)
- Progress review panels for over a dozen PhD and Masters students, covering quantum science, atomic and particle physics, and astronomy and cosmology
- *Chair of Examiners* for PhD thesis defence
- 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
- Encourage and facilitate student outreach, including media interviews and public talks
- 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*, *Physical Review A & D*, and others