

Benjamin M. Roberts – CV

Senior Lecturer (Amplify), School of Mathematics and Physics, University of Queensland, Brisbane, Australia

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My research lies at the intersection of theoretical atomic physics, quantum science, particle phenomenology, and astrophysics. I develop and apply precision atomic theory to enable experiments with quantum sensors and precision measurement techniques to probe fundamental physics, including searches for dark matter and physics beyond the Standard Model. I have extensive experience in scientific computing and software development, including C++, python, Fortran. 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, with both fundamental and quantum sensing applications. I actively collaborate with world-leading experimental groups, including at the ISOLDE facility, CERN, and PTB, the German metrology institute. I supervise PhD, honours, masters, and undergraduate research students, and lecture across a wide range of courses, from first year to postgraduate.

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Academic Positions

- 2021 – **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
- 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 graduate level. My experience includes course coordination, curriculum development, new course design, and diverse teaching styles. I consistently receive excellent student feedback, with several students noting my courses or teaching as the highlight of their studies and praising my clarity, preparedness, and ability to make complex material engaging and accessible.

- 2024 – **Quantum Field Theory** (UQ), *Lecturer*
- PHYS4040 – 4th year course (honours-level), classes of 30 students
- 2024 – **Theory & Practice in Science** (UQ), *Lecturer*
- SCIE1000 – 1st year general science course, classes of 100+ students
- 2022 – **Frontiers in Astrophysics** (UQ), *Lecturer*
- PHYS4080 – 4th year course (honours-level), classes of 5–10 students
 - Designed new particle astrophysics modules and assessment
- 2021 – **Computational Physics** (UQ), *Course Coordinator and Lecturer*
- PHYS4070 – 4th year course (honours-level), classes of 20 students
 - Led curriculum development, including shift of assessment to major projects, with great success
 - Developed new module on many-body atomic physics
 - Coordinate and mentor junior lecturers and teaching assistants
- 2023 **Data Visualisation and Analysis** (UQ), *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** (UQ), *Lecturer and course development*
- 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 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 4
 - Graduated: 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, won awards, 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, and 1 undergraduate research project
 - 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

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 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 methods to detect dark matter with precision quantum sensors, 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. Steinell, 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, ... and P. Wolf, *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
- *Quantum Sensors and New Physics* workshop, **MIAPbP** Munich, Germany, 2023
- *International Workshop on Atomic Parity Violation (virtual)*, 2022
- *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. Peretto, 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 Assessment Academic Review*
 - Consulted on questions regarding year 12 physics syllabus and assessment
- 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, review abstracts for AIP conferences, recommend invited ATMOP talks
- 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 high-performance computing workshops, run scientific software development 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**
Alexander von Humboldt Foundation (2025 – current)
- Referee for Humboldt Research Fellowship
- 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