Benjamin M. Roberts – Publications

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

broberts.io ORCiD: 0000-0002-0345-6375 Google Scholar: 5i5bTuwAAAAJ Inspire HEP: B.M.Roberts.1 arXiv: roberts_b_1

Research Articles

[1] *R. B. Cserveny** and B. M. Roberts, *Theoretical characterisation of the Barium II and Radium II ions*, Physical Review A (Under Review) (2025), [arXiv:2505.05230]

[2] J. Vandeleur, G. Sanamyan, B. M. Roberts, and J. S. M. Ginges, *Hyperfine anomaly in mercury and test of the Moskowitz-Lombardi rule*, Physical Review A **111**, L050801 (2025), [arXiv:2411.09912]

- Featured on front page of Physical Review A website

[3] *J. C. Hasted*†, *C. J. Fairhall*†, O. R. Smits, B. M. Roberts, and J. S. M. Ginges, *Vacuum polarization corrections to hyperfine structure in many-electron atoms*, Physical Review A **111**, 032812 (2025), [arXiv:2409.17979]

[4] M. Filzinger, *A. R. Caddell*†, *D. Jani**, M. Steinel, L. Giani, N. Huntemann, and B. M. Roberts, *Ultralight Dark Matter Search with Space-Time Separated Atomic Clocks and Cavities*, **Physical Review Letters 134**, 031001 (2025), [arXiv:2312.13723v2]

- Covered in *Cosmos*: *Atomic clocks and lasers could help find dark matter*, as well as *phys.org*, *scientias*, others

[5] *A. R. Caddell*†, V. V. Flambaum, and B. M. Roberts, *Accurate electron-recoil ionization factors for dark matter direct detection in xenon, krypton, and argon*, Physical Review D **108**, 083030 (2023), [arXiv:2305.05125]

[6] B. M. Roberts, *C. J. Fairhall*†, and J. S. M. Ginges, *Electric dipole transition amplitudes for atoms and ions with one valence electron*, Physical Review A **107**, 052812 (2023), [arXiv:2211.11134]

[7] R. Hamilton, B. M. Roberts, S. K. Scholten, C. Locke, A. N. Luiten, J. S. M. Ginges, and C. Perrella, *Experimental and theoretical study of dynamic polarizabilities in the $5S - 5D_{5/2}$ clock transition in rubidium-87 and determination of electric dipole matrix elements*, Physical Review Applied **19**, 054059 (2023), [arXiv:2212.10743]

[8] *C. J. Fairhall*†, B. M. Roberts, and J. S. M. Ginges, *QED radiative corrections to electric dipole amplitudes in heavy atoms*, Physical Review A **107**, 022813 (2023), [arXiv:2212.11490]

[9] *G. Sanamyan**, B. M. Roberts, and J. S. M. Ginges, *Empirical Determination of the Bohr-Weisskopf Effect in Cesium and Improved Tests of Precision Atomic Theory in Searches for New Physics*, **Physical Review Letters 130**, 053001 (2023), [arXiv:2209.05099]

- Covered in *The Brisbane Times*: *'Unusual' atom helps search for dark matter – and a quicker car ride*, as well as *The Sydney Morning Herald*, *The Age*, and *WA Today*. Also featured in *phys.org* and others

[10] B. M. Roberts, P. G. Ranclaud, and J. S. M. Ginges, *Bohr-Weisskopf effect: From hydrogenlike-ion experiments to heavy-atom calculations of the hyperfine structure*, Physical Review A **105**, 052802 (2022), [arXiv:2111.12954]

[11] B. M. Roberts and J. S. M. Ginges, *Comment on "New physics constraints from atomic parity violation in ^{133}Cs"*, Physical Review D **105**, 018301 (2022), [arXiv:2110.11621]

[12] B. M. Roberts and J. S. M. Ginges, *Hyperfine anomaly in heavy atoms and its role in precision atomic searches for new physics*, Physical Review A **104**, 022823 (2021), [arXiv:2101.09924]

[13] E. Savalle, A. Hees, F. Frank, E. Cantin, P.-E. Pottie, B. M. Roberts, L. Cros, B. T. McAllister, and P. Wolf, *Searching for Dark Matter with an Optical Cavity and an Unequal-Delay Interferometer*, **Physical Review Letters 126**, 051301 (2021), [arXiv:2006.07055]

[14] B. M. Roberts and A. Derevianko, *Precision Measurement Noise Asymmetry and Its Annual Modulation as a Dark Matter Signature*, Universe **7**, 50 (2021), [arXiv:1803.00617]

† My PhD students, * My honours/masters students

[15] B. M. Roberts and J. S. M. Ginges, *Nuclear Magnetic Moments of Francium-207–213 from Precision Hyperfine Comparisons*, **Physical Review Letters 125**, 063002 (2020), [arXiv:2001.01907]

- Featured in phys.org: *Improved modelling of nuclear structure in francium aids searches for new physics*

[16] A. Hees, T. Do, B. M. Roberts, A. M. Ghez, S. Nishiyama, R. O. Bentley, A. K. Gautam, S. Jia, T. Kara, J. R. Lu, H. Saida, S. Sakai, M. Takahashi, and Y. Takamori, *Search for a Variation of the Fine Structure Constant around the Supermassive Black Hole in Our Galactic Center*, **Physical Review Letters 124**, 081101 (2020), [arXiv:2002.11567]

- Editors' Suggestion; featured on front-page of PRL website
- Featured in APS Physics Synopsis [*Constants Still Constant Near Black Holes*]
- Covered in: Spektrum (DE), Science News, and several other outlets
- Co-authored with Prof. Andrea Ghez, 2020 Physics Nobel Prize winner

[17] B. M. Roberts, P. Delva, A. Al-Masoudi, A. Amy-Klein, C. Bærentsen, C. F. A. Baynham, E. Benkler, S. Bilicki, S. Bize, W. Bowden, J. Calvert, V. Cambier, E. Cantin, E. A. Curtis, S. Dörscher, M. Favier, F. Frank, P. Gill, R. M. Godun, G. Grosche, C. Guo, A. Hees, I. R. Hill, R. Hobson, N. Huntemann, J. Kronjäger, S. Koke, A. Kuhl, R. Lange, T. Legero, B. Lipphardt, C. Lisdat, J. Lodewyck, O. Lopez, H. S. Margolis, H. Álvarez-Martínez, F. Meynadier, F. Ozimek, E. Peik, P.-E. Pottie, N. Quintin, C. Sanner, L. De Sarlo, M. Schioppo, R. Schwarz, A. Silva, U. Sterr, C. Tamm, R. Le Targat, P. Tuckey, G. Vallet, T. Waterholter, D. Xu, and P. Wolf, *Search for transient variations of the fine structure constant and dark matter using fiber-linked optical atomic clocks*, New Journal of Physics **22**, 093010 (2020), [arXiv:1907.02661]

- Featured Article (chosen by the editors for "novelty, significance and potential impact")

[18] G. Panelli, B. M. Roberts, and A. Derevianko, *Applying the matched-filter technique to the search for dark matter transients with networks of quantum sensors*, EPJ Quantum Technology **7**, 5 (2020), [arXiv:1908.03320]

[19] S. J. Grunefeld, B. M. Roberts, and J. S. M. Ginges, *Correlation trends in the hyperfine structure for Rb, Cs, and Fr, and high-accuracy predictions for hyperfine constants*, Physical Review A **100**, 042506 (2019), [arXiv:1907.02657]

[20] E. Savalle, B. M. Roberts, F. Frank, P.-E. Pottie, B. T. McAllister, C. Dailey, A. Derevianko, and P. Wolf, *Novel approaches to dark-matter detection using space-time separated clocks*, arXiv preprint (2019), [arXiv:1902.07192]

[21] B. M. Roberts and V. V. Flambaum, *Electron-interacting dark matter: Implications from DAMA/LIBRA-phase2 and prospects for liquid xenon detectors and NaI detectors*, Physical Review D **100**, 063017 (2019), [arXiv:1904.07127]

[22] V. A. Dzuba, V. V. Flambaum, and B. M. Roberts, *Calculations of the atomic structure for the low-lying states of actinium*, Physical Review A **100**, 022504 (2019), [arXiv:1905.02365]

[23] B. M. Roberts, G. Blewitt, *C. Dailey**, and A. Derevianko, *Search for transient ultralight dark matter signatures with networks of precision measurement devices using a Bayesian statistics method*, Physical Review D **97**, 083009 (2018), [arXiv:1803.10264]

[24] B. M. Roberts, G. Blewitt, *C. Dailey**, M. Murphy, M. Pospelov, A. Rollings, J. Sherman, *W. Williams**, and A. Derevianko, *Search for domain wall dark matter with atomic clocks on board global positioning system satellites*, **Nature Communications 8**, 1195 (2017), [arXiv:1704.06844]

- Covered in Science [doi: 10.1126/science.aal0676], and Eos (AGU) [doi: 10.1029/2018EO104623]
- Also covered in Quanta, NBC News, Cosmos Magazine, MIT Tech. Review, and others

[25] V. V. Flambaum, B. M. Roberts, and Y. V. Stadnik, *Comment on "Axion induced oscillating electric dipole moments"*, Physical Review D **95**, 058701 (2017), [arXiv:1507.05265]

[26] B. M. Roberts, V. V. Flambaum, and G. F. Gribakin, *Reply to 'Comment on: Ionization of Atoms by Slow Heavy Particles, Including Dark Matter'*, **Physical Review Letters 117**, 089302 (2016)

[27] B. M. Roberts, V. A. Dzuba, V. V. Flambaum, M. Pospelov, and Y. V. Stadnik, *Dark matter scattering on electrons: Accurate calculations of atomic excitations and implications for the DAMA signal*, Physical Review D **93**, 115037 (2016), [arXiv:1604.04559]

[28] B. M. Roberts, V. V. Flambaum, and G. F. Gribakin, *Ionization of Atoms by Slow Heavy Particles, Including Dark Matter*, **Physical Review Letters 116**, 023201 (2016), [arXiv:1509.09044]

[29] B. M. Roberts, V. A. Dzuba, and V. V. Flambaum, *Parity and Time-Reversal Violation in Atomic Systems*, **Annual Review of Nuclear and Particle Science 65**, 63 (2015), [arXiv:1412.6644]

[30] B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker, *Parity-violating interactions of cosmic fields with atoms, molecules, and nuclei: Concepts and calculations for laboratory searches and extracting limits*, Physical Review D **90**, 096005 (2014), [arXiv:1409.2564]

- Editors' Suggestion; featured on front-page of PRD website
- Covered in *Physics Today* [doi: 10.1063/PT.3.2896]

[31] Y. V. Stadnik, B. M. Roberts, and V. V. Flambaum, *Tests of CPT and Lorentz symmetry from muon anomalous magnetic dipole moment*, Physical Review D **90**, 045035 (2014), [arXiv:1407.5728]

[32] B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker, *Limiting P-Odd Interactions of Cosmic Fields with Electrons, Protons, and Neutrons*, **Physical Review Letters 113**, 081601 (2014), [arXiv:1404.2723]

[33] B. M. Roberts, V. A. Dzuba, and V. V. Flambaum, *Strongly enhanced atomic parity violation due to close levels of opposite parity*, Physical Review A **89**, 042509 (2014), [arXiv:1401.6262]

[34] B. M. Roberts, V. A. Dzuba, and V. V. Flambaum, *Nuclear-spin-dependent parity nonconservation in s-$d_{5/2}$ and s-$d_{3/2}$ transitions*, Physical Review A **89**, 012502 (2014), [arXiv:1311.2373]

[35] B. M. Roberts, V. A. Dzuba, and V. V. Flambaum, *Double-core-polarization contribution to atomic parity-nonconservation and electric-dipole-moment calculations*, Physical Review A **88**, 042507 (2013), [arXiv:1309.3371]

[36] B. M. Roberts, V. A. Dzuba, and V. V. Flambaum, *Parity nonconservation in Fr-like actinide and Cs-like rare-earth-metal ions*, Physical Review A **88**, 012510 (2013), [arXiv:1304.7591]

[37] B. M. Roberts, V. A. Dzuba, and V. V. Flambaum, *Quantum electrodynamics corrections to energies, transition amplitudes, and parity nonconservation in Rb, Cs, Ba^+, Tl, Fr, and Ra^+*, Physical Review A **87**, 054502 (2013), [arXiv:1302.0593]

[38] V. A. Dzuba, V. V. Flambaum, and B. M. Roberts, *Calculation of the parity-violating 5s-6s E1 amplitude in the rubidium atom*, Physical Review A **86**, 062512 (2012), [arXiv:1211.0075]

[39] V. A. Dzuba, J. C. Berengut, V. V. Flambaum, and B. M. Roberts, *Revisiting Parity Nonconservation in Cesium*, **Physical Review Letters 109**, 203003 (2012), [arXiv:1207.5864]

- Allowed highest-precision low-energy test of electroweak theory; cited in *Particle data Group* reports

Conference Proceedings

[40] T. Do, A. Hees, A. Ghez, G. D. Martinez, D. S. Chu, S. Jia, S. Sakai, J. R. Lu, A. K. Gautam, K. Kosmo O'neil, E. E. Becklin, M. R. Morris, K. Matthews, S. Nishiyama, R. Campbell, S. Chappell, Z. Chen, A. Ciurlo, A. Witzel, E. Gallego-Cano, W. E. Kerzendorf, J. E. Lyke, S. Naoz, H. Saida, R. Schödel, M. Takahashi, Y. Takamori, G. Witzel, P. Wizinowich, and B. M. Roberts, *Testing Fundamental Physics With Stellar Orbits at the Galactic Center*, ASP Conference Series: New Horizons in Galactic Center Astronomy and Beyond **528**, 249 (2019)

[41] E. Savalle, A. Hees, F. Frank, E. Cantin, P.-E. Pottie, B. M. Roberts, L. Cros, B. T. McAllister, and P. Wolf, *The DAMNED experiment! New constraints on ultralight dark matter scalar field oscillations*, Proceedings of the 55th Rencontres de Moriond - Gravitation Session, 17 (2021)

[42] E. Savalle, B. M. Roberts, F. Frank, P.-E. Pottie, B. T. McAllister, C. Dailey, A. Derevianko, and P. Wolf, *DAMNED - DArk Matter from Non Equal Delays New test of the fundamental constants variation*, 2019 Joint Conference of the IEEE International Frequency Control Symposium and European Frequency and Time Forum (EFTF/IFC) (2019)

[43] E. Savalle, B. M. Roberts, F. Frank, P.-E. Pottie, B. T. McAllister, C. B. Dailey, A. Derevianko, and P. Wolf, *The damned experiment: dark matter from non equal delays*, Proceedings of the 54th Rencontres de Moriond - Gravitation Session, 241 (2019)

[44] A. Hees, O. Minazzoli, E. Savalle, Y. V. Stadnik, P. Wolf, and B. M. Roberts, *Violation of the equivalence principle from light scalar fields: from Dark Matter candidates to scalarized black holes*, Proceedings of the 54th Rencontres de Moriond - 2019 Gravitation, 175 (2019), [arXiv:1905.08524]

[45] B. M. Roberts, Y. V. Stadnik, V. V. Flambaum, and V. A. Dzuba, *Searching for Axion Dark Matter in Atoms: Oscillating Electric Dipole Moments and Spin-Precession Effects*, Proceddings of the 11th PATRAS Workshop on Axions, WIMPs and WISPs (2015), [arXiv:1511.04098]

[46] Y. V. Stadnik, B. M. Roberts, V. V. Flambaum, and V. A. Dzuba, *Searching for Scalar Dark Matter in Atoms and Astrophysical Phenomena: Variation of Fundamental Constants*, Proceddings of the 11th PATRAS Workshop on Axions, WIMPs and WISPs (2015), [arXiv:1511.04100]

[47] B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker, *ICPEAC2015: New Atomic Methods for Dark Matter Detection*, Journal of Physics: Conference Series **635**, 022033 (2015)

[48] V. V. Flambaum, V. A. Dzuba, M. Pospelov, A. Derevianko, and B. M. Roberts, *ICPEAC2015: Atomic Ionization by Dark Matter Particles*, Journal of Physics: Conference Series **635**, 022012 (2015)

Other Research Outputs

[49] GPS-analysis, B. M. Roberts, *A. R. Caddell*†, and M. Filzinger (2024). Open-source python program to analyse GPS data for oscillating shifts in the frequency of the on board atomic clocks. github.com/benroberts999/gps-analysis
- Companion code to paper: **Physical Review Letters 134**, 031001, (2025)

[50] AtomicIonisation, *A. R. Caddell*† and B. M. Roberts (2023). Open-source C++ and python programs to calculate example DM-electron-induced ionisation rates. Also provides tables of high-accuracy atomic ionisation factors (matrix elements), which are required to calculate atomic ionisation rates, including from dark matter electron scattering. github.com/benroberts999/AtomicIonisation
- Companion code to paper: Physical Review D **108**, 083030, (2023)
- Employed by NEON Collaboration for their dark matter interpretation [arXiv:2407.16194].

[51] AdamsMoulton, B. M. Roberts (2023). An open-source C++ implementation of the Adams-Moulton method for solving general second-order ODEs. github.com/benroberts999/AdamsMoulton

[52] ampsci, B. M. Roberts (2022). An open-source C++ program for high-precision atomic structure calculations of single-valence systems. github.com/benroberts999/ampsci
- Used in many papers, including by other groups; first major publication: Physical Review A **107**, 052812, (2023)

[53] FGRP, B. M. Roberts (2022). An open-source C++ implementation of the Flambaum-Ginges radiative potential method, a method for including radiative quantum electrodynamics effects into calculations of atomic wavefunctions, including finite nuclear size corrections. github.com/benroberts999/FGRP
- Used in many papers, first in: Physical Review A **107**, 022813, (2023). Also used by other groups, e.g., Phys. Rev. A **107**, 042809 (2023)

[54] transientDM, B. M. Roberts (2019). An open-course C++ program for searching for transient dark matter signals in data from atomic clock networks. github.com/benroberts999/transientDM
- Companion code to paper: New Journal of Physics **22**, 093010, (2020)

[55] DM-ClockAsymmetry, B. M. Roberts (2018). An open-source python program for simulating dark matter induced asymmetries in atomic clock data, and their annual modulation. github.com/benroberts999/DM-ClockAsymmetry
- Companion code to paper: Universe **7**, 50, (2021)

[56] InverseNumericalCDF, B. M. Roberts (2017). An open-source C++ program that finds the inverse of numerical cumulative distribution functions for inverse transform sampling in Monte-Carlo methods. github.com/benroberts999/InverseNumericalCDF
- Used in: **Nature Communications 8**, 1195, (2017)

Invited Seminars, Colloquiums

[1] Colloquium: Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany, November 2024.
Talk: *Enlightening the search for dark matter (and exotic physics) with atomic phenomena*
Part of the "Virtual Seminar on Precision Physics and Fundamental Symmetries" series and of the *SFB DQ-mat colloquium* series: indico.cern.ch/category/12183/ – [Slides]

[2] Colloquium: CSIRO Space & Astronomy Colloquium, Marsfield, Sydney, July 2024.
Talk: *A brief history of time(-keeping): atomic clocks at the precision frontier of fundamental physics* [Slides]

[3] Seminar: University of Sussex, UK, QSNET Seminar (presented virtually), February 2024.
Talk: *Search for scalar dark matter and variation of fundamental constants with spatially separated sensors* [Slides]

[4] Colloquium: University of Melbourne, Astrophysics Colloquium (presented virtually), August 2023.
Talk: *Variation of fundamental constants: Search for new physics around a supermassive black hole*

[5] Colloquium: University of Queensland, Physics Colloquium, August 2023.
Talk: *Enlightening the search for dark matter (and exotic physics)* [Slides]

[6] Lecture: PhysTeV 2023, Physics at TeV Colliders and Beyond the Standard Model, Les Houches, France, June 2023.
Lecture for "precision low-energy school": *Atomic parity violation as a low-energy probe of electroweak theory*

[7] Seminar: University of Melbourne, particle physics seminar (virtual), March 2022.
Talk: *Dark matter induced atomic ionisation* [Slides]

[8] Seminar: Observatoire de Paris, Seminaire Temps & Frequencies (SYRTE seminar), May 2018.
Talk: *Searching for dark matter with GPS and global networks of atomic clocks*

Invited and Plenary Conference Presentations

[9] TMEX-2025, Theory Meets Experiment: Particle Astrophysics and Cosmology, 21st Rencontres du Vietnam, ICISE, Quy Nhon, Vietnam, January 2025.
Talk: *Atomic frontiers in dark matter detection* [Slides]

[10] 2023 MIAPbP (Munich Institute for Astro-, Particle, and Bio Physics) program: Particle & AMO physicists discussing quantum sensors and new physics 2023), Munich, Germany, September 2023.

[11] APV2022, The International Workshop on Atomic Parity Violation (virtual), November 2022.
Talk: *Study of electric dipole amplitudes for alkali-like atoms and implications for atomic parity violation* [Slides]

[12] ATMOP (AIP) Summer Workshop, Australian National University, Canberra, February 2020.
Talk: *Signatures of GeV-scale dark matter in liquid xenon experiments due to scattering off electrons and atomic ionisation*

[13] Frontiers in Quantum Matter Workshop, Australian National University (ANU), Canberra, November 2019.
Talk: *Dark matter signatures in EDM and precision physics experiments*

[14] 7th International Colloquium on Scientific and Fundamental Aspects of GNSS, ESA (European Space Agency), ETH Zürich, Zurich, Switzerland, September 2019.
Talk: *Searching for dark matter and exotic physics with space and ground-based atomic clocks*

[15] MG15 – Fifteenth Marcel Grossmann Meeting, University of Rome, La Sapienza, Rome, July 2018.
Talk: *Searching for transient dark matter signatures with atomic clocks*

[16] New Directions in Dark Matter and Neutrino Physics, Perimeter Institute for Theoretical Physics, Canada, July 2017.
Talk: *Searching for dark matter with GPS and global networks of atomic clocks* [Recording]

[17] The Ultra-Light Frontier, Mainz Institute for Theoretical Physics, Johannes Gutenberg University, Germany, June 2015.
Talk: *Axion-induced EDMs in paramagnetic systems* [Slides]

Contributed Conference Presentations

[18] Dark Matter and Stars: Multi-Messenger Probes of Dark Matter and Modified Gravity, Queen's University, Kingston, Canada, July 2025 *(upcoming)*.
Talk: *Enlightening the search for dark matter (and exotic physics) with atomic phenomena*

[19] DSU2025: The Dark Side of the Universe, Université de Montreal, Canada, July 2025 *(upcoming)*.
Talk: *Ultralight Dark Matter Search with Space-Time Separated Atomic Clocks and Cavities*

[20] Tabletop-scale Cosmology At Home, (virtual), May 2025.
Talk: *Searching for Ultralight Dark Matter with Space-Time Separated Quantum Sensors* [Slides]

[21] AIP-2024, Australian Institute of Physics Congress, Melbourne, December 2024.
Talk: *Ultralight Dark Matter Search with Space-Time Separated Atomic Clocks and Cavities* [Slides]
Talk: *Study of electric dipole amplitudes for alkali-like atoms and implications for atomic parity violation* [Slides]

[22] APS April Meeting 2024 , Sacramento, California, USA, April 2024.
Talk: *Search for scalar dark matter and variation of fundamental constants with spatially separated sensors* [Slides]

[23] 2023 AIP Summer Meeting, ANU, Canberra, Australia, December 2023.
Talk: *Atomic phenomena in the search for GeV scale WIMPs: enlightening the search for dark matter* [Slides]

[24] 9th Symposium on Frequency Standards and Metrology, Kingscliff, NSW, Australia, October 2023.
Poster: *Electric-dipole transition amplitudes for atoms and ions with one valence electron* [Poster]

[25] DAMOP 2023 (APS Division of Atomic, Molecular and Optical Physics), Spokane, WA, USA, June 2023.
Talk: *Using atomic phenomena to search for GeV scale dark matter* [Slides]
Talk: *Hyperfine anomaly in cesium: From exotic atoms to improved searches for new physics* [Slides]
Poster: *Electric-dipole transition amplitudes for atoms and ions with one valence electron* [Poster]

[26] AIP2022, Australian Institute of Physics Congress, Adelaide, December 2022.
Talk: *Search for a Variation of the Fine Structure Constant around the Supermassive Black Hole in Our Galactic Centre*
Poster: *High-precision study of E1 transition amplitudes for single-valence atoms and ions* [Poster]

[27] DSU2022, The Dark Side of the Universe, University of New South Wales, Sydney, Australia, December 2022.
Talk: *Search for a Variation of the Fine Structure Constant around the Supermassive Black Hole in Our Galactic Centre* [Slides]

[28] Australian Institute of Physics (AIP) Summer Meeting, QUT, Brisbane, December 2021.
Talk: *Search for a variation of the fine-structure constant around the supermassive Black Hole in our Galactic Centre*

[29] ASA2021, Astronomical Society of Australia Science Meeting, University of Melbourne (virtual), July 2021.
Talk: *Search for a variation of the fine-structure constant around the supermassive Black Hole in our Galactic Centre* [Slides]

[30] DAMOP, Portland, Oregon, USA (held virtually), June 2020.
Talk: *Electron-interacting dark matter: prospects for liquid xenon detectors and NaI detectors* [Slides]
Poster: *Do constants remain constant around a Supermassive Black hole?* [Poster]

[31] CHEP 2019, 24th International Conference on Computing in High Energy and Nuclear Physics, Adelaide, Australia, November 2019.
Talk: *Searching for dark matter signatures in 20 years of GPS atomic clock data*

[32] Rencontres de Moriond, Gravitation Session, La Thuile, Valle d'Aosta, Italy, March 2019.
Talk: *Search for dark matter and transient variations in α using fibre-linked optical atomic clocks* [Slides]

[33] AIP2018, Australian Institute of Physics Congress, University of Western Australia, Perth, December 2018.
Talk: *Searching for transient dark matter signatures with atomic clock networks*
Talk: *Ionisation signatures of GeV–scale dark matter due to absorption and scattering off electrons*

[34] ACES Workshop, Technical University of Munich, Germany, October 2018.
Talk: *Searching for transient dark matter signatures with atomic clock networks*

[35] NASA Fundamental Physics Workshop, La Jolla, CA, USA, April 2018.
Talk: *Searching for dark matter and exotic physics with atomic clocks and GPS* [Slides]

[36] DAMOP (APS Division of Atomic, Molecular and Optical Physics), Sacramento Convention Center, CA, USA, June 2017.
Talk: *Searching for dark matter and exotic physics with atomic clocks and the GPS constellation*
Poster: *Electron-interacting WIMPs: Can dark matter scattering on electrons explain the DAMA annual modulation signal?* [Poster]

[37] APS April Meeting, Marriott Wardman Park, Washington DC, USA, January 2017.
Poster: *Electron-interacting WIMPs: Can dark matter scattering on electrons explain the DAMA annual modulation signal?* [Poster]
Talk: *First Results of the GPS.DM Observatory: Search for Dark Matter and exotic Physics with Atomic Clocks and GPS Constellation*
- Talk was the focus of an article in *Science* Magazine [10.1126/science.aal0676].

[38] GPMFC Workshop (Topical Group on Precision Measurement & Fundamental Constants Pre-Meeting Workshop: Ultra-light Dark Matter), Marriott Wardman Park, Washington DC, USA, January 2017.
Poster: *GPS.DM: Search for Dark Matter and Exotic Physics with Atomic Clocks and GPS Constellation*

[39] CosPA (13th Conference in the Symposium on Cosmology and Particle Astrophysics), Sydney Nanoscience Hub, University of Sydney, Australia, December 2016.
Talk: *First Results of the GPS.DM Observatory: Search for Dark Matter and Exotic Physics with Atomic Clocks and GPS Constellation*

[40] DAMOP 2016 (APS Division of Atomic, Molecular and Optical Physics), Rhode Island Convention Center, Providence, RI, USA, May 2016.
Talk: *Atomic ionization from dark matter–electron scattering: Implications for DAMA and XENON interpretation*
Poster: *GPS.DM: Search for Dark Matter and Exotic Physics with Atomic Clocks and GPS Constellation*

[41] PATRAS (11th Patras Workshop on Axions, WIMPs and WISPs), Universidad de Zaragoza, Spain, June 2015.
Talk: *Axion and WIMP phenomena in atomic systems* [Slides]
Talk: *New Effects of Dark Matter which are Linear in the Interaction Strength (on behalf of Victor Flambaum)* [Slides]
Poster: *Axion Dark Matter: New atomic detection schemes*

[42] SSP (6th International Symposium on Symmetries in Subatomic Physics), Victoria BC, Canada, June 2015.
Talk: *Atomic Methods for Dark Matter Detection* [Slides]
Poster: *Axion Dark Matter: New atomic detection schemes*
Poster: *Atomic Symmetry Violation: New applications for tests of fundamental physics*

[43] CosPA (10th Conference in the Symposium on Cosmology and Particle Astrophysics Series), University of Auckland, New Zealand, December 2014.
Talk: *Manifestations of dark matter and cosmic fields in atomic phenomena* [Slides]

[44] AIP2014, Australian Institute of Physics Congress, Australian National University, Canberra, December 2014.
Talk: *Violations of fundamental symmetries in atoms and tests of unification theories* [Slides]
Poster: *Limits on P-odd interactions of cosmic fields with electrons, protons and neutrons*

[45] Australian Institute of Physics Congress, UNSW Australia, December 2012.
Poster: *Parity nonconservation in cesium and the search for physics beyond the standard model*

Public Talks and Outreach

[46] Junior Physics Odyssey (JPhO) lecture, UQ, Brisbane, Australia, July 2024.
Introduction to relativity and space-time – Lecture to year 10 students with UQ 'Junior Physics Odyssey' program

[47] Public Outreach Talk: Pint of Science, Brisbane, Australia, May 2024.
Talk: *The next frontier in fundamental physics* [Slides]

[48] Public Lecture: National Quantum and Dark Matter Roadshow, Brisbane QLD, August 2023.
qdmroadtrip.org/event/public-lecture-brisbane/
Talk: *Enlightening the search for dark matter* [Slides]

[49] Public Talk: UQ ASA (student society) outreach talk, University of Queensland, Australia, April 2022.
Talk: *Variation of fundamental constants: Search for new physics around a supermassive black hole* [Slides]

Selected Coverage in Popular Press

[1] *Atomic clocks and lasers could help find dark matter*, Imma Perfetto, Cosmos Magazine, 10 February 2025.
> "Scientists will now be able to investigate a broader range of dark matter scenarios and perhaps answer some fundamental questions about the fabric of the universe"

[2] *Onderzoekers openen de jacht op donkere materie met behulp van ultraprecieze atoomklokken en lasers (Researchers open hunt for dark matter using ultra-precise atomic clocks and lasers)*, Vivian Lammerse, Scientias [NL], 14 February 2025.

[3] *'Unusual' atom helps search for dark matter – and a quicker car ride*, Stuart Layt, The Brisbane Times, 28 February 2023.
> "Queensland researchers have used an "unusual" atom of caesium to reveal the fundamental forces at work in the universe..."

[4] *A Minimalist Approach to the Hunt for Dark Matter*, Sophia Chen, WIRED, 2 August 2022
> "In one notable example, physicists recast atomic clocks to look for dark matter instead of for timekeeping."

[5] *Improved modelling of nuclear structure in francium aids searches for new physics*, phys.org, 5 August 2020.
> "...By combining precision experiments in atoms with high-precision atomic theory, we get a powerful way to search for new physics"

[6] *This fundamental constant remains the same even near a black hole*, Emily Conover, Science News, 28 March 2020.
> "...'The work is very important because it denotes the beginning of a new type of study' says physicist John Webb"

[7] *Im Angesicht des Schwarzen Lochs (In the face of the black hole)*, Robert Gast, Spectrum [DE], 3 March 2020.
> "...The astrophysicists have looked at radiation that comes from the center of the Milky Way....to determine the size of the so-called fine structure constant" (translated)

[8] *Constants Still Constant Near Black Holes*, M. Stephens, Physics (APS) Synopsis, 26 February 2020.
> "...A spectral analysis of stars at our Galaxy's center sets the first constraints on how much the fine-structure constant varies in the vicinity of a supermassive black hole."

[9] *Harnessing the GPS Data Explosion for Interdisciplinary Science*, G. Blewitt, W. C. Hammond and C. Kreemer, Eos (American Geophysical Union), 24 September 2018.
> "...even fundamental physics is fair game, as we collaborate with physicists using the constellation of GPS atomic clocks (on board GPS satellites) as a giant dark matter detector [Roberts et al., 2017]."

[10] *Is This A Good Time To Start Looking For Dark Matter?*, C. Orzel, Forbes, 4 June 2018.
> "...Other experiments, like the GPS-based dark matter search developed by Andrei Derevianko's group, don't even require new apparatus. They're looking through years of records from the clocks on the Global Positioning system satellites..."

[11] *Ultra-Accurate Clocks Lead Search for New Laws of Physics*, G. Popkin, Quanta, 16 April 2018.

"...reported in fall 2017 that they had found no dark matter-induced hiccups in 16 years' worth of GPS data, tightening the lid on theories of such "topological" dark matter by a factor of 10^3 to 10^5..."

[12] *GPS satellites "the largest dark matter detector ever built"*, R. A. Lovett, Cosmos, 10 November 2017.

"...'The electrons and the nucleus 'feel' the effect of the dark matter, and this can change their properties temporarily,' says Benjamin Roberts, an Australian postdoctoral researcher working with Derevianko in Reno...."

[13] *The search for dark matter just took a big step forward*, Brad Bergan, NBC News, 3 November 2017.

"...'While there is no definitive evidence after looking at 16 years of data, it could be that the interaction is weaker or that the defects cross paths with the Earth less often,' Benjamin Roberts, lead author of team's paper..."

[14] *One step closer to defining dark matter*, AAAS EurekAlert, 1 November 2017.

"...'What we looked for was clumps of dark matter in the shape of walls, using a model that – if it exists – would have collisions that are evidenced in irregularities in the atomic clock signals,' Benjamin Roberts, postdoctoral associate and lead author for the Nature paper, said...."

[15] *Astrophysicists turn GPS constellation into giant dark matter detector*, MIT Technology Review, 4 May 2017.

"...Enter Roberts and co. They start with a different vision of what dark matter may consist of. Instead of small particles, another option is that dark matter may take the form of topological defects in space-time left over from the Big Bang..."

[16] *Hunting dark matter with GPS data*, Adrian Cho, Science, 30 January 2017.

"...Now, Benjamin Roberts and Andrei Derevianko, two physicists at the University of Nevada in Reno, and their colleagues say they have performed the most stringent search yet for topological dark matter, using archival data from the constellation of 31 orbiting GPS satellites..."