

Ryan Bayes

To learn, to grow, to foster growth in others

Email **rbayes@laurentian.ca**
Phone +1 705 920 4985
Address Unit D, 261 Walnut Street, Sudbury, Ontario, Canada

Current position

Postdoctoral Research Associate, Queen's University

Research Focus

Muon decay processes; standard model decay and rare processes
Lepton flavour violation processes and neutrino oscillation physics
Astrophysical neutrino sources
Neutrino-nucleus interactions

Skills

Computer programming	Python, C++, Perl
Statistical analysis	Model testing, Machine Learning
Low background experiment	assembly and methods
Detector calibration	Radio-active and optical sources
Teaching and supervision	Graduate and undergraduate levels
Technical writing	Papers, reports, presentations

Education

Ph.D. in Physics 2006-2010
University of Victoria, Victoria, B.C.

Dissertation: "A precision measurement of the decay parameter ρ and a search for non-Standard Model processes in the muon decay spectrum"

Master's Degree in Physics 2003-2006
University of Victoria, Victoria, B.C.

Thesis: "A Search for Exotic Muon Decays in The TWIST Muon Decay Spectrum"

Bachelor's Degree in Physics (Honours)
Simon Fraser University, Burnaby, B.C.

1999-2003

Academic and Work Experience

Research Associate
Laurentian University

2017-2023

- Calibration working group leader for SNO+;
 - Designed and assembled of hardware for the deployment of SNO+ calibration sources.
 - Planned and executed of calibration runs with optical and radioactive sources in the underground Laboratory[13], [9].
 - Maintained and supported the calibration database.
 - Coordinated effort of international colleagues for the construction of new calibration hardware for the low background detector environment.
 - Organized meetings and workshops for the group.
 - Wrote and maintained deployment procedures and safety documents.
 - Organize and maintain the Deck Clean Room about the SNO+ detector universal interface.
- Astro-particle group convener
 - Planned Supernova system tests
- Co-supervised of undergraduate and graduate students working on SNO+ at Laurentian.
 - Proposed analysis and hardware projects for student
 - Maintain regular meetings with students
 - Provide immediate feedback on student progress
 - Acted as task lead for underground activities
- Contributed to the SNO+ analysis
 - Local analysis coordinator
 - Evaluated low energy backgrounds in scintillator.
 - Determined energy scale from calibration sources in scintillator.
 - Served on the review committees for the SNO+ measurement of neutron capture and anti-neutrino measurements in water.

- Lectures and Tutorials:
 - lecture on neutrino physics for delegates participating in the International Summer School for Young Physicists (2017)
 - Provided relief lectures and tutorials for Christine Kraus and Clarence Virtue.
 - Special tutorials for students preparing for CAP prize exam (2019)

Research Associate
University of Glasgow

2011-2016

- Led the effort to produce the simulation and reconstruction of Magnetized Iron Neutrino Detectors (MIND) for a potential Neutrino factory for the EuroNu collaboration and for the International Design Study for a Neutrino Factory.
 - Wrote the final CP violation analysis and determined the CP violation and mass hierarchy sensitivity for a neutrino factory, demonstrating that to would outperform any other future facility. [37]
- Made a leading contribution to the proposal for a unique neutrino production facility using stored muons (nuSTORM).
 - Led detector feasibility studies for nuSTORM [41].
 - Confirmed world leading capability for the measurement of short baseline neutrino oscillations and wrote paper on the results [35].
- Participating in the seminal measurement of ionization cooling in muons with the Muon Ionization Cooling Experiment (MICE).
 - Led geometry task force for the Muon Ionization Cooling Experiment as a significant contribution to the MICE analysis software [11].
 - Multiple turns as MICE operations manager acting as experimental liaison and overseeing experimental safety during commissioning activities and data collection activities (including commissioning the MICE EMR [29]).
 - Coordinated data collection and analysis for material scattering studies [23].
 - Conducted high level simulations to predict beam dynamics.
- Co-supervised 4th and 5th year undergraduate projects.
- Participated in the organization of International Neutrino Summer School (2014)/70th Scottish Universities Summer School.
- Participated in the organization of the NuFact 2014 Conference.

- Designed and managed software environment for babyMIND prototype project [18]

Graduate Student Researcher
TRIUMF

2004- 2010

- Worked with the "TRIUMF Weak Interaction Symmetry Test" (TWIST) Collaboration
- Conducted a world leading measurement of parameters describing the muon decay product energy spectrum [47]
- Involved in the collection and analysis of TWIST data
- Developed programs for analysis using C++, Python, Perl, and Fortran.
- Led a validation of physics in the GEANT simulation package in the final stage of the analysis, involving characterizing the response of the TWIST detector [45]
- Lead effort understanding the energy calibration of the TWIST experiment for the latter stages of the analysis.
- Run co-ordinator for the TWIST experiment in spring 2005 and summer 2007.
- Designed and conducted a search for exotic muon decay processes; wrote and submitted the paper to PRD[26]
- Coordinated and submitted analyses using the WestGrid computing cluster

Teaching assistant
University of Victoria

2003- 2004

- marked papers for 3rd year course on classical mechanics
- taught 1st year lab course

Professional Affiliation

- Canadian Association of Physicists
- Institute of Particle Physics

References

Christine Kraus, Laurentian University, 935 Ramsey Lake Road, Sudbury, ON, P3E 2C6 Phone: +1 705 675 1151 x4337, email:tine@snolab.ca

Paul Soler, University of Glasgow, University Avenue, Glasgow, Scotland, G12 8QQ Phone: +44 141 330 4153, email:Paul.Soler@glasgow.ac.uk

Journal articles

- [1] Allega, A. et al, “Observation of Antineutrinos from Distant Reactors using Pure Water at SNO+” *Phys.Rev.Lett.* **130** (2023) **9**, 091801 [arXiv:2210.14154](#).
- [2] Bogomilov, M. et al, “Multiple Coulomb Scattering of muons in Lithium Hydride” *Phys.Rev.D* **106** (2022) **9**, 092003 [arXiv:2209.10251](#).
- [3] Allega, A. et al, “Improved search for invisible modes of nucleon decay in water with the SNO+ detector”, *Phys.Rev.D* **105**, 112012 (2022).
- [4] Bogomilov, M. et al, ”Performance of the MICE diagnostic system”.*JINST08 P08046* (2021).
- [5] V. Alabese et al, ”The SNO+ Experiment”. *JINST16 P08059* (2021).
- [6] M. R. Anderson et al.. ”Development, characterisation, and deployment of the SNO+ liquid scintillator”. *JINST16 P05009* (2021)
- [7] M. R. Anderson et al. (The SNO+ Collaboration), ”Measurement of neutron-proton capture in the SNO+ water phase”, *Phys. Rev. C* **102**, 014002 (2020)
- [8] Bogomilov, M., Tsenov, R., Vankova-Kirilova, G. et al. “Demonstration of cooling by the Muon Ionization Cooling Experiment” *Nature* **578**, 53–59 (2020).
- [9] M. Anderson et al., ”Search of invisible modes of nucleon decay in water with the SNO+ detector” *Phys. Rev. D* **99**, 032008 (2019)
- [10] M. Anderson et al., ”Measurement of the ^8B Solar Neutrino Flux in SNO+ with Very Low Backgrounds”, *Phys. Rev. D* **99** 012012 (2018).
- [11] R. Asfandiyarov et al., “MAUS: the MICE analysis user software”, *J. Inst.* **14** T04005 (2019).

- [12] D. Addams et al., “First particle-by-particle measurement of emittance in the Muon Ionization Cooling Experiment” *Eur. Phys. J.* **79** no.3, 257 (2019).
- [13] Y. Liu et al., “Neutron detection in the SNO+ water phase”, [arXiv:1808.07020](https://arxiv.org/abs/1808.07020).
- [14] John Columba Nugent et al., “Recent Results from MICE on Multiple Coulomb Scattering and Energy Loss”, *PoS NuFact2017* 097 (2017).
- [15] Ryan Bayes et al., “Measurement of muon multiple scattering in MICE”, *J.Phys.Conf.Ser* **888** 012212 (2017).
- [16] John Nugent et al., “Recent Results from MICE on Multiple Coulomb Scattering and Energy Loss”, DOI: 10.18429/JACoW-COOL2017-MOA22 (2017).
- [17] D. Adey et al., ”Overview of the Neutrinos from Stored Muons Facility - nuSTORM”, *J. Inst.* **12** P07020 (2017).
- [18] M. Antonova et al., “Baby MIND: A Magnetized Segmented Neutrino Detector for the WAGASCI Experiment”, *J. Inst.* **12** C07028 (2017).
- [19] M. Antonova et al., “Baby MIND Experiment Construction Status”, [arXiv:1704.08917](https://arxiv.org/abs/1704.08917)
- [20] M. Antonova et al., “Baby MIND: A Magnetised Spectrometer for the WAGASCI Experiment”, [arXiv:1704.08079](https://arxiv.org/abs/1704.08079).
- [21] M. Bogomilov et al., “Lattice design and expected performance of the Muon Ionization Cooling Experiment demonstration of ionization cooling”, [arXiv:1701.06403](https://arxiv.org/abs/1701.06403).
- [22] M. Antonova et al., “The Baby MIND spectrometer for the J-PARC T59(WAGASCI) experiment”, *PoS EPS-HEP2017* 508 (2017).
- [23] R. Bayes et al., ”Measurements of the Multiple Coulomb Scattering of Muons by MICE”, *Conference:* C16-08-21.
- [24] M. Bogomilov et al., ”Pion Contamination in the MICE Muon Beam”, *J. Inst.* **11** P03001 (2016).
- [25] R. Bayes, ”MIND at Neutrino Factories”, *PoS NuFACT2014*, 044 (2015).
- [26] R. Bayes et al., ”A search for two body muon decay signals”, *Phys. Rev. D*, **91**, 052020 (2015).
- [27] R. Bayes et al., ”The Physics Programme of MICE Step IV”, *PoS NU-FACT2014* (2015) 065

- [28] R. Asfandiyarov et al., "Proposal for SPS beam time for the baby MIND and TAsD neutrino detector prototypes", [arXiv:1405.6089](#).
- [29] D. Adams et al., "Electron-Muon Ranger: performance in the MICE Muon Beam", *J. Inst.* **10** P12012 (2015).
- [30] R. Bayes et al., "Towards Revised Step IV MICE Optics in the Absence of M1 SSD", *MICE-NOTE-475*, *FERMILAB-FN-1005-APC*.
- [31] D. Adey et al., "nuSTORM and A Path to a Muon Collider", *Ann. Rev. Nucl. Part. Sci.*, **65**, 145-175 (2015).
- [32] R. Bayes, "MIND at Neutrino Factories", *PoS Nufact2014* 044 (2015).
- [33] M. Bogomilov et al., "Neutrino Factory", *Phys.Rev.ST Accel.Beams* **17**, 121002 (2014).
- [34] I. DeBonis et al., "LBNO-DEMO: Large-scale neutrino detector demonstrators for phased performance assessment in view of a long-baseline oscillation experiment", [arXiv:1409.4405](#).
- [35] D. Adey et al., "Light sterile neutrino sensitivity at the nuSTORM facility", *Physical Review D* **89**, 071301 (2014).
- [36] R. Bayes et al., "Status of a MIND type neutrino factory far detector", *J.Phys.Conf.Ser.* **408**, 012075 (2013).
- [37] A. Bross et al., "Toroidal magnetized iron neutrino detector for a neutrino factory", *Physical Review ST Accel. Beams* **16**, 081002 (2013).
- [38] T.R. Edgecock et al., "High intensity neutrino oscillation facilities in Europe", *Physical Review ST Accel. Beams* **16**, 021002 (2013)
- [39] R. Bayes, "The final measurements of the muon decay parameters from the TWIST experiment", *J.Phys.Conf.Ser.* **408**, 012071 (2013).
- [40] D. Adey et al., "nuSTORM - Neutrinos from STORed Muons: Proposal to the Fermilab PAC", [arXiv:1308.6822](#), Report Number: Fermilab-proposal-1028
- [41] D. Adey et al., "Neutrinos from Stored Muons nuSTORM: Expression of Interest", [arXiv:1305.1419](#), Report Number: CERN-SPSC-2013-015.
- [42] R. Bayes et al., "The Golden Channel at a Neutrino Factory revisited: improved sensitivities from a Magnetized Iron neutrino Detector", *Physical Review D* **86**, 093015 (2012).

- [43] D. Adams et al., "Characterisation of the muon beams for Muon Ionization Cooling Experiment", *Eur. Phys. J. C* **73**, 2582 (2012).
 - [44] P. Kyberd et al., "nuSTORM - Neutrinos from STORed Muons: Letter of Intent to the Fermilab Physics Advisory Committee", [arXiv:1206.0294](https://arxiv.org/abs/1206.0294).
 - [45] A. Hillairet et al., "Precision muon decay measurements and improved constraints on the weak interaction", *Physical Review D* **85**, 092013 (2012).
 - [46] J. Bueno et al., "Precise measurement of parity violation in polarized muon decay", *Physical Review D* **84**, 032005 (2011).
 - [47] R. Bayes et al., "Experimental Constraints for the Standard Model from Muon Decay", *Physical Review Letters* **106**, 041804 (2010).
 - [48] A. Grossheim et al., "Decay of negative muons bound in Al-27", *Phys.Rev. D* **80** 052012 (2009)
 - [49] R.P. MacDonald et al., "Precision measurement of the muon decay parameters rho and delta", *Physical Review D* **78** 032010 (2008).
 - [50] B. Jamieson et al., "Measurement of Pmuxi in Polarized Muon Decay", *Physical Review D* **74**, 072007 (2006).
 - [51] A. Gaponenko et al., "Measurement of the Muon Decay Parameter delta", *Physical Review D* **71** 071101 (2005).
 - [52] J.R. Musser et al., "Measurement of the Muon Decay Parameter rho in Muon Decay", *Physical Review Letters* **94**, 101805 (2005).
-