Curriculum Vitae

Vincent MacKay, PhD Candidate, University of Toronto
Citizenship: Canadian
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Research interests

I develop **instrumentation** for long wavelength radio observatories, specializing in mutual coupling mitigation in close-packed array. I devise **data analysis** methods for removing foregrounds from cosmological data. The scientific goals that motivate my work are **21 cm intensity mapping**, and detection of **fast radio bursts (FRBs)**.

Education

PhD, Physics (expected graduation: summer 2023) — *2019–present*
University of Toronto, Toronto
Supervisor: Professor Keith Vanderlinde

MSc, Physics (one year, fast-tracked) — *2018-2019*
University of Toronto, Toronto
Supervisor: Professor Keith Vanderlinde

BSc, First-Class Honours, Mathematics and Physics — *2015-2018*
McGill University, Montréal

BMus, Piano performance — *2012-2015*
Conservatoire de musique de Québec, Québec City

Research experience

Graduate research in Physics — *2018–present*
Designing, manufacturing, and testing ultra wideband feeds and receiving systems
Simulating dishes and arrays to model and mitigate mutual coupling
Leading the team in charge of deploying the analog instrumentation for CHORD prototypes
Analyzing large radio interferometric data products from the CHIME telescope
University of Toronto, Toronto

Undergraduate research in Physics and Physiology — *2017–2019*
Modeling re-entry in cardiac tissue and other nonlinear patterns in excitable media
McGill University, Montréal

Undergraduate research in Physics — *Summer 2017*
Simulating high energy *pp* collisions to compare graviton models against data from the LHC
University of Alberta, Edmonton

Undergraduate research in Physics — *Summer 2016*
Developing a low-cost Compton imaging device for locating sources of gamma rays
McGill University, Montréal

Competitive scholarships and awards

Ontario Graduate Scholarship — *2020–2021*
CAD $15,000.00

University of Alberta Undergraduate Summer Research Award — *Summer 2017*
CAD $8,000.00

NSERC Undergraduate Summer Research Award — *Summer 2016*
CAD $4,500.00

FRQNT Supplement to NSERC — *Summer 2016*
CAD $2,000.00

Publications

As (co-)lead author

1. Vincent MacKay, Mark Lai, et al. Low-cost, Low-loss, Ultra-wideband Miniaturized Feed for Modern Interferometric Radio Telescopes. Submitted to the *Journal of Astronomical Instrumentation*, 2022 arXiv:2210.07477

   PhD work

2. Eric N. Cytrynbaum, Vincent MacKay, et al. Double-wave reentry in excitable media. *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 29(7):073103, 2019

   Undergraduate work

As contributing author

3. Devin Crichton, Moumita Aich, et al. Hydrogen Intensity and Real-Time Analysis Experiment: 256-element array status and overview. *Journal of Astronomical Telescopes, Instruments, and Systems*, 8(1):011019, 2022

   PhD work

4. Benjamin R. B. Saliwanchik, Aaron Ewall-Wice, et al. Mechanical and optical design of the HIRAX radio telescope. In Heather K. Marshall, Jason Spyromilio, et al., editors, *Ground-based and Airborne Telescopes VIII*, volume 11445, page 114455O. International Society for Optics and Photonics, SPIE, 2021

   PhD work

Talks

Conference talks

1. National Radio Science Meeting *Boulder, CO, USA, 2023*

   "An Ultra-Wideband, Low-Loss, Low-Cost Feed Design for Large-N, Small-D Observatories, and Implementation on CHORD"

2. URSI Atlantic Radio Science Meeting *Gran Canaria, Spain, 2022*

   "Hardware Design and Array Layout for CHORD: the Canadian Hydrogen Observatory and Radio-transient Detector"

3. National Radio Science Meeting *Boulder, CO, USA (online), 2022*

   "Design Considerations for CHORD: the Canadian Hydrogen Observatory and Radio-transient Detector"

4. Science at Low Frequencies Conference *Fully online conference, 2020*

   "The Canadian Hydrogen Observatory and Radio-transient Detector (CHORD): Feed and Dish Design and Trade-offs"

5. IEEE AP-S/URSI Conference *Montréal, Canada (online), 2020*

   "A Miniaturized Ultra-Wideband, Low-Loss, Low-Cost Feed for Astrophysics"

6. Society for Mathematical Biology Annual Meeting *Montréal, Canada, 2019*

   "Double-wave Reentry in Excitable Media"

Colloquium and seminar talks

6. Astronomy and Space Physics Seminar, Kansas University *Lawrence, KS, USA (online), 2021*

   "Cosmology and Detection of Radio Transients with CHORD: Science Goals and Design Considerations"

7. Summer colloquium, Department of Physics, University of Toronto *Toronto, Canada (online), 2020*

   "Development of CHORD: the Canadian Hydrogen Observatory and Radio-transient Detector"

Outreach talks

8. Astronomy on Tap NYC: Cosmic Happy Hour *New York, NY, USA (online), 2022*

   "The Hubble Tension: A Crisis of Cosmic Proportions"

9. Cosmos From Your Couch *Toronto, Canada (online), 2020*

   "Peeking into the Invisible Universe with Radio Astronomy"

Teaching

Teaching Assistant, University of Toronto

PHY293: Waves and Modern Physics — *Fall 2020, Fall 2022*
Grading exams

PHY250: Electricity and Magnetism — *Summer 2022*
Preparing and leading tutorials

PHY294: Quantum and Thermal Physics — *Winter 2022*
Preparing and leading tutorials, grading exams

PHY151: Foundations of Physics I — *Fall 2018, Fall 2021*
Leading practical activities, grading assignments and exams

PHY205: The Physics of Everyday Life — *Summer 2021*
Preparing and leading tutorials, grading assignments and projects

PHY491/1491: Current Interpretations of Quantum Mechanics — *Winter 2021*
Grading assignments

PHY207: The Physics of Music — *Winter 2020, Winter 2021*
Preparing and leading tutorials, grading assignments and projects

PHY100: The Magic of Physics — *Fall 2019*
Preparing and leading tutorials, grading assignments and projects, and finals

PHY132: Introduction to Physics II — *Winter 2019*
Leading practical activities, grading assignments and exams

Community involvement

Advisor for the Physics Directed Reading Program
- Elaborating a reading list and schedule on advanced topics in physics for two undergraduate students (topic chosen: observational cosmology)
- Meeting with the students at least ten times during the 2022-23 school year to discuss the readings and solidify their understanding
- Guiding the students through small coding projects, and setting up a poster presentation

Member of the organizing committee for the 2021 Dunlap Instrumentation Lectures
- Helping organize a week-long virtual lecture series with invited speakers and visiting student researchers
- Organizing and leading a coding and data analysis workshop for visiting scholars, called *Radio signal detection and the properties of thermal radiation and noise*

Judge at young scientist competitions
- 2021 Canada-Wide Science Fair (CWSF)
- 2021 Canadian Undergraduate Physics Conference (CUPC)

President of the Physics Graduate Student Association 2019-2020
- Organizing social activities for physics graduate students, representing them at the graduate student union

Other volunteering activities
- Leading lab tours for University of Toronto's AstroTours
- Representing the Dunlap Institute at the 2022 Black Excellence in STEM and Medicine (BE-STEMM) conference career fair
- Discussing with grade school students on video calls as part of the *Skype a Scientist* program