Maxwell A. Fine

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Education

University of Amsterdam Sept 2023 – June 2025

Master of Science in Astronomy & Astrophysics

University of Toronto Sept 2018 – May 2023

Honours Bachelor of Science (HBSc) in Physics & Astrophysics

Research Interests

Fast Radio Bursts (FRBs), the Search for Extraterrestrial Intelligence (SETI), astrophysical transients, radio astronomy, pulsars, multi-messenger astronomy, radio interferometry, observational cosmology, scintillation, radio polarization & cosmic magnetism, techniques, surveys, algorithms, machine learning & data science in astronomy.

Technical Skills

I am highly skilled in `Python`, `Linux`, and experienced using packages such as `Astropy`, `Fetch`, `HEAsoft`, `Matplotlib`, `Numpy`, `Pandas`, `Presto`, `Pytorch`, `RM-TOOLS`, `Scikit-Learn`, `Scipy`, `TensorFlow`, and `Xspec`. I am skilled in data analysis, Bayesian analysis, time-series analysis, algorithm development, Convolutional Neural Networks (CNNs), GPU computing (`CUDA`), Fourier analysis, signal processing, machine learning, deep learning, big data (Tb Scale), `Git`, `Bash`, `Docker`, cloud computing (AWS, GCP), and scientific computing. Additionally, I have experience with `RaspberryPi` projects, and moderate experience in `C++`, `Julia`, `SQL`, `Kubernetes`, and High-Performance Computing (HPC) environments.

Publications

Maxwell A. Fine, Cameron L. Van Eck, & Luke Pratley. (2023). "Correcting Bandwidth Depolarization by Extreme Faraday Rotation." *Monthly Notices of the Royal Astronomical Society*. ArXiv link.

Awards

John Pounder Prize in Astronomy (3rd Year), University of Toronto Fall 2021

- Awarded to a full-time student entering the third year of a physical sciences program for having the highest grades in second-year astronomy courses ($200).

Undergraduate Student Research Award (USRA), Canadian Institute for Theoretical Astrophysics Spring 2021

- Awarded to support my second undergraduate research fellowship ($6,000).

Student Excellence and Leadership Award, University of Toronto July 2020

- Awarded by the Department of Physical & Environmental Sciences (DPES) for academic excellence and community leadership. Recognized as a 'role model student', awarded to no more than one physics student per year ($250).

John Pounder Prize in Astronomy (2nd Year), University of Toronto Fall 2019

- Awarded to a full-time student entering the second year of a physical sciences program for having the highest grades in first-year astronomy courses ($300).

Research Experience

Deciphering the Local Environments of Repeating Fast Radio Bursts Using Scintillation Sept 2024 – Present

University of Amsterdam

Master's Thesis; Advisors: Prof. Ziggy Pleunis & Prof. Jason Hessels

- Using scintillation to study the local environments of repeating FRBs detected by CHIME, focusing on emission size regions of repeating FRBs.
- Investigating potential time variations in scintillation, which could provide insights into local environments, such as orbital periods.

Real-Time Detection Pipeline for Repeating Fast Radio Bursts Using the Dwingeloo Radio Telescope (DRT) June 2024 – August 2024
Summer Graduate Student Research Fellow; Advisors: Dr. Tammo Jan Dijkema & Prof. Jason Hessels *Astron & JIVE*

- Operated the 25m Dwingeloo Radio Telescope (DRT), and developed a real-time detection pipeline for repeating FRBs in `Python` based on `Fetch` and `Presto`.
- Achieved data processing rates of ∼1 Gb/s. Detected a burst from FRB20240619D, showcasing the telescope's scientific capabilities. See the GitHub repository for this project.

Multi-wavelength search for Fast Radio Bursts with Swift/BAT May 2022 – April 2023
AST425 Undergraduate Thesis; Supervisors: Dr. Ziggy Pleunis, Dr. Paul Scholz, & Prof. Bryan Gaensler *University of Toronto*

- Started as a Summer Undergraduate Research Fellowship project.
- Conducted a search for X-ray, and gamma-ray counterparts from CHIME/FRBs using Swift/BAT and GUANO,
- Developed data pipelines and gained experience with multi-messenger astronomy using `HEAsoft`, and `XSPEC` for fluence modeling.

Gravitational Waves from Magnetar Giant Flares Dec 2021 – April 2022
PHYD01 Undergraduate Thesis; Advisors: Dr. Sarah Gossan & Prof. Bryan Gaensler *University of Toronto*

- Investigated the detectability of gravitational wave emission from magnetar giant flares using next-generation ground-based detectors.
- Modeled toy gravitational waves and analyzed theoretical telescope sensitivity curves.

Developing Robust Error Analysis for Radio Polarization Surveys May 2021 – August 2021
Summer Undergraduate Research Fellow; Advisor: Dr. Cameron L. Van Eck *University of Toronto*

- Tested one of the error analysis pipelines for the Polarization Sky Survey of the Universe's Magnetism (POSSUM) using the `RM-Tools` package.
- Identified and implemented a correction for an underestimated error in the analysis pipeline.

Hunting for Radio Sources in Extreme Magnetized Environments May 2020 – August 2020
Summer Undergraduate Research Fellow; Advisor: Dr. Cameron L. Van Eck *University of Toronto*

- Developed an improvement to the Rotation Measure (RM) synthesis algorithm in `RM-Tools` for cases with extreme bandwidth depolarization.
- Implemented a bandwidth depolarization version into the open-source package `RM-Tools`, and a published paper. See the RM-Tools GitHub repository.
- Work led to my first-author paper published in *Monthly Notices of the Royal Astronomical Society*. See the paper on ArXiv.

Invited Talks

Invited speaker, St. Johns River State College, Florida — Guest Lecture Nov 2024

Expert panelist, Anti-Defamation League (ADL), New York — Discussion on antisemitism, anti-racism, and community resilience Oct 2022

Conferences and Workshops Attended

Scintillometry Workshop 2024 (University of Central Florida) Oct 2024

Fast Radio Burst follow-up workshop (University of Toronto) April 2023

Teaching Experience

Teaching Assistant (TA), University of Toronto

PHYA10: Introduction to Physics I for the Physical Sciences Fall 2021, Fall 2020
PHYA22: Introduction to Physics II for the Life Sciences Winter 2021
PHYA11: Introduction to Physics I for the Life Sciences Fall 2020

- Led weekly 2-hour practical sessions for ∼10-15 students.
- Marked assignments and exams.

Facilitated Study Group (FSG) Leader, University of Toronto
UofT PHYA10: Introduction to Physics I for the Physical Sciences — Fall 2020, Fall 2019
UofT PHYA21: Introduction to Physics II for the Physical Sciences — Winter 2020

- Led & organized review sessions for midterms and finals.
- Ran weekly 3-hour review sessions for ∼10-15 students.
- Created practice problem sets for the review sessions, and attended lectures.

Community Engagement

Executive & Co-founder, University of Toronto Amateur Astronomy Society (UTAAS) 2022–2023
As a co-founder and executive member of UTAAS, helped organize outreach activities, including a field trip to observe the Perseid meteor shower and regular "sidewalk" astronomy telescope viewings in downtown Toronto. For more information, visit the UTAAS Instagram.

UofT Scarborough Campus Student Union: Director for Physics 2021–2022
Attended monthly Student Union meetings and helped plan student-led initiatives, including the Fall 2020 Climate Strike. Served as a liaison between the student union and the department association and helped organize the university's "frosh" week.

UofT Environmental & Physical Sciences Student Association: Director for Physics & Astrophysics
2018–2020
Responsible for organizing and programming events, including the "Mix and Mingle" for physics, and astronomy students, and operating the Physics Study Center. Participated in various outreach events aimed at raising awareness of environmental and physical sciences.

Volunteering

Volunteer: 25m Dwingeloo Radio Telescope (DRT) Summer 2024
Led public tours and demonstrations of the 25m radio telescope, engaging small groups of 3-5 people. Provided an overview of the history of radio astronomy and led observations of the 21cm H line and a pulsar. For more information, visit the Dwingeloo Radio Telescope website.

Volunteer: Age of the Universe Summer 2023
Assisted in creating a `Jupyter-notebook` to explain the Cosmic Microwave Background (CMB) for a high school astronomy workshop in Toronto. The workshop, organized by Dr. Simran Nerval, aimed to teach students about the age of the universe. See the Age-of-The-Universe workshop.

Dunlap Institute: Astrotours Volunteer 2022–2023
Volunteered at the Dunlap Institute's monthly public outreach events, where I answered questions from the public and operated small optical telescopes for viewing.

Dunlap Institute: Earth Hour Volunteer Winter 2019
Volunteered at the Dunlap Institute's Earth Hour event, where I stood by a giant inflatable moon and gave presentations on the formation of the Moon and the sites of moon landings.

UofT Physics Tutor 2019–2022
Volunteered as a tutor at the Physics Study Centre, offering free tutoring for first- and second-year physics and astronomy classes.