

Maxwell A. Fine
max.fine@student.uva.nl
Amsterdam, Noord Holland
The Netherlands

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Greetings Members of the Northwestern PhD Admissions Committee,

I am currently pursuing a master's degree in astronomy at the University of Amsterdam to prepare myself to excel in Northwestern's PhD program. My research is focused on Fast Radio Bursts (FRBs). My research is focused on Fast Radio Bursts (FRBs). Northwestern's PhD program offers a unique opportunity to continue this work under the guidance of Professor Wen-fai Fong. I completed my undergraduate degree in physics & astrophysics at the University of Toronto, where I received the John Pounder Prize twice for achieving the highest grades in first- and second-year astronomy courses. During my undergraduate studies, I gained extensive teaching, and research experience, culminating in a [first-author publication](#). I have a strong passion for radio astronomy, particularly FRBs, and I am excited by their potential to reveal new insights about the cosmos. My research interests also include transients, multi-wavelength astronomy, time-domain astrophysics, radio polarization, cosmic magnetism, scintillation, observational cosmology, hydrogen mapping, techniques, surveys, algorithms, instrumentation, and data science in astronomy.

For my masters thesis, I am working with Professor Ziggy Pleunis and Professor Jason Hessels, on exploring the time-variability of scintillation in repeating FRBs detected by [CHIME](#). This is a promising technique for constraining FRB emission models, and identifying potential orbital periods of their sources. In November, I presented the interim results of my thesis to Professor Masui's research group at the Massachusetts Institute of Technology (MIT). This past summer, I worked as a summer research fellow at Astron in the Netherlands using the historic [25m Dwingeloo Radio Telescope \(DRT\)](#). The DRT was the largest radio telescope in the world when it was built in 1956, and is now a museum, and national monument in the Netherlands. I worked closely with Dr. Tammo Jan Dijkema, and Professor Jason Hessels on this project, where I operated the DRT and developed a real-time detection pipeline in [Python](#) for repeating FRBs using [Presto](#) and [Fetch](#). The pipeline processes data at a rate of ~ 1 Gb/s. A highlight of the project was [detecting a burst from FRB20240619D](#). These results will contribute to an upcoming publication, and the DRT will be utilized in future FRB observation campaigns. I am excited to continue similar research at Northwestern.

During my undergraduate studies at the University of Toronto, I worked on four research projects and completed two theses by special request. I was awarded a competitive summer research fellowship three years in a row. For my second thesis, I searched for γ -ray counterparts to FRBs detected by CHIME using [Swift/BAT](#) data. Working with Dr. Paul Scholz and Dr. Ziggy Pleunis, I developed a pipeline to analyze archival Swift/BAT data, producing lightcurves and images. While some parts of the script utilized functions from [HEASoft](#) - the specialized software for Swift/BAT, I had to implement several components myself, as the software was not designed for my applications. My fluence limits agreed with the literature values. Additionally, I completed two fellowships that focused on rotation measure (RM) synthesis, a key technique for studying cosmic magnetism through Faraday Rotation. Working with Dr. Cameron Van Eck, and Professor Bryan Gaensler, I developed a new RM synthesis algorithm for cases of extreme bandwidth depolarization - where the classical algorithm begins to break down. The results have been integrated into the [RM-Tools Python](#) package, and culminated in my [first-author publication](#) in the Monthly Notices of the Royal Astronomical Society. These experiences solidified my passion for astronomy research.

Beyond academics, I am involved in community engagement. At the University of Toronto, I represented the physics department on the student union, managed a free physics tutoring center, and led facilitated study groups for first-year physics courses. I also organized outreach events, including a field trip for the Perseid meteor shower, and sidewalk telescope viewings. I am eager to continue similar outreach initiatives at Northwestern.

Northwestern's PhD program offers an unparalleled opportunity to continue my research on transients and their host galaxy environments. I am particularly interested in working with Professor Wen-fai Fong's work in unveiling FRB progenitors through the [F4](#), [SAGUARO](#), and CRAFT collaborations. My master's thesis focuses on the local environments and emission properties of repeating FRBs, aligning well with the group's approach of using host galaxy characteristics to infer progenitor properties. Additionally, I am excited by the SAGUARO collaboration's efforts to track electromagnetic counterparts to gravitational wave sources, which bridges my passion for transient astronomy, and multi-messenger astronomy. I am confident that I will make meaningful contributions to Professor Wen-fai Fong's group, while honing my skills in astronomy, growing into a professional astronomer, and addressing fundamental questions about the universe.

Looking forward, I aspire to become a professional astronomer, either as a research professor or in a national lab. Pursuing a PhD is not just a means to an end but a worthwhile journey in itself. I am eager to see where this path takes me, and I am confident that Northwestern is the right place to continue this journey. Thank you for considering my application.

Astronomy is looking up!

Maxwell A. Fine

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