Matthew C. H. Leung

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Education

Harvard University

Doctor of Philosophy (Ph.D.) in Astronomy and Astrophysics, GPA: 4.0/4.0 — 2023 – Present

Master of Arts (A.M.) in Astronomy and Astrophysics, GPA: 4.0/4.0 — 2023 – 2025

- Research Project: "Novel High Resolution Spectrograph for the Helium 10830Å Absorption Line", supervised by Prof. David Charbonneau and Dr. Andrew Szentgyorgyi

University of Toronto

Bachelor of Applied Science (B.A.Sc.) in Engineering Science, GPA: 3.90/4.00, High Honours — 2018 – 2023

- Engineering Physics Specialization, Minor in Artificial Intelligence Engineering
- Bachelor's Thesis: "Light Curve Analysis of a Young Type II-L Supernova from the KMTNet Supernova Program", supervised by Prof. Dae-Sik Moon
- Completed a co-op/gap year internship at the Harvard-Smithsonian Center for Astrophysics

Publications

7 total publications: 4 first author, 1 second author

[7] **Leung, M. C. H.**, Charbonneau, D., Szentgyorgyi, A., [and 7 others], "VIPER: A high-resolution multimode fiber-fed VIPA spectrograph concept for characterizing exoplanet atmospheric escape," in *Techniques and Instrumentation for Detection of Exoplanets XII*, Proc. SPIE 13627 (2025)

[6] **Leung, M. C. H.**, Jurgenson, C., Szentgyorgyi, A., [and 7 others], "Crank-rocker optical fiber mode scrambler prototype for the GMT-Consortium Large Earth Finder (G-CLEF)," in *Techniques and Instrumentation for Detection of Exoplanets XII*, Proc. SPIE 13627 (2025)

[5] **Leung, M. C. H.**, Jurgenson, C. A., Szentgyorgyi, A., [and 10 others], "Off-axis Hartmann wavefront sensing for the GMT-Consortium Large Earth Finder (G-CLEF) red camera optics," in *Ground-based and Airborne Instrumentation for Astronomy X*, Proc. SPIE 13096, 130964M (2024), DOI: 10.1117/12.3018467

[4] Szentgyorgyi, A., Ben-Ami S., Oh, J. S., [and 49 others, including **Leung, M.**], "Innovations in the design and construction of the GMT-Consortium Large Earth Finder (G-CLEF), a first-light instrument for the Giant Magellan Telescope (GMT)," in *Ground-based and Airborne Instrumentation for Astronomy X*, Proc. SPIE 13096, 130960Z (2024), DOI: 10.1117/12.3018439

[3] Jurgenson, C., Szentgyorgyi, A., Mueller, M. [and 7 others, including **Leung, M.**], "Assembly, integration, and verification of the GMT-Consortium Large Earth Finder (G-CLEF) red channel camera optics," in *Ground-based and Airborne Instrumentation for Astronomy X*, Proc. SPIE 13096, 130964P (2024), DOI: 10.1117/12.3020389

[2] **Leung, M. C. H.**, Chen, S., and Jurgenson, C., "Accurately measuring hyperspectral imaging distortion in grating spectrographs using a clustering algorithm," in *Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation V*, Proc. SPIE 12188, 121883W (2022), DOI: 10.1117/12.2630442

[1] Chen, S., **Leung, M. C. H.**, Yao, X., Sivanandam, S., Sanders, I., and Liang, R., "Optical design and wavelength calibration of a DMD-based multi-object spectrograph," in *Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation V*, Proc. SPIE 12188, 1218856 (2022), DOI: 10.1117/12.2630372

Research Experience

Harvard-Smithsonian Center for Astrophysics
September 2023 – Present
Graduate Research Assistant
Cambridge, MA, USA

- Working with **Prof. David Charbonneau** and **Dr. Andrew Szentgyorgyi** on a new near-infrared high resolution spectrograph concept for characterizing exoplanet atmospheres
- Also involved with **G-CLEF**, a high resolution first-light spectrograph for the **Giant Magellan Telescope**; **Published 4 papers** (2 first author) in SPIE conferences

Harvard-Smithsonian Center for Astrophysics
September 2021 – June 2022
Research Intern, Optical and Infrared Astronomy Division
Cambridge, MA, USA

- Worked with **Dr. Andrew Szentgyorgyi** and **Dr. Colby Jurgenson** on **G-CLEF**
- Designed and created a prototype **optical fiber mode scrambler** for G-CLEF, and an optical fiber testing setup for fiber near field and far field imaging and focal ratio degradation measurement
- Designed and analyzed optical systems in **Zemax OpticStudio**; wrote custom image analysis software in **Python**

University of Toronto
May 2021 – April 2022
Research Assistant, Department of Astronomy and Astrophysics
Toronto, ON, Canada

- Worked with **Prof. Dae-Sik Moon** to investigate a **young Type II-L supernova** (SN)
- Analyzed a large dataset (>230GB) of images from the KMTNet Supernova Program, using **Python** to construct multi-band light curves of the SN; performed image subtraction, PSF photometry, and filtering of light curves
- Fitted **analytic models** to SN light curves in order to estimate the SN's **physical parameters** and to infer the **physical processes** behind the light curve's rise (e.g. radioactive decay and shock cooling emission)

University of Toronto
May 2020 – August 2022
Research Assistant, Dunlap Institute for Astronomy and Astrophysics
Toronto, ON, Canada

- Worked with **Dr. Shaojie Chen** in **Prof. Suresh Sivanandam**'s research group on a multi-object spectrograph (MOS) which uses a **digital micromirror device (DMD)** as a programmable slit
- Created a **novel clustering algorithm** for hyperspectral imaging distortion correction in astronomical spectra; **Published 2 papers** (1 first author, 1 second author) in SPIE Astronomical Telescopes + Instrumentation 2022
- Used **MATLAB ZOS-API** to generate simulated ray tracing data in **Zemax OpticStudio** for the DMD-based MOS; analyzed data in **Python**

National University of Singapore
May 2019 – August 2019
Research Assistant, Department of Electrical and Computer Engineering
Singapore

- Worked with **Prof. Ghim Wei Ho** in a multidisciplinary nanophotonics laboratory to investigate surface plasmon resonance in **photocatalytic hydrogen generation** and **solar reflective nanofilms**
- Experimented with different reactants to synthesize TiO_2/Ag nanofibers by electrospinning; wrote Python code to interface with an ADC; worked safely with high voltages (>17.5 kV) and hazardous substances

Selected Awards

- **NSERC** Canada Graduate Scholarship (converted to PGS-D) ($120,000) 2025
- **NASA Academy Alumni Association** Dr. Gerald A. Soffen Memorial Fund Grant ($500) 2024
- **U of T Division of Engineering Science** Award of Excellence 2023
- **U of T Department of Astronomy and Astrophysics** SURP Research Fellowship ($9,595) 2021
- **U of T Engineering Competition** 2nd Place, Programming Category 2021
- **IEEE (Institute of Electrical and Electronics Engineers)** Toronto Scholarship ($2,000) 2020
- **U of T Dunlap Institute for Astronomy and Astrophysics** SURP Research Fellowship ($9,500) 2020
- **Hack The 6ix 2020** Major League Hacking Best Use of Google Cloud Prize 2020
- **Society of Petroleum Engineers** Canadian Educational Foundation Scholarship Award ($2,500) 2020

- **Electro-Federation Canada** Scholarship Award ($1,000) 2019
- **U of T / National University of Singapore** ESROP Global Research Fellowship ($4,000) 2019
- **U of T** Bennett Scholar ($10,000) 2018
- **U of T Faculty of Applied Science and Engineering** Admission Scholarship ($5,000) 2018
- **TC Energy / TransCanada** Community Leaders Scholarship ($1,000) 2018

Selected Posters

- "VIPER: A high-resolution multimode fiber-fed VIPA spectrograph concept for characterizing exoplanet atmospheric escape" August 2025
  SPIE Optics + Photonics 2025 San Diego, CA, USA
- "The GMT-Consortium Large Earth Finder (G-CLEF) at the Magellan Clay Telescope" July 2024
  Two HoRSEs: High-Resolution Exoplanet and Stellar Characterization Today and in the ELT Era Berlin, Germany
- "Off-axis Hartmann wavefront sensing for the GMT-Consortium Large Earth Finder (G-CLEF) red camera optics" June 2024
  SPIE Astronomical Telescopes + Instrumentation 2024 Yokohama, Japan
- "Accurately Measuring Hyperspectral Imaging Distortion in Grating Spectrographs Using a Clustering Algorithm" July 2022
  SPIE Astronomical Telescopes + Instrumentation 2022 Montréal, Canada
- "Light Curve Analysis of a Young Type II-L Supernova KSP-ZN7090" August 2021
  University of Toronto Astronomy and Astrophysics SURP 2021 Poster Symposium Toronto, Canada
- "DMD-Based Multi-Object Spectrograph Design and Wavelength Calibration" September 2020
  Royal Astronomical Society Early Career Poster Exhibition Remote

Summer Schools

European Adaptive Optics Summer School 2023 June 2023
Newcastle Univ., Durham Univ., Univ. of Manchester, Univ. of Oxford, Institut d'Optique, and others Remote

- Attended a week-long summer school about **adaptive optics (AO)**, covering wavefront measurement, wavefront correction, control systems, AO systems design, and AO simulations and algorithms in Python
- Learned about cutting-edge AO techniques in astronomy, ophthalmology, microscopy, and optical communications

Astromatic 2022 August 2022
University of Montréal Montréal, QC, Canada

- Attended a week-long workshop and hackathon in **machine learning and astrophysics**; completed a project in a team of 3 to estimate cosmological density parameters using CNNs with **PyTorch**; awarded "Judge's Prize"
- 1 of 15 selected attendees out of 120 applicants worldwide

GROWTH Astronomy School 2020 August 2020
California Institute of Technology Remote

- Attended a week-long summer school in **multi-messenger astronomy**; learned about a variety of data analysis techniques and tools (e.g. Astropy, MCMC, SExtractor, DS9) which I ultimately applied to my Bachelor's thesis
- 1 of 85 selected attendees out of 875 applicants worldwide

Teaching

- **Teaching Fellow** for ASTRON 1: The Big Questions of Astronomy, *Harvard University* 2025
  Earned a perfect 5.0/5.0 rating on student course evaluations for Spring 2025 (72% response rate)

Professional Service

- Referee for IEEE Transactions on Instrumentation and Measurement 2025

Extracurricular Activities

NSight Mentorship Program September 2019 – April 2023
Mentor Toronto, ON, Canada

- Mentored freshman Engineering Science students at U of T, helping them transition to university
- Provided my mentees advice in **finding summer research opportunities** (e.g. CVs, statements, cold emailing)

U of T Machine Intelligence Student Team (UTMIST) September 2020 – May 2022
Project Developer Toronto, ON, Canada

- Created custom neural network architectures for Toronto real estate price prediction using **TensorFlow** and **scikit-learn**, achieving **9% MAPE**; used autoencoders, CNNs, MLPs, ensemble methods, and SVR

IEEE University of Toronto Student Branch April 2019 – April 2022
Marketing Managing Director and Advisor Toronto, ON, Canada

- Led a marketing team of 5 students in the largest engineering professional development organization at U of T; designed graphics for **10+ professional development events** and managed social media accounts
- Organized technical workshops and large-scale hackathons backed by major sponsors, most notably **MLH NewHacks 2020**, a 24-hour hackathon with 200+ attendees, for students with no programming experience
- Was awarded the **IEEE Toronto Scholarship** for my academic excellence and community involvement

Extracurricular Courses

- **Laser Safety Training**, *University of Toronto* October 2022
  An 8 hour course in using ANSI Class 3B and Class 4 lasers in research settings
- **Astrophysics XSeries Program**, *Australian National University (through EdX)* December 2020
  A series of 4 courses about modern astrophysics, covering exoplanets, cosmology, compact objects, etc.
- **First Order Optical System Design**, *University of Colorado Boulder (through Coursera)* July 2020
  A course I took to self-learn Zemax OpticStudio and basic optical system design
- **Basic Machining**, *George Brown College* March 2020
  A course in using a lathe, mill, and drill press to cut metal parts; final project: machining a piston

Skills

- **Programming Languages:** Python, C/C++, Java, MATLAB, Verilog
- **Libraries and Frameworks:** NumPy, Pandas, SciPy, scikit-learn, PyTorch, TensorFlow, OpenCV
- **Graphics and Media:** Photoshop, Lightroom, Illustrator, Figma, Vegas Pro, After Effects
- **Engineering Design/Simulation:** Ansys Zemax OpticStudio, Tidy3D FDTD, SketchUp, LTspice, KiCad

Last Updated: August 2025