

# Matthew C. H. Leung

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## EDUCATION

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### 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

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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), DOI: 10.1117/12.3062307
- [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), DOI: 10.1117/12.3063478
- [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

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### Harvard University

September 2023 – Present

Graduate Research Assistant, Department of Astronomy

Cambridge, MA, USA

- Working with **Prof. David Charbonneau** and **Dr. Andrew Szentgyorgyi** on a new near-infrared high-resolution spectrograph called VIPER which will study 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

### Smithsonian Astrophysical Observatory

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  $\text{TiO}_2/\text{Ag}$  nanofibers by electrospinning; wrote Python code to interface with an ADC; worked safely with high voltages (>17.5 kV) and hazardous substances

## SELECTED AWARDS

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|----------------------------------------------------------------------------------------------|------|
| • 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

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- “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

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**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

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- **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).  
Prepared and delivered lectures on exoplanets and dark energy.

## PROFESSIONAL SERVICE

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- Referee for IEEE Transactions on Instrumentation and Measurement

2025

## EXTRACURRICULAR ACTIVITIES

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### 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

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- **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

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- **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: October 2025