

Matthew C. H. Leung

✉ matthewleung310@gmail.com ; matthewchingho.leung@mail.utoronto.ca | 💻 mchleung.com
🆔 orcid.org/0000-0001-5716-6851 | 🔗 linkedin.com/in/matthewchleung | 🐙 github.com/mattleung10

EDUCATION

University of Toronto

2018 – Present

Bachelor of Applied Science (B.A.Sc.) in Engineering Science

Toronto, ON, Canada

- 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

- [3] M. C. H. Leung, S. Chen, and C. Jurgenson, "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
- [2] S. Chen, M. C. H. Leung, X. Yao, S. Sivanandam, I. Sanders, and R. Liang, "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
- [1] M. C. H. Leung, "Light Curve Analysis of a Young Type II-L Supernova from the KMTNet Supernova Program", B.A.Sc. Thesis, University of Toronto (2022)

RESEARCH EXPERIENCE

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**, a precision radial velocity echelle spectrograph which will be the first light instrument for the **Giant Magellan Telescope**
- 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**

- 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

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| • U of T Department of Astronomy and Astrophysics SURP Research Fellowship (\$9,595) | 2021 |
| • U of T Engineering Competition 2nd Place, Programming Category | 2021 |
| • U of T Dunlap Institute for Astronomy and Astrophysics SURP Research Fellowship (\$9,500) | 2020 |
| • IEEE (Institute of Electrical and Electronics Engineers) Toronto Scholarship (\$2,000) | 2020 |
| • Hack The 6ix 2020 Major League Hacking Best Use of Google Cloud Prize | 2020 |
| • Electro-Federation Canada Scholarship Award (\$1,000) | 2019 |
| • U of T Division of Engineering Science 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 |
| • TransCanada Community Leaders Scholarship (\$1,000) | 2018 |

SELECTED POSTERS

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| • “Accurately Measuring Hyperspectral Imaging Distortion in Grating Spectrographs Using a Clustering Algorithm”
<i>SPIE Astronomical Telescopes + Instrumentation 2022</i> | July 2022 |
| • “Optical Design and Wavelength Calibration of a DMD-based Multi-Object Spectrograph”
<i>SPIE Astronomical Telescopes + Instrumentation 2022</i> | July 2022 |
| • “Light Curve Analysis of a Young Type II-L Supernova KSP-ZN7090”
<i>University of Toronto Astronomy and Astrophysics SURP 2021 Poster Symposium</i> | August 2021 |
| • “DMD-Based Multi-Object Spectrograph Design and Wavelength Calibration”
<i>Royal Astronomical Society Early Career Poster Exhibition</i> | September 2020 |

SUMMER SCHOOLS

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| • Astromatic 2022
University of Montréal | August 2022
Montréal, QC, Canada |
| <ul style="list-style-type: none"> • 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
California Institute of Technology | August 2020
Remote |
| <ul style="list-style-type: none"> • 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 | |

EXTRACURRICULAR ACTIVITIES

U of T Machine Intelligence Student Team (UTMIST)

September 2020 – May 2022

Project Developer

Toronto, ON, Canada

- Created a custom neural network architecture for Toronto real estate price prediction using TensorFlow and scikit-learn, achieving 9% MAPE; investigated the use of 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 people in the largest engineering professional development organization at U of T
- Organized technical workshops and large-scale hackathons (e.g. MakeUofT, MLH NewHacks) backed by major sponsors; created graphics for 10+ professional development events and managed social media accounts

NSight Mentorship Program

September 2019 – Present

Mentor

Toronto, ON, Canada

- Mentored freshman Engineering Science students at U of T
- Provided students with advice in transitioning to university and finding summer research opportunities

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
- **Libraries and Frameworks:** NumPy, SciPy, Pandas, OpenCV, PyTorch, TensorFlow, scikit-learn, Astropy
- **Hardware:** Arduino, Raspberry Pi, Verilog
- **Graphics, Media, and Typesetting:** Photoshop, Illustrator, Figma, Inkscape, Vegas Pro, After Effects, L^AT_EX
- **Engineering Design/Simulation Software:** Zemax OpticStudio, SketchUp, LTspice, KiCad