# Chloe M. Cheng

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**PRINCIPAL INTERESTS**

Galaxy formation and evolution, with a particular interest in using spectroscopic techniques to measure elemental abundances and stellar population parameters.

**EDUCATION**

*Doctor of Philosophy* Expected Aug. 2026
Leiden Observatory, Leiden University, Leiden, The Netherlands

- Supervisor: Professor Mariska Kriek.
- Thesis: Unravelling the formation histories of distant quiescent galaxies using ultra-deep spectroscopy.
- Projects:
  - Age & metal gradients in massive quiescent galaxies at $0.6 \lesssim z \lesssim 1.0$ using LEGA-C, 10.1093/mnras/stae1739, arXiv:2407.10974.
  - Understanding the relationship between $UVJ$ colours and ages and metallicities at $0.6 \lesssim z \lesssim 3.0$. In prep.
  - Age & metal gradients in massive quiescent galaxies at $1.0 \lesssim z \lesssim 3.0$ using JWST-SUSPENSE.
  - Measuring the stellar initial mass function in massive early-type galaxies at $z \sim 0.7$ using JWST.

*Master of Science* Oct. 2022
University of Waterloo, Department of Physics & Astronomy/Waterloo Centre for Astrophysics, Waterloo, Ontario, Canada

- Supervisor: Professor Michael L. Balogh.
- Thesis: Testing the extremes of initial mass function variability using compact stellar systems (http://hdl.handle.net/10012/18473, arXiv:2309.14415, 10.1093/mnras/stad2967).
- Cum. GPA: 83.5% / 100%

*Honours Bachelor of Science with Distinction* Jun. 2020
University of Toronto, Faculty of Arts & Science, Trinity College, Toronto, Ontario, Canada

- Astronomy & Physics Specialist, Mathematics Minor
- Supervisor: Professor Jo Bovy.
- Thesis: Testing the chemical homogeneity of chemically-tagged dissolved birth clusters (10.1093/mnras/stab2106).
- Cum. GPA: 3.24 / 4.0

**OTHER RESEARCH EXPERIENCE**

*Research Assistant* May – Aug. 2019
GRIFFIN Collaboration, TRIUMF, Vancouver, BC, Canada

- Supervisor: Dr. Adam B. Garnsworthy
- Project: Probing shape coexistence in $^{192}$Hg through combined electron and $\gamma$-ray spectroscopy (established spin-parity assignments for negative-parity band and $8^-$ state; measured mixing ratio for $8^- \rightarrow 7^-$ transition).
- Hands-on work: re-configuring detectors; re-cabling data acquisition systems; assisting during experimental beam run-time (calibrating and monitoring equipment and experiment, communicating with beam operations staff).

*NSERC USRA/Institute of Medical Science Research Student* May - Aug. 2018
Toronto Western Hospital/Krembil Research Institute, Toronto, ON, Canada

- Supervisor: Dr. Liang Zhang, Department of Fundamental Neurobiology
- Project: Verification of the mouse model for MRI-negative temporal lobe epilepsy (duties detailed below).
- Leadership role - taught, organized, supervised, and managed undergraduate students, International Research Fellows, and Faculty members.

**PUBLICATIONS**

*As First Author*

- **Cheng, C. M.**, Kriek, M., Beverage, A. G., van der Wel, A., Bezanson, R., D'Eugenio, F., Franx, M., Mancera Piña, P. E., Nersesian, A., Slob, M., Suess, K. A., van Dokkum, P. G., Wu, P.-F., Gallazzi, A., & Zibetti, S. "Age and metal gradients in massive quiescent galaxies at $0.6 \lesssim z \lesssim 1.0$: implications for quenching and assembly histories". 2024, MNRAS, 532, 3604, doi: 10.1093/mnras/stae1739. arXiv:2407.10974.
- **Cheng, C. M.**, Villaume, A., Balogh, M., Brodie, J. P., Martín-Navarro, I., Romanowsky, A. J., & van Dokkum P. G. "Initial mass function variability from the integrated light of diverse stellar systems". 2023, MNRAS, 526, 4004, doi: 10.1093/mnras/stad2967. arXiv:2309.14415.
- **Cheng, C. M.**, Price-Jones, N., & Bovy, J. "Testing the chemical homogeneity of chemically tagged dissolved birth clusters". 2021, MNRAS, 506, 5573, doi: 10.1093/mnras/stab2106. arXiv:2010.09721.

*As Co-Author*

- Beverage, A. G., Slob, M., Kriek, M., Conroy, C., Barro, G., Bezanson, R., Brammer, G., **Cheng, C. M.**, et al. "Carbon and Iron Deficiencies in Quiescent Galaxies at $z = 1 - 3$ from JWST-SUSPENSE: Implications for the Formation Histories of Massive Galaxies". 2024, ApJ, submitted. arXiv:2407.02556.
- Slob, M., Kriek, M., Beverage, A. G., Suess, K. A., Barro, G., Bezanson, R., **Cheng, C. M.**, et al. "The JWST-SUSPENSE Ultradeep Spectroscopic Program: Survey Overview and Star-Formation Histories of Quiescent Galaxies at $1 < z < 3$". 2024, ApJ, in press. arXiv:2404.12432.
- Romanowsky, A. J., Larsen, S. S., Villaume, A., Carlin, J., Janz, J., Sand, D., Strader, J., Brodie, J. P., **Cheng, C. M.**, et al. "Low-density star cluster formation: discovery of a young faint fuzzy on the outskirts of the low-mass spiral galaxy NGC 247". 2023, MNRAS, 518, 3164. 10.1093/mnras/stac2898. arXiv:2210.03220.

*Non-Astronomy*

- Rocchini, M., Garrett, P. E., Zielińska, M., Lenzi, S. M., Dao, D. D., Nowacki, F., Bildstein, V., MacLean, A. D., Olaizola, B., Ahmed, Z., Andreoiu, C.,

Babu, A., Ball, G. C., Bhattacharjee, S. S., Bidaman, H., **Cheng, C.**, et al. "First Evidence of Axial Shape Asymmetry and Configuration Coexistence in $^{74}$Zn: Suggestion for a Northern Extension of the $N = 40$ Island of Inversion". 2023, Phys. Rev. Lett., 130, 122502. 10.1103/PhysRevLett.130.122502. arXiv:2302.07394.

- Liu, H., Hameed, A. Z., Chow, J., Sivanenthiran, N., **Cheng, C.**, et al. "EEG features of spontaneous recurrent seizures in a mouse model of extended hippocampal kindling". 2021, Clinph, 132(9), e2, doi: 10.1016/j.clinph.2021.03.028.
- Liu, H., Tufa, U., Zahra, A., Chow, J., Sivanenthiran, N., **Cheng, C.**, et al. "Electrographic Features of Spontaneous Recurrent Seizures in a Mouse Model of Extended Hippocampal Kindling". 2021, TexCom, 2(1), doi: 10.1093/texcom/tgab004.
- MacLean, A. D., Laffoley, A. T., Svensson, C. E., et al, incl. **Cheng, C.**. "High-precision branching ratio measurement and spin assignment implications for $^{62}$Ga superallowed $\beta$ decay". 2020, Phys Rev C, 102(5), doi: 10.1103/physrevc.102.054325. arXiv:2011.03857.
- Liu, H., Stover, K. R., Sivanenthiran, N., Chow, J., **Cheng, C.**, et al. "Impaired Spatial Learning and Memory in Middle-Aged Mice with Kindling-Induced Spontaneous Recurrent Seizures". 2019, Front. Pharmacol., 10, 1077, doi: 10.3389/fphar.2019.01077.
- Song, H., Tufa, U., Chow, J., Sivanenthiran, N., **Cheng, C.**, et al. "Effects of Antiepileptic Drugs on Spontaneous Recurrent Seizures in a Novel Model of Extended Hippocampal Kindling in Mice". 2018, Front. Pharmacol., 9, 451, doi: 10.3389/fphar.2018.00451.

**CONFERENCE CONTRIBUTIONS**

*Invited Talks*

- *APOGEE Monthly Teleconference.* "Testing the chemical homogeneity of chemically-tagged dissolved birth clusters". 10 Nov. 2020.

*Contributed Talks*

- *Observing and Simulating Galaxy Evolution in the Era of JWST.* "New clues to assembly history: Exploring age and metallicity gradients in quiescent galaxies over cosmic time with LEGA-C and JWST". 21 Aug. 2024; Ascona, Switzerland.
- *NOVA NW1 Autumn 2023 Meeting.* "Age and metal gradients in quiescent galaxies over cosmic time with LEGA-C and JWST". 23 Nov. 2023; Leiden, The Netherlands.
- *A Life Devoted to Stellar Populations.* "Age and metal gradients in quiescent galaxies over cosmic time with LEGA-C and JWST". 5 Oct. 2023; Puerto de la Cruz, Tenerife, Canary Islands, Spain.
- *SDSS 2020 Collaboration Meeting Lightning Talks.* "Testing the chemical homogeneity of open clusters". 23 Jun. 2020.
- *TRIUMF Summer Undergraduate Student Symposium.* "Examining internal conversion electrons in $^{192}$Hg". 15 Aug. 2019; TRIUMF, Vancouver, BC, Canada.

*Posters*

- **Cheng, C. M.**, Kriek, M., Beverage, A. G., van der Wel, A., et al. "Age and metal gradients in massive quiescent galaxies at $0.6 \lesssim z \lesssim 1.0$: implications for

quenching and assembly histories". Presented at: *Netherlands Astronomers' Conference (NAC) 2024*; May 2024, Egmond aan Zee, The Netherlands.

- **Cheng, C. M.**, Villaume, A., Balogh, M. L., et al. "Initial mass function variability from the integrated light of diverse stellar systems". Presented at: *A Life Devoted to Stellar Populations*; Oct. 2023, Puerto de la Cruz, Tenerife, Canary Islands, Spain.
- **Cheng, C. M.**, Kriek, M., Beverage, A. G., et al. "Resolving the formation histories of $0.6 < z < 2.5$ galaxies with LEGA-C and JWST". Presented at: *IAU Symposium 377: Early Disk-Galaxy Formation from JWST to the Milky Way*; Feb. 2023; Kuala Lumpur, Malaysia.
- **Cheng, C. M.**, Villaume, A., and Balogh, M. L. "Testing the extremes of initial mass function variability using compact stellar systems". Presented at: *CASCA 2022 Annual General Meeting*; May 2022; Waterloo, ON, Canada.
- **Cheng, C.**, Olaizola, B., Paxman, C., et al. "Probing shape coexistence in $^{192}$Hg through combined electron and $\gamma$-ray spectroscopy". Presented at:
  - *The Canadian Conference for Undergraduate Women in Physics 2020*; 19 Jan. 2020; University of Toronto, Toronto, ON, Canada.
  - *The Department of Physics Undergraduate Research Fair 2019*; 26 Sept. 2019; University of Toronto, Toronto, ON, Canada.
  - *The TRIUMF Users' Group Annual General Meeting Student Poster Slam and Oral Presentation Competition*; 22 Aug. 2019; TRIUMF, Vancouver, BC, Canada.
- **Cheng, C.**, Chow, J., Lim, S., et al. "Verification of the mouse model for MRI-negative temporal lobe epilepsy". Presented at: *50th Annual Institute of Medical Science Summer Undergraduate Research Day*; 15 Aug. 2018; Toronto, ON, Canada.

## AWARDS AND ACHIEVEMENTS

- *Leids Kerkhoven-Bosscha Fonds (LKBF) Grant* (600 EUR), subsidy number 24.1.017, May 2024 - Oct. 2024.
- *Leids Kerkhoven-Bosscha Fonds (LKBF) Grant* (400 EUR), subsidy number 23.2.009, Nov. 2023 - Apr. 2024.
- *IAU Grant* (320 EUR) for Symposium 377: Early Disc-Galaxy Formation from JWST to the Milky Way, Kuala Lumpur, Malaysia, Feb. 6-10, 2023.
- *Science Graduate Award* (8332 CAD), University of Waterloo, 2020-2022.
- *Marie Curie Graduate Award* (4100 CAD), University of Waterloo, 2020-2022.
- *2nd Place*, Department of Physics Undergraduate Research Fair for poster titled "Probing shape coexistence in $^{192}$Hg through combined electron and $\gamma$-ray spectroscopy", University of Toronto, Sept. 2019.
- *Undergraduate Student Research Award (USRA)* (5625 CAD), Natural Sciences and Engineering Research Council (NSERC), University of Toronto/Toronto Western Hopsital/Krembil Research Institute, May-Aug. 2018.
- *President's Entrance Scholarship* (2000 CAD), University of Toronto, Sept. 2016.

## OBSERVING PROPOSALS

- I am a Co-PI on a Cycle 3 JWST observing program (GO-5629: "Extremely deep spectroscopy of quiescent galaxies at $z \sim 0.7$: A direct measurement of the stellar initial mass function beyond the low-redshift universe". PI: Mariska Kriek, Co-PIs: Aliza Beverage and Chloe Cheng. 40.24 hours on NIRSpec/MOS).
- I have participated as a Co-PI on two JWST observing proposals.
- I have participated as a collaborator on observing proposals for JWST (4), HST (2), and ALMA (3).

## TECHNICAL SKILLS

*Languages*
Python • Bash shell • LaTeX • C++ • MATLAB • Fortran • R

*Tools*
alf • PypeIt • GALFIT • apogee • astropy • docopt • numpy • PyTorch • SLURM • ROOT • GRSISort • SciDraw

*Techniques*
spectroscopy • stellar population synthesis • full spectrum fitting • data reduction • Bayesian statistics • forward modeling • detector configuration

## TEACHING

- Galaxies & Cosmology, Teaching Assistant, Universiteit Leiden, Feb. 2023 - Jun. 2023, Feb. 2024 - Jun 2024.
- Stars (PHYS 375), Teaching Assistant, University of Waterloo, Jan. - Apr. 2022.
- Electricity & Magnetism 2 (PHYS 342), Teaching Assistant, University of Waterloo, Sept. - Dec. 2021.
- Physics 2 Laboratory (PHYS 112L), Teaching Assistant, University of Waterloo, Jan. - Apr. 2021.
- Mechanics (PHYS 121), Teaching Assistant, University of Waterloo, Sept. - Dec. 2020.
- Fundamentals of University Teaching Program, University of Waterloo, 2020 - 2021.

## LEADERSHIP AND EXTRA-CURRICULAR

*Committees*
- Member, Social Committee, Leiden Observatory, Apr. 2023 - Present.
- Member, Borrel Committee, Leiden Observatory, Sept. 2023 - Sept. 2024.
- Member, Equity, Diversity, & Inclusion Committee, Leiden Observatory, Sept. 2022 - Apr. 2024.
- Social Media Coordinator and Representative, Graduate Student Committee, Canadian Astronomical Society (CASCA), Sept. 2021 - Aug. 2022.

*Extra-Curricular Activities*
- Member, Phski Comittee, Leiden Observatory, Aug. 2023 - Jan. 2024.
- Player, Rotterdam Ravens Quidditch Team, Rotterdam, Sept. 2022 - Aug. 2023.
- Player, University of Toronto Centaurs Quidditch Team, University of Toronto, Sept. 2017 - Apr. 2022.

- Co-Captain & Vice President, University of Toronto Centaurs Quidditch Team, University of Toronto, Sept. 2019 - Apr. 2020.
- Treasurer, University of Toronto Centaurs Quidditch Team, University of Toronto, Sept. 2018 - Aug. 2021.
- Voice Experience, Sept. 2010 - Apr. 2022
  - National Association of Teachers of Singing (NATS) Ontario Chapter Auditions 3rd Place (Nov. 2021)
  - NATS Ontario Chapter Auditions 2nd Place (Nov. 2019)

**VOLUNTEER EXPERIENCE**

*Seeing Stars Leiden* Sept. 25, 2023
Leiden, The Netherlands
- Supervised observing station for the public.

*Canadian Conference for Undergraduate Women in Physics* Jan. 19, 2020
University of Toronto, Toronto, ON, Canada
- Directed conference attendees and speakers to workshops, talks, and activities. Arranged refreshments and gifts. Led small-group lab tours.

*Zhang Lab* May – Aug. 2017
Toronto Western Hospital/Krembil Research Institute, Toronto, ON, Canada
- Kindled seizures in mice. Sectioned brain tissue and prepared slides. Performed cell counting. Soldered electrodes. Analyzed EEG recordings of seizures using MATLAB.

**LANGUAGES** English (native), French (conversational), Dutch (basic, A2)