

Claude Cournoyer-Cloutier

✉ cournoyc@mcmaster.ca | 🏠 <https://cournoyercloutierc.github.io/> | 🌐 0000-0002-6116-1014

Education

McMaster University

PHD ASTROPHYSICS

Hamilton, Canada

2021 - 2025 (expected)

Advisors: Dr. Alison Sills & Dr. William E. Harris

Thesis: "Dynamics and Feedback of Massive Binaries in Young Massive Star Clusters"

Visit to the Max Planck Institute for Astrophysics from April to July 2023, supported by supplement to PhD scholarship

Comprehensive exam passed with distinction, A+ in all courses

McMaster University

MSC ASTROPHYSICS

Hamilton, Canada

2019 - 2021

Advisors: Dr. Alison Sills & Dr. William E. Harris

Thesis: "Dynamical Modification of a Primordial Population of Binaries in Simulations of Star Cluster Formation"

McGill University

BSc PHYSICS, WITH MINOR IN MATHEMATICS

Montreal, Canada

2016 - 2019

Thesis advisor: Dr. Nicolas Cowan

Senior thesis: "Determination of Terrestrial Exoplanets' Rotation Rates from their Reflected Lightcurves"

Awards

2025	Co-PI, ACCESS allocation PHY240335 U.S. National Science Foundation	2.6M CPU hours
2022-2025	Canada Graduate Scholarships – Doctoral (CGS D) Natural Sciences and Engineering Research Council of Canada	CAD 110,000
2023	Michael Smith Foreign Study Supplement (CGS MSFSS) Natural Sciences and Engineering Research Council of Canada	CAD 6,000
2021-2022	Queen Elizabeth II Scholarship in Science and Technology (QEII-GSST) Ontario Graduate Scholarship, Government of Ontario	CAD 15,000

Publications

† denotes supervised students. An up to date publication record can be found on NASA ADS.

12. **Cournoyer-Cloutier C.**, Andersson E. P., Appel S. M., Lahén N., Polak B., Rantala A., Toonen S., Sills A., Rieder S., Portegies Zwart, Mac Low M.-M., Harris W. E. 2025. *Massive Interacting Binaries Enhance Feedback in Star-Forming Regions*. Submitted to ApJ.
11. Laverde-Villareal E.†, Sills A., **Cournoyer-Cloutier C.**, Arias Callejas V. 2025. *The Evolution of Substructure during Star Cluster Assembly*. Submitted to ApJ.
10. Lewis S., Polak B., Mac Low M.-M., McMillan S., **Cournoyer-Cloutier C.**, Li H., Wilhelm M., Portegies Zwart S. 2025. *Transferring Data from A Voronoi Mesh to An Adaptive Cartesian Grid in Pursuit of Self-consistent Top-down Star Formation*. Submitted to ApJ.
9. Polak B., Mac Low M.-M., Klessen R. S., Portegies Zwart S., Andersson E. P., Appel S. M., **Cournoyer-Cloutier C.**, Glover S. C. O., McMillan S. L. W. 2024. *Massive star cluster formation III. Early mass segregation during cluster assembly*. A&A 695, A188.
8. **Cournoyer-Cloutier C.**, Sills A., Harris W. E., Polak B., Rieder S., Andersson E. P., Appel S. M., Mac-Low M., McMillan S., Portegies Zwart S. 2024. *Massive Star Cluster Formation with Binaries. I. Evolution of Binary Populations*. ApJ 977:203 (12pp).
7. **Cournoyer-Cloutier C.**, Karam J., Sills A., Portegies Zwart S., Wilhelm M. J. C. 2024. *Binary Disruption and Ejected Stars from Hierarchical Star Cluster Assembly*. ApJ 975:207 (9pp).

6. Polak B., Mac Low M.-M., Klessen R. S., Portegies Zwart S., Andersson E. P., Appel S. M., **Cournoyer-Cloutier C.**, Glover S. C. O., McMillan S. L. W. 2024. *Massive Star Cluster Formation II. Runaway Stars as Fossils of Sub-Cluster Mergers*. A&A 690, A207.
5. Polak B., Mac Low M.-M., Klessen R. S., Teh J. W., **Cournoyer-Cloutier C.**, Andersson E. P., Appel S. M., Tran A., Lewis S. C., Wilhelm M. J. C., Portegies Zwart S., Glover S. C. O., Rieder S., Wang L., McMillan S. L. W. 2024. *Massive Star Cluster Formation I. High Star Formation Efficiency While Resolving Feedback of Individual Stars*. A&A 690, A94.
4. **Cournoyer-Cloutier C.**, Sills A., Harris W. E., Appel S. M., Lewis S. C., Polak B., Tran A., Wilhelm M. J. C., Mac Low M.-M., McMillan S. L. W., Portegies Zwart S. 2023. *Early evolution and three-dimensional structure of embedded star clusters*. MNRAS 521(1): 1338–1352.
3. Wilhelm M. J. C., Portegies Zwart S., **Cournoyer-Cloutier C.**, Lewis S. C., Polak B., Tran A., Mac Low M.-M. 2023. *Radiation shielding of protoplanetary discs in young star-forming regions*. MNRAS 520(4): 5331–5353.
2. Lewis S. C., McMillan S. L. W., Mac Low M.-M., **Cournoyer-Cloutier, C.**, Polak B., Wilhelm M. J. C., Tran A., Sills A., Portegies Zwart S., Klessen R. S., Wall J. E. 2023. *Early-forming Massive Stars Suppress Star Formation and Hierarchical Cluster Assembly*. ApJ 944(2): 211 (13pp).
1. **Cournoyer-Cloutier C.**, Tran A., Lewis S. C., Wall J. E., Harris W. E., Mac Low M.-M., McMillan S. L. W., Portegies Zwart S., Sills A. 2021. *Implementing primordial binaries in simulations of star cluster formation with a hybrid MHD and direct N-body method*. MNRAS 501(3): 4464–4478.

Presentations

CONTRIBUTED TALKS

- | | |
|---|----------------|
| 15. Feedback from Massive Interacting Binaries in Cluster-Forming Regions
<i>Globular Clusters: From the Milky Way to High-Redshift Galaxies, Saint Mary's University, Halifax (Canada)</i> | June 2025 |
| 14. The Impact of Feedback from Massive Interacting Binaries on the Interstellar Medium
<i>Annual CASCA Meeting, Saint Mary's University, Halifax (Canada)</i> | June 2025 |
| 13. Massive Binaries in Young Massive Star Clusters
<i>Star formation across the scales: star clusters to galactic disks, McMaster University, Hamilton (Canada)</i> | August 2024 |
| 12. Massive Binaries in Young Massive Star Clusters (invited)
<i>2024 Alpbach workshop on clouds, star clusters & black holes, Congress Centrum Alpbach, Alpbach (Austria)</i> | June 2024 |
| 11. Massive Binaries in Young Massive Star Clusters (honourable mention, best talk)
<i>Annual CASCA Meeting, University of Toronto & York University, Toronto (Canada)</i> | June 2024 |
| 10. Massive Binaries in Young Massive Star Clusters
<i>Globular Clusters and Their Tidal Tails: From the Milky Way to the Local Group, University of Toronto, Toronto (Canada)</i> | May 2024 |
| 9. A New Framework for Feedback from Massive Binaries in Simulations of Cluster Formation
<i>"Two in a million" - The interplay between binaries and star clusters, ESO Headquarters, Garching bei München (Germany)</i> | September 2023 |
| 8. The Evolution of Binary Populations and Cluster Structure During Star Cluster Formation
<i>MODEST-23: Star clusters in the post-pandemic era, Northwestern University, Evanston (USA)</i> | August 2023 |
| 7. The Impact of Massive Interacting Binaries on Star Cluster Formation
<i>Great Lakes Clusters and Streams, University of Michigan, Ann Arbor, USA</i> | August 2023 |
| 6. The Impact of Binaries on Star Cluster Formation
<i>A multi-wavelength view on globular clusters near and far: from JWST to the ELT, Sexten Center for Astrophysics, Sexten (Italy)</i> | July 2023 |
| 5. The Influence of Binaries on the Hierarchical Assembly of Star Clusters
<i>Clusters @ McMaster Conference, McMaster University, Hamilton (Canada)</i> | August 2022 |

4. Binaries in TORCH: The Tug of War Between Binaries and Hierarchical Assembly During Cluster Formation August 2022
TORCH workshop, Center for Computational Astrophysics, New York (USA)
3. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation July 2021
MODEST 21a Workshop, Leiden University (virtual), Leiden (the Netherlands)
2. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation June 2021
Annual CASCA Meeting, University of Waterloo (virtual), Waterloo (Canada)
1. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation (**best talk**) October 2020
Physics & Astronomy Graduate Symposium, McMaster University (virtual), Hamilton (Canada)

SEMINARS

9. Massive Binaries in Young Massive Star Clusters June 2024
Observatoire astronomique de Strasbourg, Strasbourg, France
8. Binary Hardening and Disruption from Hierarchical Star Cluster Assembly (**invited**) March 2024
Toronto Astrophysics Talks, University of Toronto, Toronto (Canada)
7. The Interplay Between Binary Stars and Star Cluster Formation (**invited**) September 2023
University of Cologne, Cologne (Germany)
6. The Evolution of Binary Populations and Cluster Structure During Star Cluster Formation June 2023
Galaxy Group Meeting, Max Planck Institute for Astrophysics, Garching bei München (Germany)
5. The Impact of Binaries on Star Cluster Formation June 2023
Anton Pannekoek Institute, University of Amsterdam, Amsterdam (the Netherlands)
4. The Impact of Binaries on Star Cluster Formation June 2023
Institute of Astronomy, KU Leuven, Leuven (Belgium)
3. The Impact of Binaries on Star Cluster Formation May 2023
Seminar on Stellar Astrophysics, Max Planck Institute for Astrophysics, Garching bei München (Germany)
2. Binaries in Simulations of Star Cluster Formation: Dynamics and Feedback (blackboard talk) May 2023
ESO Informal Discussion, ESO Headquarters, Garching bei München (Germany)
1. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation (**invited**) February 2021
Pizza Lunch Informal Talk, Columbia University (virtual), New York (USA)

POSTERS

[†] denotes supervised students

11. Armstrong I[†], **Cournoyer-Cloutier C**, Sills A. *Insights into the physics encoded in star cluster dating techniques*. 2025. Annual CASCA Meeting, St Mary's University, Halifax, Canada.
10. Khadour Z[†], **Cournoyer-Cloutier C**, Sills A. *Binary Stars as Sources of Chemical Anomalies in Stellar Clusters*. 2025. Annual CASCA Meeting, St Mary's University, Halifax, Canada.
9. Laverde-Villareal E[†], **Cournoyer-Cloutier C**, Sills A. *Kinematic Sub-Structure During Star Cluster Assembly*. 2024. Star formation across the scales: star clusters to galactic disks, McMaster University, Hamilton, Canada.
8. **Cournoyer-Cloutier C**, Sills A, Harris W E, Polak B, Andersson E, Appel S M, Mac Low M-M, McMillan S L W, Portegies Zwart S. 2024. *Massive binaries in young massive star clusters*. Annual CASCA Meeting, University of Toronto, Canada.
7. **Cournoyer-Cloutier C**, Sills A, Harris W E, Appel S M, Lewis S C, Polak B, Tran A, Wilhelm M J C, Mac Low M-M, McMillan S L

W, Portegies Zwart S. 2023. *Early Evolution and 3D Structure of Embedded Star Clusters*. The Physics of Star Formation: From Stellar Cores to Galactic Scales, Lyon, France.

6. Mac Low M-M, **Cournoyer-Cloutier C**, Lewis S C, Appel S M, Harris W E, Klessen R S, McMillan S L W, Polak B, Portegies Zwart S, Sills A, Tran A, Wall J E, Wilhelm M J C. 2023. *Torch Simulations of the Structure of Star Clusters Emerging from Gas: Binaries and Early Massive Stars*. Protostars & Planets VII, Kyoto, Japan.
5. Wilhelm M, Portegies Zwart S, **Cournoyer-Cloutier C**, Lewis S, Polak B, Tran A, Mac Low M-M. 2023. *Radiation shielding of Young Protoplanetary Disks*. Protostars & Planets VII, Kyoto, Japan.
4. **Cournoyer-Cloutier C**, Sills A, Harris W. E. 2022. *The influence of binaries on the structure of embedded star clusters*. Annual CASCA Meeting, University of Waterloo (virtual), Canada.
3. Lewis S, **Cournoyer-Cloutier C**, Tran A, Farner W, McMillan S, Mac Low M, Portegies Zwart S, Toonen S, Wall J. 2021. *The Effects of Early Massive Star Formation: Gas Expulsion & Cluster Dynamics*. AAS Meeting #238 (virtual), USA.
2. **Cournoyer-Cloutier C**, Sills A, Harris W. E. 2021. *Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation*. Annual EAS Meeting, Leiden University (virtual), the Netherlands.
1. **Cournoyer-Cloutier C**, Sills A, Harris W. E. 2020. *Primordial Binaries in Simulations of Star Cluster Formation*. Annual CASCA Meeting, York University (virtual), Canada.

CONFERENCE PROCEEDINGS

4. Polak B, Mac Low M.-M, Klessen R., Appel S. M., **Cournoyer-Cloutier C.**, Lewis S., Tran A., ; Wilhelm, M., Portegies Zwart S., Glover S., McMillan S. 2023. Modeling Evolution from Gas to Young Massive Star Clusters. American Astronomical Society meeting #242, Albuquerque (NM), USA.
3. Lewis S, McMillan S, Mac Low M-M, **Cournoyer-Cloutier C**, Polak B, Tran A, Wilhelm, M, Sills A, Klessen R, Wall J. 2023. Star Cluster Formation: The effects of early forming massive stars and building a bridge between Voronoi mesh and block-structured codes. American Astronomical Society meeting #241, Seattle (WA), USA.
2. Wilhelm M J C, Portegies Zwart S, **Cournoyer-Cloutier C**, Lewis S, Polak B, Tran A, Mac Low M-M, McMillan S L W. 2023. Modeling protoplanetary disk evolution in young star forming regions. Proceedings of the International Astronomical Union, Volume 362, pp. 300-305.
1. Lewis S, **Cournoyer-Cloutier C**, Tran A, Farner W, McMillan S L W, Mac Low M-M, Portegies Zwart S, Toonen S & Wall J E 2021. The Effects of Early Massive Star Formation: Gas Expulsion & Cluster Dynamics. American Astronomical Society meeting #238 (virtual).

Professional experience _____

STUDENT SUPERVISION

Co-supervision of MSc students with Dr. Alison Sills 2024-now
Students supervised: Isabella Armstrong, Zena Khadour

Co-supervision of MITACS student with Dr. Alison Sills 2024
Student supervised: Edwin Laverde-Villareal

TEACHING

2020-now	Waves, Electricity and Magnetic Fields for Engineering Head Teaching Assistant, coordination and supervision of 55-60 TAs, 900-1100 students, 10 hours per week on average	PHYS 1E03
2020-2023	Introductory Mechanics for Engineering Head Teaching Assistant, coordination and supervision of 55-60 TAs, 1100-1300 students, 10 hours per week on average	PHYS 1D03
2020-2022	Light, the Universe, and Everything: Integrated Science Literature Review Course Expert consultant, supervision of 5-6 students	ISCI 3A12
2019	Introductory Mechanics for Engineering Teaching Assistant, 35 students, 5 hours per week	PHYS 1D03
2019	The Big Questions: General Interest Astronomy Teaching Assistant, McMaster University, 35 students, 5 hours per week	ASTRO 2B03

EMPLOYMENT HISTORY

2019-now	Teaching Assistant McMaster University, Hamilton (Canada)
2016-2018	Guide for National Historic Sites Parks Canada, Quebec City (Canada)
2015-2016	Physics Tutor CÉGEP Garneau, Quebec City (Canada)
2014	Chemistry Lab Tutor CÉGEP Garneau, Quebec City (Canada)

Service

2024-now	Referee for Astronomy & Astrophysics
----------	---

DEPARTMENT & FACULTY-LEVEL ROLES

2020-2024	Student Representative on Physics & Astronomy Faculty Meetings Attend monthly meetings of the department's faculty, and liaise with the graduate students and postdoctoral fellows. Responsibilities include providing a report to the graduate students and postdoctoral fellows following each meeting, and passing along concerns from the graduate student body back to the faculty.
2021-2022	Student Member, Hiring Committee for Observational Exoplanet Astronomy Non-voting member of the hiring committee for a tenure-track position in observational exoplanet astronomy, for McMaster University's Department of Physics & Astronomy. Responsibilities include reading the application material and attending the interviews for all the long-list and short list candidates, preparing and asking one question related to graduate student supervision for each interview, organizing a meeting between graduate students and each short-list candidate, collecting feedback from the graduate students regarding the candidates, produce a report in collaboration with the non-voting postdoc member, and presenting the report to the hiring committee.

- 2021-2022 **Student Member, Departmental Equity, Diversity and Inclusion (EDI) Committee**
Elected student member of the department's EDI committee. Responsibilities include attending weekly meeting, organizing EDI workshops for students and postdocs, and contributing to the development of department-wide EDI initiatives, including the choice of EDI colloquium speakers.
- 2020 **Selection Committee for the Acting Associate Dean of Graduate Studies, Student member, Faculty of Science, McMaster University**
Voting member of the selection committee. Responsibilities include reading the application material and attending the interviews for all the short list candidates, asking one question related to graduate student supervision for each interview, and providing succinct feedback on the candidates to the selection committee.

STUDENT-LEAD EDI INITIATIVES

- 2019-now **Active member of Promoting Inclusion in Physics & Astronomy (McMaster University)**
Main contribution is the organization of several online inter-department events, including inviting and coordinating with speakers for discussion panels and colloquium series, obtaining funding, and advertising the events
- 2018-2019 **Communication Officer, STEM Support Committee (McGill University)**
Organization of monthly EDI-based seminars and networking events for physics, computer science and mathematics students. Responsibilities include contacting speakers, advertising the events to the Department of Physics, and writing funding applications at the university and provincial government levels.

CONFERENCE & COLLOQUIUM SERIES ORGANIZATION

- 2024 **Member of Local Organizing Committee**
"Star formation across the scales: star clusters to galactic disks", McMaster University
- 2022 **Member of Local Organizing Committee**
Clusters @ McMaster Conference, McMaster University
- 2022 **Organiser of Summer Colloquium Series**
Department of Physics & Astronomy, McMaster University

Outreach

MENTORING

- 2020-now **Mentor to first-year MSc students, McMaster University**
Seven students mentored, in the Department of Physics & Astronomy. Responsibilities include helping onboarding students by providing resources and help to find housing, register for classes, and meet other students. For several mentees, the responsibilities extend to meeting with them several times during their MSc and helping them with scholarship applications.

PHYSICS & ASTRONOMY OUTREACH

- 2022-now **Presenter for McMaster's portable planetarium**
> 50 presentations for school groups (5-18 years old) and the general public, including eclipse-related shows and presentations of *The Celestial Bear: The Six Nations' Night Sky*, developed in collaboration with Indigenous partners.
- 2019-now **Presenter for McMaster's W. J. McCallion Planetarium**
> 60 presentations for school groups (5-18 years old) and the general public, including presentations of *The Celestial Bear: The Six Nations' Night Sky*. Design and presentation of a themed show focused on nebulae.
- 2024 **Invited speaker, Royal Astronomical Society of Canada Toronto Centre**
Online public talk for amateur astronomers on binary stars and star clusters
- 2024 **Eclipse ambassador, McMaster University**
Outreach to the general public regarding the April 2024 solar eclipse
- 2020 **Invited presenter for Ask a Scientist**
Online talk answering children's questions on stars and planets
- 2016 **Volunteer for CEGEP Garneau's Physical Sciences Demonstration Centre**
Outreach to the general public and apparatus design for lab demonstrations

MEDIA APPEARANCES

- Radio interview with CBC April 2024
Live interview about the solar eclipse, for the local radio station of the Canadian Broadcasting Company (CBC)
- TikTok interview with CBC April 2024
Live interview about the solar eclipse, for the Tiktok account of the Canadian Broadcasting Company (CBC)
- Interview with CFMU April 2024
Pre-recorded interview about the solar eclipse, for the McMaster radio station CFMU
- Interview with AMI-tv April 2024
Pre-recorded interview about the solar eclipse, for the TV channel Accessible Media Inc.
- Interview with CHCH April 2024
Pre-recorded interview about the solar eclipse, for the Hamilton, Halton and Niagara-based TV channel CHCH
- Interview with the City of Burlington March 2024
Pre-recorded interview about the solar eclipse, for the City of Burlington public viewing event

Professional development _____

TRAINING & CERTIFICATIONS

- Teaching and Learning Certificate of Completion** 2022
MACPHERSON INSTITUTE, MCMASTER UNIVERSITY
Training in teaching methods and course development, three semester-long courses
- Professor Hippo-on-Campus Certificate of Completion** 2022
MCMASTER UNIVERSITY
Student mental health education program for educators
- Mental Health First Aid** 2019
MENTAL HEALTH COMMISSION OF CANADA
Training course in how to assist someone experiencing a mental health crisis