Claude Cournoyer-Cloutier

PhD Candidate · Astrophysics

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Education

McMaster University — Hamilton, Canada
PhD Astrophysics — 2021 - 2025 (expected)
Advisors: Dr. Alison Sills & Dr. William E. Harris
Thesis (working title): "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 a CGS MSFSS
Comprehensive exam passed with distinction, A+ in all courses

McMaster University — Hamilton, Canada
MSc Astrophysics — 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 — Montreal, Canada
BSc Physics, with Minor in Mathematics — 2016 - 2019
Thesis advisor: Dr. Nicolas Cowan
Senior thesis: "Determination of Terrestrial Exoplanets' Rotation Rates from their Reflected Lightcurves"

Awards

2022-2025	**Canada Graduate Scholarships – Doctoral (CGS D)** Natural Sciences and Engineering Research Council of Canada	$ 110,000
2023	**Michael Smith Foreign Study Supplement (CGS MSFSS)** Natural Sciences and Engineering Research Council of Canada	$ 6,000
2021-2022	**Queen Elizabeth II Scholarship in Science and Technology (QEII-GSST)** Ontario Graduate Scholarship, Government of Ontario	$ 15,000

Publications

An up to date publication record can be found on NASA ADS

9. **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*. Submitted to ApJ, arXiv:2410.07433.

8. 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*. Submitted to A&A, arXiv:2408.14592.

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*. Accepted for publication in ApJ, arXiv:2409.13564.

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

13. Massive Binaries in Young Massive Star Clusters — August 2024
Star formation across the scales: star clusters to galactic disks, McMaster University, Hamilton (Canada)

12. Massive Binaries in Young Massive Star Clusters (**invited**) — June 2024
2024 Alpbach workshop on clouds, star clusters & black holes, Congress Centrum Alpbach, Alpbach (Austria)

11. Massive Binaries in Young Massive Star Clusters (**honourable mention, best talk**) — June 2024
Annual CASCA Meeting, University of Toronto & York University, Toronto (Canada)

10. Massive Binaries in Young Massive Star Clusters — May 2024
Globular Clusters and Their Tidal Tails: From the Milky Way to the Local Group, University of Toronto, Toronto (Canada)

9. A New Framework for Feedback from Massive Binaries in Simulations of Cluster Formation — September 2023
"Two in a million" - The interplay between binaries and star clusters, ESO Headquarters, Garching bei München (Germany)

8. The Evolution of Binary Populations and Cluster Structure During Star Cluster Formation — August 2023
MODEST-23: Star clusters in the post-pandemic era, Northwestern University, Evanston (USA)

7. The Impact of Massive Interacting Binaries on Star Cluster Formation — August 2023
Great Lakes Clusters and Streams, University of Michigan, Ann Arbor, USA

6. The Impact of Binaries on Star Cluster Formation — July 2023
A multi-wavelength view on globular clusters near and far: from JWST to the ELT, Sexten Center for Astrophysics, Sexten (Italy)

5. The Influence of Binaries on the Hierarchical Assembly of Star Clusters — August 2022
Clusters @ McMaster Conference, McMaster University, Hamilton (Canada)

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

9. Laverde 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
Student supervised: Isabella Armstrong, Zena Khadour

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

Teaching

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

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 colloquim 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**
> 50 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 **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 **Volunter 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 statoin 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