Claude Cournoyer-Cloutier

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Education

McMaster University — Hamilton, Canada
PhD Astrophysics — 2021 - 2025
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 — 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

2025-2027	**Postdoctoral Fellowship** Natural Sciences and Engineering Research Council of Canada	$140,000 CAD
2025	**Co-PI, ACCESS allocation PHY240335** U.S. National Science Foundation	2.6M CPU hours
2022-2025	**Canada Graduate Scholarships – Doctoral** Natural Sciences and Engineering Research Council of Canada	$110,000 CAD
2023	**Michael Smith Foreign Study Supplement** Natural Sciences and Engineering Research Council of Canada	$6,000 CAD
2021-2022	**Queen Elizabeth II Scholarship in Science and Technology** Ontario Graduate Scholarship, Government of Ontario	$15,000 CAD

Publications

Supervised students are underlined. An up to date publication record can be found on NASA ADS.

13. Assilhan A., Mac Low M.-M., Polak B., Abdikamalov E., **Cournoyer-Cloutier C.**, Lewis S., Kalambay M., Otebay A., Shukirgaliyev B. 2025. *Centrally concentrated star formation in young clusters*. Submitted to A&A.

12. 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.

11. **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*. Accepted for publication in ApJ, arXiv:2507.02780.

10. Laverde-Villareal E., Sills A., **Cournoyer-Cloutier C.**, Arias Callejas V. 2025. *The Evolution of Substructure during Star Cluster Assembly*. Accepted for publication in ApJ, arXiv:2507.00815.

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. 2025. *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.

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.

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, 1338.

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, 5331.

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, 211.

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, 4464.

Presentations

Conference Talks

16. Feedback from Massive Interacting Binaries: the Impact of Binary Mass Transfer on Cluster Formation 09/2025
Bridging scales: star clusters and their host galaxies from the Local to the high-z Universe, Matera, Italy

15. Caveats and Challenges in Star Formation Simulations with Binaries 07/2025
Numerical Recipes in Star Formation, Lorentz Center, Leiden, the Netherlands

14. Feedback from Massive Interacting Binaries in Cluster-Forming Regions 06/2025
Globular Clusters: From the Milky Way to High-Redshift Galaxies, Saint Mary's University, Halifax, Canada

13. The Impact of Feedback from Massive Interacting Binaries on the Interstellar Medium 06/2025
Annual CASCA Meeting, Saint Mary's University, Halifax, Canada (**runner up, best talk**)

12. Massive Binaries in Young Massive Star Clusters 08/2024
Star formation across the scales: star clusters to galactic disks, McMaster University, Hamilton, Canada

11. Massive Binaries in Young Massive Star Clusters (**invited**) 06/2024
2024 Alpbach workshop on clouds, star clusters & black holes, Congress Centrum Alpbach, Alpbach, Austria

10. Massive Binaries in Young Massive Star Clusters 06/2024
Annual CASCA Meeting, University of Toronto & York University, Toronto, Canada (**honourable mention, best talk**)

9. Massive Binaries in Young Massive Star Clusters 05/2024
Globular Clusters and Their Tidal Tails: From the Milky Way to the Local Group, University of Toronto, Toronto, Canada

8. A New Framework for Feedback from Massive Binaries in Simulations of Cluster Formation 09/2023
"Two in a million" - The interplay between binaries and star clusters, ESO Headquarters, Garching bei München, Germany

7. The Evolution of Binary Populations and Cluster Structure During Star Cluster Formation 08/2023
MODEST-23: Star clusters in the post-pandemic era, Northwestern University, Evanston, USA

6. The Impact of Massive Interacting Binaries on Star Cluster Formation 08/2023
Great Lakes Clusters and Streams, University of Michigan, Ann Arbor, USA

5. The Impact of Binaries on Star Cluster Formation 07/2023
A multi-wavelength view on globular clusters near and far: from JWST to the ELT, Sexten Center for Astrophysics, Sexten, Italy

4. The Influence of Binaries on the Hierarchical Assembly of Star Clusters 08/2022
Clusters @ McMaster Conference, McMaster University, Hamilton, Canada

3. Binaries in Torch: The Tug of War Between Binaries and Hierarchical Assembly During Cluster Formation 08/2022
TORCH workshop, Center for Computational Astrophysics, New York, USA

2. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation 07/2021
MODEST 21a Workshop, Leiden University (virtual), Leiden, the Netherlands

1. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation 06/2021
Annual CASCA Meeting, University of Waterloo (virtual), Waterloo, Canada

Seminars

9. Massive Binaries in Young Massive Star Clusters 06/2024
Observatoire astronomique de Strasbourg, Strasbourg, France

8. Binary Hardening and Disruption from Hierarchical Star Cluster Assembly 03/2024
Toronto Astrophysics Talks, University of Toronto, Toronto, Canada

7. The Interplay Between Binary Stars and Star Cluster Formation 09/2023
University of Cologne, Cologne, Germany

6. The Evolution of Binary Populations and Cluster Structure During Star Cluster Formation 06/2023
Galaxy Group Meeting, Max Planck Institute for Astrophysics, Garching bei München, Germany

5. The Impact of Binaries on Star Cluster Formation 06/2023
Anton Pannekoek Institute, University of Amsterdam, Amsterdam, the Netherlands

4. The Impact of Binaries on Star Cluster Formation 06/2023
Institute of Astronomy, KU Leuven, Leuven, Belgium

3. The Impact of Binaries on Star Cluster Formation 05/2023
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) 05/2023
ESO Informal Discussion, ESO Headquarters, Garching bei München, Germany

1. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation 02/2021
Pizza Lunch Informal Talk, Columbia University (virtual), New York, USA

Posters

Supervised students are underlined.

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

2020-2025 **Head Teaching Assistant: Waves, Electricity and Magnetic Fields for Engineering** PHYS 1E03
Coordination and supervision of 55-60 TAs; 900-1100 students, 130+ hours/semester

2020-2023 **Head Teaching Assistant: Introductory Mechanics for Engineering** PHYS 1D03
Coordination and supervision of 55-60 TAs; 1100-1300 students, 130+ hours/semester

2020-2022 **Light, the Universe, and Everything: Integrated Science Literature Review Course** ISCI 3A12
Expert consultant, supervision of 5-6 students

2019 **Teaching Assistant: Introductory Mechanics for Engineering** PHYS 1D03
Leading labs and tutorials, grading and invigilating exams; 35 students, 65 hours

2019 **The Big Questions: General Interest Astronomy** ASTRO 2B03
Leading tutorials, grading presentations; 35 students, 65 hours

Employment history

2019-2025 **Teaching Assistant**
McMaster University, Hamilton (Canada)

2016-2018 **Guide for National Historic Sites**
Parks Canada, Quebec City (Canada)

2014-2016 **Physics & Chemistry 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, McMaster University**
Attend monthly meetings of the department's faculty, and liaise with the graduate students and postdoctoral fellows by providing a report following each meeting and passing along concerns back to the faculty.

2021-2022 **Student Member, Hiring Committee for Observational Exoplanet Astronomy, McMaster University**
Read the application material and attend the interviews for all the long-list and short list candidates, prepare and ask one question related to student supervision for each interview, organize a meeting between graduate students and each short-list candidate, collect student feedback, produce a report in collaboration with the non-voting postdoc member, and present 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 **Student Member, Selection Committee for the Acting Associate Dean of Graduate Studies**
Mcmaster University, Faculty of Science. 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 feedback on the candidates to the selection committee.

Student-lead EDI initiatives

2020-now **Mentor to seven first-year MSc students, McMaster University**
Meet regularly with the students during their first year; provide resources and help to find housing, register for classes, and meet other students; provide help with scholarship applications.

2019-now **Active member of Promoting Inclusion in Physics & Astronomy (McMaster University)**
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

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**
65+ 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 for April 2024 total solar eclipse, McMaster University**
Outreach to the general public, including seven media interviews for CBC and local media.

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

Professional development

Training & certifications

Teaching and Learning Certificate of Completion, MacPherson Institute, McMaster University 2022
Training in teaching methods and course development, three semester-long courses

Professor Hippo-on-Campus Certificate of Completion, McMaster University 2022
Student mental health education program for educators

Mental Health First Aid, Mental Health Commission of Canada 2019
Training course in how to assist someone experiencing a mental health crisis