

# Claude Cournoyer-Cloutier

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## Employment

### Postdoctoral Fellow

MAX PLANCK INSTITUTE FOR ASTROPHYSICS (MPA)  
Five-year combined NSERC and MPA fellowship

Garching, Germany  
2025 - current

## Education

### PhD in Astrophysics

MCMASTER UNIVERSITY

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

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

Hamilton, Canada  
2021 - 2025

### MSc in Astrophysics

MCMASTER UNIVERSITY

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

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

Hamilton, Canada  
2019 - 2021

### BSc in Physics, with Minor in Mathematics

MCGILL UNIVERSITY

Thesis advisor: Dr. Nicolas Cowan

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

Montreal, Canada  
2016 - 2019

## Awards

2025-2027	<b>Postdoctoral Fellowship</b> Natural Sciences and Engineering Research Council of Canada	\$140,000 CAD
2025	<b>Governor General's Academic Gold Medal</b> McMaster University, awarded for highest academic standing at graduate level	
2025	<b>Co-PI, ACCESS allocation PHY240335</b> U.S. National Science Foundation	2.6M CPU hours
2023	<b>Michael Smith Foreign Study Supplement, supporting research visit to MPA</b> Natural Sciences and Engineering Research Council of Canada	\$6,000 CAD
2022-2025	<b>Canada Graduate Scholarships – Doctoral</b> Natural Sciences and Engineering Research Council of Canada	\$110,000 CAD
2021-2022	<b>Queen Elizabeth II Scholarship in Science and Technology</b> Ontario Graduate Scholarship, Government of Ontario	\$15,000 CAD

## Publications

Co-supervised students are underlined>.

- Appel S. M., Burkhart B., Mac Low M.-M., Andersson E. P., **Cournoyer-Cloutier C.**, Lewis S., McMillan S. L. M., Polak B., Portegies Zwart S., Tran A., Wilhelm M.. 2025. *Protostellar Jets in Star Cluster Formation and Evolution: I. Implementation and Initial Results*. Submitted to ApJ, arXiv:2509.15311.
- 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*. Accepted to A&A, arXiv:2507.05016v2.
- 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*. ApJ 994, 69.

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*. ApJ 990, 112.
10. Laverde-Villareal E., Sills A., **Cournoyer-Cloutier C.**, Arias Callejas V. 2025. *The Evolution of Substructure during Star Cluster Assembly*. ApJ 989, 22.
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

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### CONFERENCE TALKS

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| 17. Feedback from Massive Interacting Binaries: the Impact of Binary Mass Transfer on Cluster Formation<br><i>Bridging scales: star clusters and their host galaxies from the Local to the high-z Universe, Matera, Italy</i> | 09/2025 |
| 16. Caveats and Challenges in Star Formation Simulations with Binaries<br><i>Numerical Recipes in Star Formation, Lorentz Center, Leiden, the Netherlands</i>   | 07/2025 |
| 15. Feedback from Massive Interacting Binaries in Cluster-Forming Regions<br><i>Globular Clusters: From the Milky Way to High-Redshift Galaxies, Saint Mary's University, Halifax, Canada</i>                                 | 06/2025 |
| 14. The Impact of Feedback from Massive Interacting Binaries on the Interstellar Medium<br><i>Annual CASCA Meeting, Saint Mary's University, Halifax, Canada (runner-up, best talk)</i>                                       | 06/2025 |
| 13. Massive Binaries in Young Massive Star Clusters<br><i>Star formation across the scales: star clusters to galactic disks, McMaster University, Hamilton, Canada</i>  | 08/2024 |
| 12. Massive Binaries in Young Massive Star Clusters ( <b>invited</b> )<br><i>2024 Alpbach workshop on clouds, star clusters &amp; black holes, Congress Centrum Alpbach, Alpbach, Austria</i>                                 | 06/2024 |
| 11. Massive Binaries in Young Massive Star Clusters<br><i>Annual CASCA Meeting, University of Toronto &amp; York University, Toronto, Canada (runner-up, best talk)</i>   | 06/2024 |

10. 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*
9. 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*
8. 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*
7. The Impact of Massive Interacting Binaries on Star Cluster Formation 08/2023  
*Great Lakes Clusters and Streams, University of Michigan, Ann Arbor, USA*
6. 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*
5. The Influence of Binaries on the Hierarchical Assembly of Star Clusters 08/2022  
*Clusters @ McMaster Conference, McMaster University, Hamilton, Canada*
4. 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*
3. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation 07/2021  
*MODEST 21a Workshop, Leiden University (virtual), Leiden, the Netherlands*
2. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation 06/2021  
*Annual CASCA Meeting, University of Waterloo (virtual), Waterloo, Canada*
1. Dynamical Formation and Destruction of Binaries in Simulations of Star Cluster Formation 10/2020  
*Physics & Astronomy Graduate Symposium , McMaster University (virtual), Hamilton, Canada (best talk)*

## 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

Co-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

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### STUDENT SUPERVISION

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

2024 - 2025

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

2024

## TEACHING

2020-2025	<b>Head Teaching Assistant: Waves, Electricity and Magnetic Fields for Engineering</b> Coordination and supervision of 55-60 TAs, guest lectures, development of marking schemes; 900-1100 students, 130+ hours/semester	PHYS 1E03
2020-2023	<b>Head Teaching Assistant: Introductory Mechanics for Engineering</b> Coordination and supervision of 55-60 TAs, development of marking schemes; 1100-1300 students, 130+ hours/semester	PHYS 1D03
2020-2022	<b>Light, the Universe, and Everything: Integrated Science Literature Review Course</b> Expert consultant, supervision of 5-6 students	ISCI 3A12
2019	<b>Teaching Assistant: Introductory Mechanics for Engineering</b> Leading labs and tutorials, grading and invigilating exams; 35 students, 65 hours	PHYS 1D03
2019	<b>The Big Questions: General Interest Astronomy</b> Leading tutorials, grading presentations; 35 students, 65 hours	ASTRO 2B03

## Service

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

## DEPARTMENT & FACULTY-LEVEL ROLES

2020-2024	<b>Student Representative on Physics &amp; Astronomy Faculty Meetings, McMaster University</b> 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	<b>Student Member, Hiring Committee for Observational Exoplanet Astronomy, McMaster University</b> 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	<b>Student Member, Departmental Equity, Diversity and Inclusion (EDI) Committee</b> 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	<b>Student Member, Selection Committee for the Acting Associate Dean of Graduate Studies</b> 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- AND POSTDOC-LEAD EDI INITIATIVES

2025-now	<b>Mentor, MPA Mentorship Programme, Max Planck Institute for Astrophysics</b> Provide guidance and support to high school, undergraduate, and Master's students interested in a career in astrophysics, with a focus on students from underrepresented groups.
2020-2025	<b>Mentor to seven first-year MSc students, McMaster University</b> 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.

- 2019-2025 **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

- 2025-now **Organizer of “Seminars in Stellar Astrophysics”**  
Stellar department, Max Planck Institute for Astrophysics
- 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 **Organizer of Summer Colloquium Series**  
Department of Physics & Astronomy, McMaster University

## OUTREACH

- 2019-2025 **Presenter for McMaster’s W. J. McCallion Planetarium**  
70+ presentations for school groups (5-18 years old) and the general public, including the shows *The Celestial Bear: The Six Nations’ Night Sky* and *Onekwá:tara – the Seven Dancers of the Pleiades*, developed in collaboration with Indigenous partners. Design and presentation of a themed show focused on nebulae.
- 2022-2025 **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*.
- 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.
- 2016-2018 **Guide, Parks Canada National Historic Sites in Quebec City**  
Guided tours and educational activities for the general public and school groups, in English and French. Development of guided tour scripts and training of new guides.
- 2016 **Volunteer for CEGEP Garneau’s Physical Sciences Demonstration Centre**  
Outreach to the general public and apparatus design for lab demonstrations.

## Professional development

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### TRAINING & CERTIFICATIONS

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| Teaching and Learning Certificate of Completion, MacPherson Institute, McMaster University<br><i>Training in teaching methods and course development, three semester-long courses</i> | 2022 |
| Professor Hippo-on-Campus Certificate of Completion, McMaster University<br><i>Student mental health education program for educators</i>  | 2022 |
| Mental Health First Aid, Mental Health Commission of Canada<br><i>Training course in how to assist someone experiencing a mental health crisis</i>                                    | 2019 |