Alexandre Champagne-Ruel

Ph.D candidate – astrophysics

Université de Montréal

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Research interests

major evolutionary transitions – origin of life – complex systems – information theory

Publications

Manuscripts in preparation:

- A. Champagne-Ruel, *Information-Theoretic Approaches to the Origin of Life*, (2023)
- A. Champagne-Ruel and P. Charbonneau, *A Phase Transition to Cooperative Takeover*, (2022)

Under review:

- A. Champagne-Ruel, S. Zakaib-Bernier, and P. Charbonneau, *Diffusion and Pattern Formation in Spatial Games*, (2023)
- OoLEN, S. Asche, C. Bautista, D. Boulesteix, A. Champagne-Ruel, C. Mathis, O. Markovitch, Z. Peng, A. Adams, A. V. Dass, A. Buch, E. Camprubi, E. S. Colizzi, S. Colón-Santos, H. Dromiack, V. Estrova, A. Garcia, G. Grimaud, A. Halpern, S. A. Harrison, S. F. Jordan, T. Z. Jia, A. Kahana, A. Kolchinsky, O. Moron-Garcia, R. Mizuuchi, J. Nan, Y. Orlova, B. K. D. Pearce, K. Paschek, M. Preiner, S. Pinna, E. Rodríguez-Román, L. Schwander, S. Sharma, H. B. Smith, A. Vieira, and J. C. Xavier, *What it takes to solve the Origin(s) of Life: An integrated review of techniques*, (2023) http://arxiv.org/abs/2308.11665.

Published:

- A. Champagne-Ruel and P. Charbonneau, "A Mutation Threshold for Cooperative Takeover", Life **12**, 254 (2022).
- S. Gelin, A. Champagne-Ruel, and N. Mousseau, "Enthalpy-entropy compensation of atomic diffusion originates from softening of low frequency phonons", Nature Communications **11**, 3977 (2020).

Invited talks:

- A. Champagne-Ruel, "Cooperation and the Origin of Life", Invited Talk, Quantum Photonics Clubhouse Podcast, 2022.
- A. Champagne-Ruel, "Coopération, émergence et transitions: comment la physique statistique peut nous éclairer sur la question des origines", Invited Talk, Qu'est-Ce Qu'expliquer Une Origine En Science ? (CIRST, UQAM), 2022.

Talks:

- A. Champagne-Ruel, "Théorie de l'information et origine de la vie", Talk, 90e Congrès de l'ACFAS, 2023.
- A. Champagne-Ruel, "A Mutation Threshold for Cooperative Takeover", Talk, AbSciCon (Atlanta), 2022.
- A. Champagne-Ruel, "Cooperation: an emergent universal feature at the dawn of life", Talk, Interdisciplinary Origin of Life Meeting for Early Career Researchers (Montréal), 2022.
- A. Champagne-Ruel, "Mutation favors the emergence of cooperation", Talk, Life and Space Poland, 2021.
- A. Champagne-Ruel, "La criticalité dans un système évolutif artificiel", Talk, Centre de Recherche En Astrophysique Du Québec (CRAQ) - Rencontre Annuelle, 2019.

Posters:

- A. Champagne-Ruel, A. Demers-Bergeron, and P. Charbonneau, "L'émergence de la coopération via l'évolution de réseaux informationnels", Poster, 90e Congrès de l'ACFAS, 2023.
- A. Champagne-Ruel, S. Zakaib-Bernier, and P. Charbonneau, "Diffusion, structures spatiales et origine de la vie", Poster, 90e Congrès de l'ACFAS, 2023.
- S. Asche, A. Champagne-Ruel, S. F. Jordan, M. Preiner, A. d. N. Vieira, J. C. Xavier, and C. Mathis, "OoLEN - The Origin of Life Early-career Network: Building the community needed to solve the problem", Poster, AbSciCon Atlanta, 2022.
- A. Champagne-Ruel and P. Charbonneau, "Les mutations favorisent la coopération en contexte évolutif", Poster, Centenaire, Département de Physique, Université de Montréal, 2021.
- A. Champagne-Ruel and P. Charbonneau, "Mutation favors the emergence of cooperative behavior", Poster, Molecular Origins of Life Munich, 2021.
- A. Champagne-Ruel and P. Charbonneau, "Mutations promote cooperation in an evolutionary setting", Poster, XIXth ISSOL Conference, 2021.
- A. Champagne-Ruel and P. Charbonneau, "Self-organized criticality : a prelude to avalanche models of solar flares", Poster, Space Climate 7 Symposium, 2019.

Media

Press coverage:

- A. Riopel, "Comment reconnaître la vie sur d'autres planètes", Le Devoir (2023).

Education

ongoing	**Ph.D. Astrophysics** Advisor: Paul Charbonneau	Université de Montréal
2020	**M.Sc. Astrophysics** Thesis: *From game theory to exobiology – the emergence of cooperation as a critical phenomenon* (link) Advisor: Paul Charbonneau	Université de Montréal
2018	**B.Sc. Physics**	Université de Montréal
2012	**B.Sc. Philosophy**	Université de Montréal

Scholarships and awards

2023	Excellence award	5 000$CAD	Université de Montréal
2022	Google Cloud Research Grant	1 000$USD	Google
2022	Excellence Scholarship	10 000$CAD	Fondation J. Armand Bombardier
2022	Doctoral Scholarship	70 000$CAD	FRQNT
2021	Best poster award	250$CAD	Université de Montréal
2021	Student initiative project	2 000$CAD	Université de Montréal
2020	Scholarship for transition to PhD	2 500$CAD	Université de Montréal
2020	Excellence award	1 000$CAD	Université de Montréal
2018	Excellence award	10 000$CAD	Université de Montréal
2017	John Low Brebner scholarship	2 500$CAD	RQMP
2014	Excellence scholarship	4 000$CAD	Université du Québec à Montréal
2011	Student initiative project	1 000$CAD	Université de Montréal

Skills

Languages:	Python/NumPy/SciPy/Matplotlib, C/C++, Fortran, LaTeX, MatLab, Assembly, Bash scripting CSS
Tools:	Machine/statistical learning, web development, network security
Operational:	Git, Linux, Parallel/high performance computing

Conferences & Workshops

2023	Origine de la vie : de l'astrophysique à la philosophie	90e Congrès de l'ACFAS
2022	Interdisciplinary Origin of Life Meeting for Early Career Researchers Montréal	OoLEN
2022	Qu'est-ce qu'expliquer une origine en science?	CIRST/Université du Québec à Montréal
2022	AbSciCon Atlanta	NASA/American Geophysical Union
2021	XIXth ISSOL conference	Inter. Soc. for the Study of the Origin of Life
2021	Life and Space Conference	Polish Astrobiological Society
2021	Molecular Origins of Life Munich	CRC 235 Emergence of Life
2019	Space Climate 7	Université de Montréal
2019	Annual Meeting	Center for Research in Astrophysics of Québec

Professional experiences

2022–	Member of the Executive Board	Origin of Life Early-career Network
2022–2022	Undergraduate internship supervision	Université de Montréal
2021–2022	Conference organizer – *OoLEN Annual Meeting*	Origin of Life Early-career Network
2021–2022	Teaching assistant – *Introduction to astrobiology*	Université de Montréal
2018–2019	Local organizing commitee – Space Climate 7	Université de Montréal
2018–2022	Tutoring – undergraduate level	Université de Montréal

Outreach

Origin of Life Digest (https://alexandrechampagne.io/ool-digest/)
Astrobiobites.org (https://astrobiobites.org)

Memberships

International Society for Artificial Life (https://alife.org)
Center for Research in Astrophysics of Québec (http://craq-astro.ca/)
Canadian Association of Physicists (https://www.cap.ca/)
Canadian Astronomical Society (https://casca.ca/)
Origin of Life Early-career Network (https://oolen.org/)
International Society for the Study of the Origin of Life (https://issol.org)
Complex Systems Society (https://cssociety.org)
Scientific Society for Astrobiology (founding member) (https://www.astrobiologyssa.org)