Christopher Cappiello

Edwin Thompson Jaynes Postdoctoral Fellow

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Professional Experience

2024— **Edwin Thompson Jaynes Postdoctoral Fellow**, Department of Physics, Washington University in St. Louis

2021—2024 **Postdoctoral Fellow**, Department of Physics, Engineering Physics, and Astronomy, Queen's University
- 2022—2024: Associate Appointment, Perimeter Institute for Theoretical Physics

Education

The Ohio State University *Columbus, OH*
PhD in Physics *2015 - 2021*
- Thesis: *Constraints on Strongly Interacting Dark Matter*
- Advisor: Professor John Beacom

Yale University *New Haven, CT*
BS in Physics (Intensive) *2011 - 2015*
- Senior Thesis: *Shapes of Galaxy Clusters*
- Undergraduate Research Advisor: Professor Daisuke Nagai
- Distinction in the Major
- Magna Cum Laude

Publications

A list of my publications can also be found on Inspire.

White Papers

1. Snowmass2021 Cosmic Frontier White Paper: Ultraheavy particle dark matter
arXiv:2203.06508, SciPost Phys. Core 6, 075 (2023)

Journal Articles

20. Boukhtouchen, Y., Bramante, J., **Cappiello, C.**, Diamond, M.
Deconstructive Composite Dark Matter Detection
arXiv:2512.16043

19. Alam, Z., **Cappiello, C.**, Ferrer, F.
Dark Matter Boosted by Terrestrial Collisions
arXiv:2510.12791

18. **Cappiello, C.**, Daylan, T.
Can a Dark Inferno Melt Earth's Core?
arXiv:2505.24070, Physical Review D 112, 075018 (2025)

17. **Cappiello, C.**, Dev, B., Patwardhan, A.
New Supernova Constraints on Neutrinophilic Dark Sector
arXiv:2503.09691

16. Acevedo, J., Boukhtouchen, Y., Bramante, J., **Cappiello, C.**, Mohlabeng, G., Sheahan, M., Tyagi, N.
Loosely Bound Composite Dark Matter
arXiv:2408.03983, JCAP 03 (2025) 013

15. Balan, S., Balázs, C., Bringmann, T., **Cappiello, C.**, Catena, R., Emken, T., Gonzalo, T., Gray, T., Handley, W., Huynh, Q., Kahlhoefer, F., Vincent, A.
Resonant or asymmetric: The status of sub-GeV dark matter
arXiv:2405.17548, JCAP 01 (2025) 053

14. Bramante, J., **Cappiello, C.**, Diamond, M., Kim, L., Liu, Q., Vincent, A.
Dissipative Dark Cosmology: From Early Matter Dominance to Delayed Compact Objects
arXiv:2405.04575, Physical Review D 110, 043041 (2024)

13. **Cappiello, C.**, Liu, Q., Mohlabeng, G., Vincent, A.
Cosmic Ray Boosted Dark Matter at IceCube
arXiv:2405.00086, Physical Review D 110, 095031 (2024)

12. Bleau, K., Bramante, J., **Cappiello, C.**
How Effective is N_{eff} at Discovering Dark Radiation in a Cosmology with Heavy Particle Decay?
arXiv:2309.06482, JCAP 01 (2024) 021

11. **Cappiello, C.**, Jafs, M., Vincent, A.
The Morphology of Exciting Dark Matter and the Galactic 511 keV Signal
arXiv:2307.15114, JCAP 11 (2023) 003

10. Diamond, M., **Cappiello, C.**, Vincent, A., Bramante, J.
Limiting Light Dark Matter with Luminous Hadronic Loops
arXiv:2307.13727, Physical Review Letters 132, 051001 (2024)

9. **Cappiello, C.**
An Analytic Approach to Light Dark Matter Propagation
arXiv:2301.07728, Physical Review Letters 130, 221001 (2023)

8. **Cappiello, C.**, Avis Kozar, N., Vincent, A.
Dark Matter from Monogem
arXiv:2210.09448, Physical Review D 107, 035003 (2023)

7. Dhakal, P., Prohira, S., **Cappiello, C.**, Beacom, J., Palo, S., Marino, J.
New Constraints on Macroscopic Dark Matter Using Radar Meteor Detectors
arXiv:2209.07690, Physical Review D 107, 043026 (2023)

6. The Prospect Collaboration and **Cappiello, C.**
Limits on Sub-GeV Dark Matter from the PROSPECT Reactor Antineutrino Experiment
arXiv:2104.11219, Physical Review D 104, 012009 (2021)

5. **Cappiello, C.**, Collar, J.I., Beacom, J.
New Experimental Constraints in a New Landscape for Composite Dark Matter
arXiv:2008.10646, Physical Review D 103, 023019 (2021)

4. Digman, M., **Cappiello, C.**, Beacom, J., Hirata, C., Peter, A.
Not as Big as a Barn: Upper Bounds on Dark Matter-Nucleus Cross Sections
arXiv:1907.10618, Physical Review D 100, 063013 (2019)

3. **Cappiello, C.**, and Beacom, J.
Strong New Limits on Light Dark Matter from Neutrino Experiments
arXiv:1906.11283, Physical Review D 100, 103011 (2019)

2. **Cappiello, C.**, Ng, K., Beacom, J.
Reverse Direct Detection: Cosmic Ray Scattering With Light Dark Matter
arXiv:1810.07705, Physical Review D 99, 063004 (2019) (*Featured as Editor's Suggestion*)

1. **Cappiello, C.**
A Closer Look at Function Transformations
Mathematics Teacher. 106 (8): 630-34. (2013)

Software

- DarkInferno (2025) — Code for modeling heat flow in the Earth's core due to dark matter annihilation. (Code, v0.1.0, Available on GitHub and zenodo)
- DMprop (2023) — Publicly available code for modeling the propagation of sub-GeV dark matter in the Earth's crust and atmosphere. (Code, v0.1.0, Available on GitHub)

Mentoring/Supervising

2025-2026	Icarus Scoville, High School Student. Helped supervise research on neutrino interactions in direct detection experiments
2024-2026	Jose Padron, MSc Candidate, Washington University. Helped supervise Master's thesis research on interactions between GZK neutrinos and the cosmic neutrino background.
2024-2025	Zamiul Alam, Graduate Student, Washington University. Supervised research on inelastic dark matter scattering in the Earth.
2023	Katarina Bleau, MSc Candidate, Queen's University. Helped supervise Master's thesis research on N_{eff} constraints on light dark matter, which was published in JCAP.
2023	Ivanna Boras, Summer Research and Outreach Fellow, Queen's University. Supervised an undergraduate summer research project on scattering of sub-GeV dark matter in the Earth's crust, which was presented at the Canadian Conference for Undergraduate Women in Physics.
2021–2023	Neal Avis Kozar, PhD Candidate, Queen's University. Supervised a research project on boosted dark matter in the framework of nonrelativistic effective field theory, which was published in Physical Review D.
2019–2023	Pawan Dhakal, MSc, The Ohio State University. Helped supervise Master's thesis research on macroscopic dark matter, which was published in Physical Review D.

Awards, Fellowships, & Grants

Grant Proposals Submitted as Co-I

2026 **ADAP**, NASA

Awards, Fellowships and Grants Awarded

2024 **Edwin Thompson Jaynes Postdoctoral Fellowship**, Washington University

2023 **Postdoctoral Scholar Award**, Arthur B. McDonald Canadian Astroparticle Physics Research Institute

2019	**Student Travel Award**, Division of Particles and Fields, American Physical Society
2016	**Student Travel Grant**, Division of Astrophysics, American Physical Society
2015	**DeForest Pioneers Prize for Distinguished Creative Achievement in Physics**, Yale University
2015	**University Fellowship**, The Ohio State University
2013	**Yale College Dean's Research Fellowship**, Yale University
2013	**Richter Summer Fellowship**, Yale University
2011	**Brown Fellows Award**, Centre College
2010	**National Merit Scholar**, National Merit Scholarship Corporation
2009	**American Invitational Mathematics Examination Qualifier**, Mathematical Association of America

Service & Outreach

Public Talks

Nov 21, 2025	"From Variable Stars to Dark Matter: The Expanding Legacy of Henrietta Leavitt", Departments of Physics and Performing Arts Colloquium, Washington University
Mar 29, 2025	"Searching for Dark Matter with Cosmic Rays", Society of Physics Students Zone 12 Meeting, Washington University
Nov 4, 2023	"Theory and Future of Dark Matter Physics", Dark Matter Day, Queen's University

Washington University

Fall 2025	TeVPA 2025, Indirect Detection Session Convener
Fall 2025–	Postdoc Peer Mentorship Program, Mentor
Spring 2025–	Particle Physics Journal Club, Organizer
March 2025	APS Global Physics Summit, Dark Matter Session Chair
2024–2025	Jaynes Fellowship Search Committee, Member
Fall 2024	Astromusers Journal Club, Organizer

Queen's University

May 2024	APS DPF Meeting/Phenomenology Symposium 2024, Beyond-Standard-Model-Physics Session Convener
2022 & 2024	Departmental Research Support Committee, Postdoc Representative
2022–2024	Science Rendezvous Kingston, Planning and Demo Station Volunteer
Summer 2023	Summer Research and Outreach Fellow Program, Undergraduate Research Project Supervisor
June 2023	1st Workshop on Boosted Dark Matter, Session Convener
June 2023	XVI International Conference on Interconnections between Particle Physics and Cosmology (PPC 2023), Dark Matter Session Convener
August 2022	TeVPA 2022, Dark Matter Session Convener and Organizing Volunteer

The Ohio State University

2017–2021	CCAPP Astroparticle Lunch, Weekly Journal Club Organizer
2016–2019	Breakfast of Science Champions (Annual Event), Assistant Instructor
April 2018	Global Star Party, Volunteer
August 2017	TeVPA 2017, Organizing Volunteer

Summer 2016 Ohio Supercomputer Center Summer Institute, Instructor
Summer 2016 OSU Young Scholars Program, Assistant Instructor

Peer Review

2024– Physical Review D
2023– Journal of Cosmology and Astroparticle Physics
2021– Physical Review Letters
2021– Physics Letters B

Grant Review

2025 Agencia Nacional de Investigación y Desarrollo (ANID), Chile

Presentations

Invited Talks

Can a Dark Inferno Melt the Earth's Core? Nature of Dark Matter Seminar, Yale University. January 29, 2026. (Virtual)

Dark Matter Scattering in the Earth: The Good, the Bad, and the Melting of the Planet's Core. Jaynes Fellowship Symposium, Washington University. December 3, 2025.

Can a Dark Inferno Melt the Earth's Core? Structure and Evolution of Astronomical Objects Workshop. December 3, 2025. (Virtual)

Producing and Accelerating Light Dark Matter with Supernovae. University of Melbourne, Melbourne, Victoria, Australia. August 13, 2025. (Virtual)

Can a Dark Inferno Melt Earth's Core? CETUP*, Lead, SD. June 18, 2025.

Upscattering Inelastic Dark Matter in the Earth. Mitchell Conference on Collider, Dark Matter, and Neutrino Physics, Texas A&M University, College Station, TX. May 14, 2025.

Dark Matter Phenomenology: From MeV to Meteors. Jaynes Fellowship Symposium, Washington University, St. Louis, MO. November 13, 2024.

Cosmic Ray-Boosted Dark Matter at IceCube. Theory Seminar, Washington University, St. Louis, MO. September 19, 2024.

Cosmic Ray-Boosted Dark Matter at IceCube. CNP Seminar, Virginia Tech, Blacksburg, VA. May 22, 2024.

An Analytic Approach to Light Dark Matter Propagation. Washington University, St. Louis, MO. December 14, 2023. (Virtual)

The Morphology of Exciting Dark Matter and the Galactic 511 keV Signal. TEPAPP Seminar, UCLA, Los Angeles, CA. October 4, 2023. (Virtual)

An Analytic Approach to Light Dark Matter Propagation. GUINEAPIG Workshop, Université de Montréal, Montreal, QC. July 13, 2023.

An Analytic Approach to Light Dark Matter Propagation. CETUP*, Lead, SD. June 22, 2023.

Boosting Light Dark Matter with Cosmic Rays and Supernovae. 1st Workshop on Boosted Dark Matter, Institute for Basic Science, Daejeon, South Korea. June 16, 2023.

An Analytic Approach to Light Dark Matter Propagation. LSSU Seminar, Jeonbuk National University, Jeonju, South Korea. June 8, 2023.

Boosting Light Dark Matter with Cosmic Rays and Supernovae. Dark Matter Beyond the Weak Scale, University of Liverpool, Liverpool, UK. March 30, 2023.

An Analytic Approach to Light Dark Matter Propagation. TPPC Seminar, King's College London, London, UK. March 24, 2023.

An Analytic Approach to Light Dark Matter Propagation. IPPP Seminar, Durham University, Durham, UK. March 23, 2023.

An Analytic Approach to Light Dark Matter Propagation. PandaX DM + nu Forum, Tsung-Dao Lee Institute, Shanghai Jiao Tong University, Shanghai, China. February 15, 2023. (Virtual)

Boosting Light Dark Matter with Cosmic Rays and Supernovae. Particle Physics Seminar, Carleton University, Ottawa, ON. November 21, 2022.

Boosting Light Dark Matter with Cosmic Rays and Supernovae. Mitchell Institute Seminar, Texas A&M University, College Station, TX. October 12, 2022.

Probing the Landscape of Heavy, Strongly Interacting, and Composite Dark Matter. Mega Dark Matter: Theory and Detection. Mainz Institute for Theoretical Physics, Mainz, Germany. May 2, 2022.

Probing the Landscape of Heavy, Strongly Interacting, and Composite Dark Matter. Particle Physics Seminar, Perimeter Institute for Theoretical Physics, Waterloo, ON. April 19, 2022.

Probing the Landscape of Heavy, Strongly Interacting, and Composite Dark Matter. McDonald Institute Seminar, Queen's University, Kingston, ON. October 14, 2021.

Probing the Landscape of Heavy, Strongly Interacting, and Composite Dark Matter. TEPAPP Seminar, UCLA, Los Angeles, CA. February 2, 2021. (Virtual)

New Experimental Constraints in a New Landscape for Composite Dark Matter. TRIUMF, Vancouver, BC. December 16, 2020. (Virtual)

Panels

Dark Matter Detection: Status and Prospects. New Horizons in Astro and Particle Theory. Queen's University, Kingston, ON. August 6–7, 2022.

Contributed Talks

Cappiello, C., Alam, Z., Ferrer, F. *Inelastic Dark Matter Boosted by Terrestrial Collisions.* TeVPA 2025. Valencia, Spain. November 4, 2025.

Cappiello, C., Alam, Z., Ferrer, F. *Upscattering Inelastic Dark Matter in the Earth.* PPC 2025. Deadwood, SD. June 24, 2025.

Cappiello, C., Daylan, T. *Can a Dark Inferno Melt Earth's Core?.* 246th Meeting of the American Astronomical Society. Anchorage, AK. June 11, 2025.

Cappiello, C., Dev, B., Patwardhan, A. *A New Supernova Bound on Neutrinophilic Dark Matter.* APS Global Physics Summit 2025. Anaheim, CA. March 19, 2025.

Cappiello, C., Liu, Q., Mohlabeng, G., Vincent, A. *Cosmic Ray-Boosted Dark Matter at IceCube.* Particle Physics on the Plains 2024. Lawrence, KS. November 2, 2024.

Cappiello, C., Liu, Q., Mohlabeng, G., Vincent, A. *Cosmic Ray-Boosted Dark Matter at IceCube.* TeVPA 2024. Chicago, IL. August 27, 2024.

Cappiello, C., Liu, Q., Mohlabeng, G., Vincent, A. *Cosmic Ray-Boosted Dark Matter at IceCube.* DPF-Pheno 2024. Pittsburgh, PA. May 13, 2024.

Cappiello, C. *An Analytic Approach to Dark Matter Propagation.* PPC 2023. Daejeon, South Korea. June 13, 2023.

Cappiello, C. *An Analytic Approach to Dark Matter Propagation.* Phenomenology Symposium 2023. Pittsburgh, PA. May 8, 2023.

Cappiello, C. *An Analytic Approach to Dark Matter Propagation.* APS April Meeting 2023. Minneapolis, MN. April 17, 2023.

Cappiello, C., Avis Kozar, N., Vincent, A. *Dark Matter from Monogem: Constraints on Velocity-Dependent Dark Matter-Nucleus Scattering.* TeVPA 2022. Kingston, ON. August 9, 2022.

Cappiello, C., Andriamirado, M., Littlejohn, B. *Cosmic ray boosted dark matter at PROSPECT—theory and propagation.* APS April Meeting 2021. Virtual. April 20, 2021.

Cappiello, C., Collar, J.I., Beacom, J. *New Experimental Constraints in a New Landscape for Composite Dark Matter.* APS April Meeting 2020. Virtual. April 20, 2020.

Cappiello, C., Beacom, J. *Strong New Limits on Light Dark Matter from Neutrino Experiments.* 8th PIKIMO Meeting. Cincinnati, OH. November 2, 2019.

Cappiello, C., Beacom, J. *Strong New Limits on Light Dark Matter from Neutrino Experiments.* 2019 Meeting of the Division of Particles and Fields (DPF) of the American Physical Society. Boston, MA. August 1, 2019.

Cappiello, C., Beacom, J. *Strong New Limits on Light Dark Matter from Neutrino Experiments.* 2019 Phenomenology Symposium. Pittsburgh, PA. May 6, 2019.

Cappiello, C., Beacom, J. *Constraining Dark Matter with Cosmic Ray Interactions.* APS April Meeting 2019. Denver, CO. April 14, 2019.

Cappiello, C., Ng, K., Beacom, J. *Reverse Direct Detection: Cosmic Ray Tests of Light Dark Matter Elastic Scattering.* 2018 Phenomenology Symposium. Pittsburgh, PA. May 7, 2018.

Cappiello, C., Ng, K., Beacom, J. *Reverse Direct Detection: Cosmic Ray Tests of Light Dark Matter Elastic Scattering.* APS April Meeting 2018. Columbus, OH. April 14, 2018.

Cappiello, C., Ng, K., Beacom, J. *Reverse Direct Detection: Cosmic Ray Tests of Light Dark Matter Elastic Scattering.* TeVPA 2017. Columbus, OH. August 10, 2017.

Cappiello, C., Ng, K., Beacom, J. *Constraining Proton-Dark Matter Scattering Using Cosmic Ray Measurements.* APS April Meeting 2017. Washington, DC. January 29, 2017.

Poster Presentations

225th Meeting of the American Astronomical Society. Seattle, WA. January 4–8, 2015.

2014 Northeast Regional Sigma Xi Conference. Old Westbury, NY. April 26, 2014. Second Place Poster Presentation Award.

Annual Northeast Undergraduate Research and Development Symposium. Biddeford, ME. March 9, 2014.

Teaching Experience

Washington University

Oct 9, 2025 Guest Lecture, PHYSICS 3330/5330 (Planets and Life in the Universe)
Sept 30, 2025 Guest Lecture, PHYSICS 5820 (Research Seminar)

Invited Summer School Lecturer, Queen's University

May 4, 2023 "Direct and Indirect Detection of Dark Matter", Summer Particle Astrophysics Workshop

Teaching Assistant, The Ohio State University

Spring 2020 Astronomy 1141: Life in the Universe
Fall 2019 Astronomy 1101: From Planets to the Cosmos
Fall 2019 Astronomy 1141: Life in the Universe
Spring 2017 Astronomy 1101: From Planets to the Cosmos
Spring 2017 Astronomy 1144: Stars, Galaxies, & the Universe
Fall 2016 Physics 1250: Mechanics, Work and Energy, Thermal Physics

Professional Development

Summer Schools

University of Michigan Cosmology Summer School 2020. Cosmology summer school. Topics included 21 cm cosmology, the CMB, galaxy clusters, numerical simulations, and weak lensing. University of Michigan. June 2020. Virtual.

Erdős Institute 2020 Data Science Bootcamp. Summer school on data manipulation and analysis. Topics focused on Python-based data analysis and machine learning, particularly the pandas and scikit-learn libraries. The Ohio State University. May 2020. Virtual.

Neutron Star Mergers for Non Experts. Summer school covering a variety of physics related to GW170817. Topics included gravitational waves, kilonova observations, neutron star equation-of-state, numerical simulations of neutron star mergers, and r-process nucleosynthesis. Michigan State University. May 2018. East Lansing, MI, USA.

Tri-Institute Summer School on Elementary Particles (TRISEP). Summer school on particle physics. Topics included accelerator physics, dark matter models and detection, running simulations with Geant4, neutrino oscillations, neutrinoless double beta decay, and statistics in particle physics. SNOLAB. July 2017. Sudbury, ON, Canada.

Other Research Appointments

2014 **REU Intern**, Smithsonian Astrophysical Observatory, Harvard University
2011-2012 **Summer Research Intern**, Brown Cancer Center, University of Louisville

Professional Memberships

American Astronomical Society (AAS)
American Physical Society (APS)

Press

Trouw, "Donkere materie, waar moet je het zoeken?" ("Dark matter, where should you look?"), Link to Article. Press Piece. November 1, 2025.

Astrobites, "A dark matter journey to the centre of the Earth," Link to Article. Press Piece. June 15, 2025.

Cosmology Talks (YouTube Channel), "Melissa Diamond - If Dark Matter Interacts with Protons We Could See It Scatter Electrons," Link to Video. Interview. October 3, 2023.

WOSU Public Media, "Ohio State researchers use radar in the search for dark matter," Link to Article. Interview. December 13, 2022.

References

Prof. John Beacom (PhD Advisor)
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