

COSMIN ILIE

Astrophysicist and Cosmologist

Dark matter • First stars and galaxies • Early-universe cosmology

Colgate University
Department of Physics and Astronomy
Hamilton, NY

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[Faculty profile](#) | [Google Scholar](#) | [ORCID](#)
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ACADEMIC APPOINTMENTS

Colgate University

Department of Physics and Astronomy

Assistant Professor

Senior Lecturer

Visiting Assistant Professor

Lecturer and Research Associate

Hamilton, NY

2021–present

2020–2021

2018–2020

2016–2018

University of North Carolina at Chapel Hill

Postdoctoral Research Associate

2014–2016

Chapel Hill, NC

NASA and CREST Centers at North Carolina Central University

Postdoctoral Fellow

2013–2014

Durham, NC

National Institute for Physics and Nuclear Engineering

Scientific Researcher, 2013–2020; Postdoctoral Researcher, 2012–2013

Magurele, Romania

Los Alamos National Laboratory

Visitor, Subatomic Physics Group (P-25)

2011–2012

Los Alamos, NM

University of Michigan

Research Assistant

2008–2011

Ann Arbor, MI

EDUCATION

University of Michigan

Ph.D. in Physics

2011

Ann Arbor, MI

Advisor: Katherine Freese | Dissertation: *Selected Topics on the Dark Side*

University of Bucharest

B.S. in Theoretical Physics

2001

Bucharest, Romania

Thesis: *Path Integrals and Their Applications in Physics*

HONORS AND RESEARCH FUNDING

PRIZES

National Academy of Sciences Cozzarelli Prize

2023

FELLOWSHIPS

Department of Physics Fellowship, University of Michigan

2002

Romanian Government Fellowship

1997–2001

RESEARCH FUNDING

Picker Interdisciplinary Science Institute Major Grant, \$84,500; Role: PI; *Probing the Nature of Dark Matter with the First Stars and Galaxies in the Universe* Apr. 2024–Jun. 2026

New York Space Grant Faculty Fellowship, \$10,000; Role: PI; Grant No. 90830-20365; *The first stars in the Universe as Dark Matter probes* Nov. 2023–Jun. 2024

Rackham Graduate Student Research Grant, University of Michigan

2011

PUBLICATIONS

REFEREED JOURNAL ARTICLES

Undergraduate coauthors are marked [†]. Publication titles are linked to the journal or preprint record.

P24	A. A. Siddiqua ('28) [†] , S. Mahmud ('26) [†] , and C. Ilie. <i>Neural Network Identification of Dark Star Candidates. II. Spectroscopy</i> . <i>Astronomy and Computing</i> 58 , 101195.	2026
P23	S. Mahmud ('26) [†] , A. A. Siddiqua ('28) [†] , and C. Ilie. <i>Neural Network Identification of Dark Star Candidates. I. Photometry</i> . <i>Astronomy and Computing</i> 58 , 101182.	2026
P22	S. Ghodla and C. Ilie. <i>Reconstructing PTA Measurements via Early Seeding of Supermassive Black Holes</i> . <i>Physical Review D</i> 114 , L041303.	2026
P21	C. Ilie, K. Freese, A. Petric, and J. Paulin ('23) [†] . <i>Dark Stars as a Possible Solution to Three Recent Astronomical Puzzles</i> . <i>Universe</i> 12 , 1. Featured on the journal cover.	2026
P20	C. Ilie, S. Mahmud ('26) [†] , J. Paulin ('23) [†] , and K. Freese. <i>Spectroscopic Supermassive Dark Star Candidates</i> . <i>Proceedings of the National Academy of Sciences</i> 122 , e2513193122.	2025
P19	J. Diks ('25) [†] and C. Ilie. <i>Constraining Asymmetric Dark Matter Properties by Black Hole Formation in Neutron Stars and Population III Stars</i> . <i>Journal of Cosmology and Astroparticle Physics</i> 09 , 017.	2025
P18	R. Casey ('24) [†] and C. Ilie. <i>Dark Sector Tunneling Field Potentials for a Dark Big Bang</i> . <i>Physical Review D</i> 110 , 103522.	2024
P17	C. Ilie. <i>Closed-Form Expressions for Dark Matter Capture Rates</i> . <i>The Astrophysical Journal</i> 970 , 159.	2024
P16	C. Ilie, C. Levy ('23) [†] , and J. Diks ('25) [†] . <i>The Effectiveness of Exoplanets and Brown Dwarfs as Sub-GeV Dark Matter Detectors</i> . <i>Journal of Cosmology and Astroparticle Physics</i> 04 , 082.	2024
P15	S. Zhang ('19) [†] , C. Ilie, and K. Freese. <i>Detectability of Supermassive Dark Stars with the Roman Space Telescope</i> . <i>The Astrophysical Journal</i> 965 , 121.	2024
P14	C. Ilie, J. Paulin ('23) [†] , and K. Freese. <i>Supermassive Dark Star Candidates Seen by JWST</i> . <i>Proceedings of the National Academy of Sciences</i> 120 , e2305762120. Recipient of the 2023 National Academy of Sciences Cozzarelli Prize.	2023
P13	C. Ilie and J. Paulin ('23) [†] . <i>Analytic Approximations for the Velocity Suppression of Dark Matter Capture</i> . <i>The Astrophysical Journal</i> 932 , 46.	2022
P12	C. Ilie and C. Levy ('23) [†] . <i>Multicomponent Multiscatter Capture of Dark Matter</i> . <i>Physical Review D</i> 104 , 083033.	2021
P11	C. Ilie, C. Levy ('23) [†] , J. Pilawa ('20) [†] , and S. Zhang ('19) [†] . <i>Constraining Dark Matter Properties with the First Generation of Stars</i> . <i>Physical Review D</i> 104 , 123031.	2021
P10	C. Ilie, J. Pilawa ('20) [†] , and S. Zhang ('19) [†] . <i>Comment on “Multiscatter Stellar Capture of Dark Matter.”</i> <i>Physical Review D</i> 102 , 048301.	2020
P9	C. Ilie and S. Zhang ('19) [†] . <i>Multiscatter Capture of Superheavy Dark Matter by Population III Stars</i> . <i>Journal of Cosmology and Astroparticle Physics</i> 12 , 051.	2019
P8	C. Ilie. <i>Gamma-Ray Polarimetry: A New Window for the Non-Thermal Universe</i> . <i>Publications of the Astronomical Society of the Pacific</i> 131 , 111001.	2019
P7	M. Eingorn, L. Fernando, B. Vlahovic, C. Ilie, B. Wojtsekhowski, G. M. Urciuoli, F. De Persio, and F. Meddi. <i>A High-Energy Photon Polarimeter for Astrophysics</i> . <i>Journal of Astronomical Telescopes, Instruments, and Systems</i> 4 (1), 011006.	2018
P6	I. Waldstein, A. Erickcek, and C. Ilie. <i>A Quasi-Decoupled State for Dark Matter in Non-Standard Thermal Histories</i> . <i>Physical Review D</i> 95 , 123531.	2017
P5	B. Vlahovic, M. Eingorn, and C. Ilie. <i>Uniformity of the CMB as a Non-Inflationary Geometrical Effect</i> . <i>Modern Physics Letters A</i> 30 , 1530026.	2015
P4	C. Ilie, K. Freese, M. Valluri, I. T. Iliev, and P. Shapiro. <i>Observing Supermassive Dark Stars with the James Webb Space Telescope</i> . <i>Monthly Notices of the Royal Astronomical Society</i> 422 , 2164.	2012
P3	C. Ilie, K. Freese, and D. Spolyar. <i>Dark Stars and Boosted Dark Matter Annihilation Rates</i> . <i>New Journal of Physics</i> 13 , 053050.	2011
P2	K. Freese, C. Ilie, D. Spolyar, M. Valluri, and P. Bodenheimer. <i>Supermassive Dark Stars: Detectable in JWST</i> . <i>The Astrophysical Journal</i> 716 , 1397–1407.	2010
P1	C. Ilie, T. Biswas, and K. Freese. <i>Are We Seeing the Beginnings of Inflation?</i> <i>Physical Review D</i> 80 , 103521.	2009

OTHER PUBLICATIONS (NON-REFEREED)

- N2** C. Ilie, C. Levy ('23)[†], J. Pilawa ('20)[†], and S. Zhang ('19)[†]. *Probing Below the Neutrino Floor with the First Generation of Stars*. arXiv:2009.11478. Non-refereed letter companion to P11. 2020
- N1** K. Freese, E. Ruiz, M. Valluri, C. Ilie, D. Spolyar, and P. Bodenheimer. *Supermassive Dark Stars: Detectable in JWST and HST*. *AIP Conference Proceedings* **1294**. 2010

MANUSCRIPTS UNDER REVIEW

- S2** C. Ilie. *JWST's Little Red Dots as Collapsed Supermassive Dark Stars*. *The Astrophysical Journal Letters* (Revise and Resubmit, revision submitted September 2026). arXiv:2606.02539. 2026
- S1** K. Freese, G. M. Fuller, S. Ghodla, C. Ilie, K. S. Kehrer, T. Rindler-Daller, and E. I. Sfakianakis. *Early Formation of Supermassive Black Holes via Dark Star Gravitational Instability*. *Proceedings of the National Academy of Sciences* (Revise and Resubmit, revision submitted September 2026). arXiv:2511.08578. 2025

INVITED TALKS

- Dark Stars: A Review** 2026
Identification of Dark Matter 2026, Zaragoza, Spain
- Dark Stars** (special evening 1-hour talk) 2026
Lake Louise Winter Institute, Lake Louise, Alberta, Canada
- Dark Stars and Their Supermassive Remnants** 2025
Space Telescope Science Institute, Galaxies and AGN Seminar
- Dark Stars: A Possible Solution to Two Key Astronomical Puzzles** 2024
Simons Foundation Center for Computational Astrophysics, New York, NY
- Dark Matter and the First Stars** (keynote address) 2024
Lake Louise Winter Institute, University of Alberta, Canada
- JWST: A New Era for the First Stars and Galaxies as Dark Matter Probes** 2024
Dark Matter, First Light workshop, Perimeter Institute, Waterloo, Ontario, Canada
- The First Generation of Stars as Dark Matter Probes** 2022
XENON Collaboration Seminar
- What can the first generation of stars tell us about dark matter?** 2020
Colgate University, NASC Colloquium, Hamilton, NY
- Cyclic Inflation in Phantom Cosmologies** 2012
IFIN-HH DFT Seminar, Magurele, Romania
- Dark Stars and Their Detectability** 2011
SF11 Cosmology Summer Workshop, Santa Fe, NM

CONTRIBUTED CONFERENCE TALKS IN THE PAST 5 YEARS

- Dark Stars: A Possible Solution to Two Recent Astronomical Puzzles** 2025
Dark Matter and Stars international conference, Kingston, Ontario, Canada
- Dark Stars: A Possible Solution to Two Recent Astronomical Puzzles** 2025
Dark Side of the Universe conference, Montreal, Canada
- Supermassive Dark Stars and Their Remnants** 2024
The Origin and Evolution of Supermassive Black Holes, Sexten, Italy
- Probing the Nature of Dark Matter with the First Stars and Galaxies in the Universe** 2024
Identification of Dark Matter conference, L'Aquila, Italy
- Supermassive Dark Star Candidates in JWST Data** 2023
American Astronomical Society 242nd Meeting, Albuquerque, NM
- Using the Roman Space Telescope to Find Supermassive Dark Stars** 2023
Roman Emerging Science Conference, Space Telescope Science Institute, Baltimore, MD
- The First Stars in the Universe as Dark Matter Laboratories** 2023
Dark Matter 2023, Santander, Spain

Probing Below the Neutrino Floor with the First Generation of Stars American Physical Society April Meeting, New York, NY	2022
Population III Stars as Dark Matter Laboratories Dark Matter 2021, Madrid, Spain (virtual)	2021
Probing Below the Neutrino Floor with the First Generation of Stars PHENO 2021, Pittsburgh, PA (virtual)	2021

RESEARCH VISIBILITY AND PUBLIC ENGAGEMENT

Selected coverage from more than 200 news stories, interviews, and videos includes:

- *Epsilon*, “Étoiles noires : le nouvel espoir” (cover story, 2026)
- *New Scientist*, “We may have discovered the first-ever stars powered by dark matter” (2025)
- NPR *Science Friday*, “Have Astrophysicists Spotted Evidence For ‘Dark Stars?’” (2025)
- *New Scientist*, “Dark stars: Have we finally found a weird sun powered by dark matter?” (cover feature, 2023)
- Reuters, “Webb telescope captures tantalizing evidence for mysterious ‘dark stars’” (2023)
- PBS *Space Time*, “Did JWST Discover Dark Matter Stars?” (2023; 1.5M+ YouTube views)
- *Scientific American*, “JWST Might Have Spotted the First Dark Matter Stars” (2023)
- *El País*, “¿Existen las estrellas oscuras?” (2023)
- *National Geographic France*, “Des astrophysiciens pensent avoir repéré des ‘étoiles noires’ pour la première fois” (2023)
- *Astronomy*, “Dark stars come into the light” (2018)
- BBC Future, “Did ‘dark stars’ help form the Universe?” (2016)

TEACHING

COURSES TAUGHT AT COLGATE UNIVERSITY

Core curriculum	CORE S122, <i>Our Universe: 95% Unknown</i>	Fall 2026
Introductory	PHYS 105, <i>Mechanical Physics</i>	Fall 2024
	PHYS 112, <i>Fundamental Physics II</i>	Spring 2019, 2021–2022
	PHYS 131, <i>Atoms and Waves</i>	Fall 2016–2017, 2020
Intermediate	PHYS 205, <i>Mathematical Methods of Physics</i>	Fall 2022; Spring/Fall 2024
	PHYS 232, <i>Introduction to Mechanics</i>	Spring 2020
Advanced	ASTR 414, <i>Astrophysics</i>	Spring 2018, 2020, 2022, 2024, 2026
	PHYS 431, <i>Classical Mechanics</i>	Fall 2018–2023
	PHYS 432, <i>Electromagnetism</i>	Spring 2017
	PHYS 456, <i>Relativity and Cosmology</i>	Spring 2019, 2023
Capstone and independent research	PHYS 410, <i>Advanced Topics and Experiments</i>	Fall 2016–2020, 2022–2025
	PHYS 491, <i>Independent Study</i>	Spring 2017
	PHYS 492 / ASTR 492, <i>Independent Study – Research</i>	Spring 2019–2021, 2023–2026

PROFESSIONAL SERVICE

SERVICE TO THE PROFESSION

Proposal Reviewer, NASA FINESST grant program	2025
Mentor, KNAC Summer Research Program	2025
Reviewer, <i>The Astrophysical Journal</i>	2022–present
Reviewer, <i>Journal of Cosmology and Astroparticle Physics</i>	2024–present
Reviewer, <i>Astronomy & Astrophysics</i>	2025–present
Manuscript Reviewer, Princeton University Press	2024–present
Conference Session Chair, Lake Louise Winter Institute	2024, 2026
Session Organizer, <i>The First Stars and Their Remnants as Dark Matter Probes</i> , Marcel Grossmann XVII Meeting, Pescara, Italy	2024
Organizer, APS Lilienfeld Prize Public Lecture, Colgate University; speaker: Katherine Freese	2019

INSTITUTIONAL AND DEPARTMENTAL SERVICE

Departmental Subcommittee on AI in Teaching	2026–present
Colgate University Research Council	2025–present
Departmental Assessment Coordinator	2024–present
Sigma Pi Sigma Advisor	2024–present
Physics and Astronomy VAP and TS Search Committees	2023–present
Colgate University STARS Program Mentor	2023
Goldwater and Churchill Fellowships Committee	2022–present
Colgate University Summer Funding Review Committee	2022
Physics and Astronomy Seminar Organizer	2021–2024

UNDERGRADUATE RESEARCH MENTORING

Colgate Honors and High Honors undergraduate research mentees.

Sayed Shafaat Mahmud <i>Dark stars</i>	2023–2026
• Coauthored a <i>PNAS</i> publication on spectroscopic dark-star candidates. • Coauthored two publications in <i>Astronomy and Computing</i> describing new machine-learning tools for identifying photometric and spectroscopic supermassive dark-star candidates. • Research awards and distinctions: Edwin Foster Kingsbury Prize; Phi Beta Kappa Saracino Prize. • Presented our work at multiple national and international conferences. • Ph.D. student at Carnegie Mellon University.	
Jared Diks <i>Astrophysical objects as dark-matter probes</i>	2022–2025
• Coauthored two publications in <i>JCAP</i>, on black-hole constraints on asymmetric dark matter and on exoplanets and brown dwarfs as sub-GeV dark-matter detectors. • Research awards and distinctions: Amato/Aveni Departmental Award for exceptional research; American Physical Society LeRoy Apker Award nominee. • Presented our work at multiple national and international conferences.	
Lance Chen <i>Nebular emission from supermassive dark stars</i>	2023–2025
• Presented our work at the APS April Meeting and the NY6 Undergraduate Research Conference. • M.S. student in Medical Physics at the University of Wisconsin–Madison.	
Richard Casey <i>Theoretical models of dark matter</i>	2023–2024
• Coauthored a publication in <i>Physical Review D</i> on the dark big bang. • Research awards and distinctions: Physics and Astronomy Department Founders Award. • Presented our work at several international conferences. • Scientist at SLAC National Accelerator Laboratory.	
Jillian Paulin <i>Dark stars and astrophysical dark-matter probes</i>	2020–2023
• Coauthored three publications on dark stars: two in <i>PNAS</i> and one in <i>Universe</i>. • Coauthored a publication in <i>The Astrophysical Journal</i> on the velocity suppression of dark-matter capture. • Research awards and distinctions: Goldwater Scholar; LeRoy Apker Award national finalist; Amato/Aveni Departmental Award. • Presented our work at multiple national and international conferences. • Ph.D. candidate at the University of Pennsylvania.	
Caleb Levy <i>Astrophysical objects as dark-matter probes</i>	2020–2023
• Coauthored four publications on dark-matter capture and first stars: two in <i>Physical Review D</i>, one in <i>JCAP</i>, and one non-refereed letter. • Research awards and distinctions: APS Beth Brown Memorial Award; Phi Beta Kappa Saracino Prize. • Presented our work at multiple national and international conferences. • Ph.D. student at Harvard University.	
Ian Bania <i>Dark matter in Population III stars</i>	2020–2021
• Research awards and distinctions: Amato/Aveni Departmental Award. • Engineer at IERUS Technologies Inc., Huntsville, Alabama.	

Jacob Pilawa <i>Dark-matter capture in Population III stars</i> • Coauthored three publications on dark-matter capture and first stars: two in <i>Physical Review D</i> and one non-refereed letter. • Research awards and distinctions: Physics and Astronomy Alumni Award; American Physical Society LeRoy Apker Award nominee. • Earned Ph.D. from the University of California, Berkeley, June 2026.	2019–2020
Saiyang Zhang <i>Non-WIMP dark-matter capture by the first stars</i> • Coauthored five publications on dark-matter capture and first stars: one in <i>The Astrophysical Journal</i>, two in <i>Physical Review D</i>, one in <i>JCAP</i>, and one non-refereed letter. • Research awards and distinctions: Amato/Aveni Departmental Award. • Earned a Ph.D. from the University of Texas at Austin in 2026. • Postdoctoral fellow at the Canadian Institute for Theoretical Astrophysics, Toronto.	2018–2019
Jonah Kudler-Flam <i>Cosmological perturbations</i> • Research awards and distinctions: Phi Beta Kappa Saracino Prize; American Physical Society LeRoy Apker Award nominee. • Earned a Ph.D. from the University of Chicago in 2022. • Marvin L. Goldberger Member at the Institute for Advanced Study, Princeton.	2016–2017