Hongwan Liu

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Employment

Assistant Professor of Physics, Boston University	2024 -
Fellow, Kavli Institute of Cosmological Physics, University of Chicago	2023 - 2024
Schramm Fellow in Theoretical Astrophysics, Fermilab	2023 - 2024
Postdoctoral Associate, New York University	2019 - 2023
Postdoctoral Associate, Princeton University	2019 - 2023

Education

Massachusetts Institute of Technology 2014 - 2019

Doctor of Philosophy in Physics

Thesis: Dark Matter Energy Deposition and Production from the Table-Top to the Cosmos
Advisor: Tracy R. Slatyer
Committee: Tracy R. Slatyer, Jesse Thaler, Kerstin Perez

Cornell University 2007 - 2011

Bachelor of Arts in Physics (summa cum laude) & Mathematics (cum laude)

Awards and Honors

Schramm Fellowship in Theoretical Astrophysics, Fermilab	2023
Andrew M. Lockett III Memorial Fund Award, MIT Physics Department	2019
Henry Kendall Teaching Award, MIT Physics Department	2016
Yennie Prize, Cornell Physics Department	2011

Highlighted Papers and h-Index

Citation count and h-index from Google Scholar.

All authors listed alphabetically following the high-energy physics convention, except †.

Google Scholar h-index: 16

1. **Hongwan Liu**, Tracy R. Slatyer and Jesús Zavala, "Contributions to Cosmic Reionization from Dark Matter Annihilation and Decay", *Physical Review* D 94, 063507 (2016), arXiv:1604.02457.
Citations: 196

2. **Hongwan Liu**, Nadav J. Outmezguine, Diego Redigolo and Tomer Volansky, "Reviving Millicharged Dark Matter for 21-cm Cosmology", *Physical Review* D 100, 123011 (2019), arXiv:1908.06986.
Citations: 134

3. **Hongwan Liu** and Tracy R. Slatyer, "Implications of a 21-cm Signal for Dark Matter Annihilation and Decay", *Physical Review* D 98, 023501 (2018), arXiv:1803.09739.
Citations: 127

4.† **Hongwan Liu**, Brodi D. Elwood, Matthew Evans and Jesse Thaler, "Searching for Axion Dark Matter with Birefringent Cavities", *Physical Review* D 100, 023548 (2019), arXiv:1809.01656.
Citations: 114

5. Andrea Caputo, **Hongwan Liu**, Siddharth Mishra-Sharma and Joshua T. Ruderman, "Dark Photon Oscillations in Our Inhomogeneous Universe", *Physical Review Letters* 125, 221303 (2020), arXiv:2002.05165.
Citations: 101

Publications

All authors listed alphabetically following the high-energy physics convention, except †.

28. Cara Giovanetti, Mariangela Lisanti, **Hongwan Liu**, Siddharth Mishra-Sharma and Joshua T. Ruderman, "LINX: A Fast, Differentiable and Extensible Big Bang Nucleosynthesis Package", submitted to *Physical Review* D, arXiv:2408.14538

27. Cara Giovanetti, Mariangela Lisanti, **Hongwan Liu**, Siddharth Mishra-Sharma and Joshua T. Ruderman, "Cosmological Parameter Estimation with a Joint-Likelihood Analysis of the Cosmic Microwave Background and Big Bang Nucleosynthesis", to be submitted to *Physical Review Letters*, arXiv:2408.14531

26† Yitian Sun, Joshua W. Foster, **Hongwan Liu**, Julian B. Muñoz and Tracy R. Slatyer, "Inhomogeneous Energy Injection in the 21-cm Power Spectrum: Sensitivity to Dark Matter Decay", submitted to *Physical Review* D, arXiv:2312.11608

25† Wenzer Qin, Julian B. Muñoz, **Hongwan Liu** and Tracy R. Slatyer, "Birth of the First Stars Amidst Decaying and Annihilating Dark Matter", *Physical Review* D 109, 103026 (2024), arXiv:2308.12992

24. **Hongwan Liu**, Wenzer Qin, Gregory W. Ridgway and Tracy R. Slatyer, "Exotic Energy Injection in the Early Universe I: A Novel Treatment for Low-Energy Electrons and Photons", *Physical Review* D 108, 043530 (2023), arXiv:2303.07366

23. Asher Berlin, **Hongwan Liu**, Maxim Pospelov and Harikrishnan Ramani, "The Terrestrial Density of Strongly-Coupled Relics", *Physical Review* D 109, 075027 (2024), arXiv:2302.06619

22. Rennan Barkana, Anastasia Fialkov, **Hongwan Liu** and Nadav Joseph Outmezguine, "Anticipating a New-Physics Signal in Upcoming 21-cm Power Spectrum Observations", *Physical Review* D 108, 063503 (2023), arXiv:2212.08082

21. James S. Bolton, Andrea Caputo, **Hongwan Liu** and Matteo Viel, "Comparison of Low-Redshift Lyman-α Forest Observations to Hydrodynamical Simulations with Dark Photon Dark Matter", *Physical Review Letters* 129, 211102 (2022), arXiv:2206.13520

20. Andrea Caputo, **Hongwan Liu**, Siddharth Mishra-Sharma, Maxim Pospelov and Joshua T. Ruderman, "Radio Excess from Stimulated Dark Matter Decay", *Physical Review* D 107, 123033 (2023), arXiv:2206.07713

19.† Adriana Dropulic, **Hongwan Liu**, Bryan Ostdiek and Mariangela Lisanti, "Revealing the Milky Way's Most Recent Major Merger with a *Gaia* EDR3 Catalog of Machine-Learned Line-of-Sight Velocities", *Monthly Notices of the Royal Astronomical Society* 521, 1633-1645 (2023), arXiv:2205.12278

18. Asher Berlin, **Hongwan Liu**, Maxim Pospelov and Harikrishnan Ramani, "Low-Energy Signals from the Formation of Dark Matter-Nuclear Bound States", *Physical Review* D 105, 095028 (2022), arXiv:2110.06217

17. Cara Giovanetti, Mariangela Lisanti, **Hongwan Liu** and Joshua T. Ruderman, "Joint Cosmic Microwave Background and Big Bang Nucleosynthesis Constraints on Light Dark Sectors with Dark Radiation", *Physical Review Letters* 129, 021302 (2022), arXiv:2109.03246

16. Patrick J. Fitzpatrick, **Hongwan Liu**, Tracy R. Slatyer and Yu-Dai Tsai, "New Thermal Relic Targets for Inelastic Vector-Portal Dark Matter", *Physical Review* D 106, 083507 (2022), arXiv:2105.05255

15.† Adriana Dropulic, Bryan Ostdiek, Laura J. Chang, **Hongwan Liu**, Timothy Cohen and Mariangela Lisanti, "Machine Learning the 6th Dimension: Stellar Radial Velocities from 5D Phase-Space Correlations", *The Astrophysical Journal Letters* 915, L14 (2021), arXiv:2103.14039

14. Patrick J. Fitzpatrick, **Hongwan Liu**, Tracy R. Slatyer and Yu-Dai Tsai, "New Pathways to the Relic Abundance of Vector-Portal Dark Matter", *Physical Review* D 106, 083517 (2022), arXiv:2011.01240

13. Andrea Caputo, **Hongwan Liu**, Siddharth Mishra-Sharma, Maxim Pospelov, Joshua T. Ruderman and Alfredo Urbano, "Edges and Endpoints in 21-cm Observations from Resonant Photon Production", *Physical Review Letters* 127, 011102 (2021), arXiv:2009.03899
12. **Hongwan Liu**, Wenzer Qin, Gregory W. Ridgway and Tracy R. Slatyer, Lyman-α "Constraints on Cosmic Heating from Dark Matter Annihilation and Decay", *Physical Review* D 104, 043514 (2021), arXiv:2008.01084
11. Masha Baryakhtar, Asher Berlin, **Hongwan Liu** and Neal Weiner, "Electromagnetic Signals of Inelastic Dark Matter Scattering", *Journal of High Energy Physics* 06, 047 (2022), arXiv:2006.13918
10. Andrea Caputo, **Hongwan Liu**, Siddharth Mishra-Sharma and Joshua T. Ruderman, "Modeling Dark Photon Oscillations in Our Inhomogeneous Universe", *Physical Review* D 102, 103533 (2020), arXiv:2004.06733
9. Andrea Caputo, **Hongwan Liu**, Siddharth Mishra-Sharma and Joshua T. Ruderman, "Dark Photon Oscillations in Our Inhomogeneous Universe", *Physical Review Letters* 125, 221303 (2020), arXiv:2002.05165
8. **Hongwan Liu**, Nadav J. Outmezguine, Diego Redigolo and Tomer Volansky, "Reviving Millicharged Dark Matter for 21-cm Cosmology", *Physical Review* D 100, 123011 (2019), arXiv:1908.06986
7. **Hongwan Liu**, "Dark Matter Energy Deposition and Production from the Table-Top to the Cosmos", arXiv:1907.04324 (*PhD Thesis*)
6. **Hongwan Liu**, Gregory W. Ridgway and Tracy R. Slatyer, "DarkHistory: A Code Package for Calculating Modified Cosmic Ionization and Thermal Histories with Dark Matter and other Exotic Energy Injections", *Physical Review* D 101, 023530 (2020), arXiv:1904.09296
5† **Hongwan Liu**, Brodi D. Elwood, Matthew Evans and Jesse Thaler, "Searching for Axion Dark Matter with Birefringent Cavities", *Physical Review* D 100, 023548 (2019), arXiv:1809.01656
4. **Hongwan Liu** and Tracy R. Slatyer, "Implications of a 21-cm Signal for Dark Matter Annihilation and Decay", *Physical Review* D 98, 023501 (2018), arXiv:1803.09739
3. Gilly Elor, **Hongwan Liu**, Tracy R. Slatyer and Yotam Soreq, "Complementarity for Dark Sector Bound States", *Physical Review* D 98, 036015 (2018), arXiv:1801.07723
2. James M. Cline, **Hongwan Liu**, Tracy R. Slatyer and Wei Xue, "Enabling Forbidden Dark Matter", *Physical Review* D 96, 083521 (2017), arXiv:1702.07716
1. **Hongwan Liu**, Tracy R. Slatyer and Jesús Zavala, "Contributions to Cosmic Reionization from Dark Matter Annihilation and Decay", *Physical Review* D 94, 063507 (2016), arXiv:1604.02457

COLLOQUIA

† Upcoming.

2† **University of Wisconsin-Madison**, to be decided — Feb 2025

1. **University of Delaware**, "Discovering the Particle Physics of Dark Matter with Cosmology" — Mar 2023

Invited Seminars

† Upcoming.

49† **University of Florida**, to be decided — Dec 2024

48† **Brown University**, to be decided — Dec 2024

47† **Stony Brook University**, to be decided — Oct 2024

46. **Stanford University**, SITP Seminar, "Fast and Differentiable Big-Bang Nucleosynthesis" — May 2024

45. **National University of Singapore**, "Discovering Dark Matter with Cosmology" — Apr 2024

44. **University of Oklahoma**, High-Energy Physics Seminar, "Fast and Differentiable Big-Bang Nucleosynthesis" — Mar 2024

43. **University of Oregon**, Institute of Fundamental Sciences Seminar, "Fast and Differentiable Big-Bang Nucleosynthesis" — Mar 2024

42. **University of Illinois Urbana-Champaign**, High-Energy Physics Seminar, "Fast and Differentiable Big-Bang Nucleosynthesis" — Feb 2024

41. **Fermilab**, Theory Seminar, "Exotic Energy Injection in the Early Universe" — Feb 2024

40. **University of Michigan**, Brown Bag Seminar, "Exotic Energy Injection in the Early Universe" — Nov 2023

39. **City University of Hong Kong**, Research Seminar, "Exotic Energy Injection in the Early Universe" — Oct 2023

38. **Hong Kong University of Science and Technology**, IAS Program on Particle Theory, "Exotic Energy Injection in the Early Universe" — Oct 2023

37. **University of California, Davis**, QMAP Particles/Cosmology Seminar, "Cosmological Signatures of Dark Photons" — May 2023

36. **Nanjing Normal University**, Particle Physics Online Seminar Series, "Cosmological Signatures of Dark Photons" — May 2023

35. **Boston University**, High-Energy Theory Seminar, "Discovering the Particle Physics of Dark Matter with Cosmology" — Mar 2023

34. **University of Delaware**, Particle Theory Research Talk, "New Signatures of Dark Matter Energy Deposition" — Mar 2023

33. **Fermilab**, Cosmic Physics Center Seminar, "A Large New Physics Signal in the 21-cm Power Spectrum" — Dec 2022

32. **Lawrence Berkeley National Laboratory**, Particle Theory Seminar, "A Stimulating Explanation of the Extragalactic Radio Excess" — Sep 2022

31. **Boston University**, High-Energy Theory Seminar, "A Stimulating Explanation of the Extragalactic Radio Excess" — May 2022

30. **Johns Hopkins University**, Theoretical Particle Physics Seminar, "A Stimulating Explanation of the Extragalactic Radio Excess" — Apr 2022

29. **University of Southern California**, Cosmology Seminar, "A Stimulating Explanation of the Extragalactic Radio Excess" — Apr 2022

28. **McGill Space Institute**, Astronomy Seminar, "A Stimulating Explanation of the Extragalactic Radio Excess" — Mar 2022

27. **University of Maryland**, Elementary Particles Seminar, "Dark Photons and the Cosmic Radiation Background" — Dec 2021

26. **Tsung-Dao Lee Institute/Shanghai Jiao Tong University**, DM+ν Forum, "Low-Energy Signals from the Formation of Dark Matter-Nuclear Bound States" — Nov 2021
25. **BSM Pandemic**, Virtual Seminar, "Low-Energy Signals from the Formation of Dark Matter-Nuclear Bound States" — Nov 2021
24. **Cornell University**, Particle Theory Seminar, "Lyman-Alpha Constraints on Cosmic Heating from Dark Matter Annihilation and Decay" — Nov 2021
23. **University of California, Berkeley**, 4D Seminar, "New Aspects of Vector-Portal Dark Matter" — May 2021
22. **Caltech**, High-Energy Physics Seminar, "Dark Photons and the Cosmic Radiation Background" — Apr 2021
21. **University of Michigan**, Brown Bag Seminar, "Dark Photons and the Cosmic Radiation Background" — Apr 2021
20. **Perimeter Institute**, Particle Physics Seminar, "Dark Photons and the Cosmic Radiation Background" — Apr 2021
19. **Stanford University**, SITP Seminar, "Dark Photons and the Cosmic Radiation Background" — Feb 2021
18. **DESY**, Theory Seminar, "New Pathways to the Relic Abundance of Vector-Portal Dark Matter" — Feb 2021
17. **McDonald Institute**, McDonald Institute Seminar Series, "Lyman-Alpha Constraints on Cosmic Heating from Dark Matter Annihilation and Decay" — Jan 2021
16. **Massachusetts Institute of Technology**, CTP LHC/DM/BSM/QCD Meeting, "Dark Photon Oscillations in Our Inhomogeneous Universe" — Nov 2020
15. **Kavli Institute for Cosmological Physics, The University of Chicago**, KICP Seminar, "Dark Photon Oscillations in Our Inhomogeneous Universe" — Jun 2020
14. **Nanyang Technological University**, Physics and Applied Physics Seminar, "Axions, Dark Matter and Light Polarization" — Dec 2019
13. **Israeli Joint Particle Physics Meeting**, "Changing the History of the Universe During the Dark Ages" — Nov 2019
12. **Fermilab**, Cosmic Physics Center Seminar, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Dec 2018
11. **Perimeter Institute**, Particle Physics Seminar, "Searching for Axion Dark Matter with Birefringent Cavities" — Dec 2018
10. **Princeton University**, Pheno & Vino, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Dec 2018
9. **New York University**, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Nov 2018
8. **The Ohio State University**, CCAPP Seminar, "DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection" — Nov 2018
7. **Lawrence Berkeley National Laboratory**, LBNL Theory Seminar, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Oct 2018

6. **SLAC National Accelerator Laboratory**, Elementary Particle Physics Theory Seminar, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Oct 2018
5. **University of California, San Diego**, Particle Physics Seminar, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Oct 2018
4. **Brown University**, Astrophysics Seminar, "DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection" — Oct 2018
3. **University of California, Irvine**, Joint Particle Seminar, "From the Table-Top to the Cosmos: Searching High and Low for Dark Matter" — Sep 2018
2. **Harvard University**, Particle Physics In-House Luncheon, "Searching for Axion Dark Matter with Birefringent Cavities" — Sep 2018
1. **Harvard-Smithsonian Center for Astrophysics**, Journal Club Seminar, "21-cm Implications for Dark Matter Annihilation and Decay" — May 2018

Conferences and Workshops

† Upcoming.
* Invited talk.

22.* **Kavli Institute for Theoretical Physics Workshop: Cosmic Signals of Dark Matter Physics**, "Fast and Differentiable Big-Bang Nucleosynthesis", Santa Barbara, California, USA — Jun 2024
21.* **ALPS 2024**, "Fast and Differentiable Big-Bang Nucleosynthesis", Obergurgl, Austria — Apr 2024
20.* **2023 National Center for Theoretical Sciences Annual Theory Meeting**, "Cosmological Probes of Dark Photons", Taipei, Taiwan — Dec 2023
19.* **New Physics from Galaxy Clustering**, "Cosmological Signatures of Dark Photons", CERN, Meyrin, Switzerland — Nov 2022
18.* **Physics of This Universe**, "A Stimulating Explanation of the Extragalactic Radio Excess", Baltimore, Maryland, USA — May 2022
17.* **Aspen Winter Conference: New Methods and Ideas at the Frontiers of Particle Physics**, "Dark Photons and the Cosmic Radiation Background", Aspen, Colorado, USA — Mar 2022
16.* **AstroDark 2021**, "DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection", Virtual — Nov 2021
15.* **Computational Tools for High Energy Physics and Cosmology**, "DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection", Virtual — Nov 2021
14. **Aspen Summer: Dark Matter from the Laboratory to the Cosmos**, "Aspen Center for Physics", Aspen, Colorado, USA — Aug 2021
13.* **Aspen Winter Conference: A Rainbow of Dark Sectors 2021**, "Cosmological Probes of Dark Matter Energy Deposition", Virtual — Mar 2021
12.* **16th Rencontres du Vietname: TMEX 2020**, "Axions and the Polarization of Light", Quy Nhon, Vietnam — Jan 2020
11. **TeVPA 2019**, "Reviving Millicharged Dark Matter for 21-cm Cosmology", Sydney, Australia — Dec 2019

10. **APS DPF Meeting 2019**, "New Aspects of Millicharged Dark Matter at 21-cm", Boston, Massachusetts, USA — Jul 2019
9. **PASCOS 2019**, "New Aspects of Millicharged Dark Matter at 21-cm", Manchester, United Kingdom — Jul 2019
8.* **Beyond Standard Model: Where Do We Go from Here?**, "Axion Detection with Interferometry", Galileo Galilei Institute, Florence, Italy — Oct 2018
7. **TeVPA 2018**, "DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection", Berlin, Germany — Aug 2018
6. **IDM 2018**, "21-cm Implications for Dark Matter", Providence, Rhode Island, USA — Jul 2018
5.* **PASCOS 2018**, "21-cm Implications for Dark Matter Annihilation and Decay", Cleveland, Ohio, USA — Jun 2018
4. **Pheno 2018**, "Complementarity in Dark Sector Bound States", Pittsburgh, Pennsylvania, USA — May 2018
3. **TeVPA 2017**, "Enabling Forbidden Dark Matter", Columbus, Ohio, USA — Aug 2017
2. **Pheno 2017**, "Enabling Forbidden Dark Matter", Pittsburgh, Pennsylvania, USA — May 2017
1. **Cosmo 2016**, "The Darkest Hour Before Dawn: Contributions to Cosmic Reionization from Dark Matter Annihilation and Decay", Ann Arbor, Michigan, USA — Aug 2016

Teaching

Overall student evaluation ratings shown in parentheses where available.

Boston University *Faculty Instructor*

PY501 **Mathematical Physics** — Fall 2024

Massachusetts Institute of Technology *Graduate Teaching Assistant*

8.323 **Relativistic Quantum Field Theory I** (6.4/7.0) — Spring 2017
8.033 **Relativity** (6.4/7.0) — Fall 2016
8.323 **Relativity** (6.9/7.0) — Fall 2015

Mentoring

Postdoctoral Researchers

Xucheng Gan, DESY — 2024 -

Graduate Students

Ethan Baker, Boston University, *anticipated Ph.D. 2029* — 2024 -
Michelle Kwok, Boston University, *anticipated Ph.D. 2029* — 2024 -
Timothy Launders, Boston University, *anticipated Ph.D. 2029* — 2024 -

Tony Zilu Zhou, New York University, *Advisor: Neal Weiner* — 2023 -
Xucheng Gan, New York University, *Advisor: Joshua T. Ruderman* — 2023 - 2024

Zachary Gelles, Princeton University, *Advisor: Mariangela Lisanti*	2022 - 2023
Yitian Sun, MIT, *Advisor: Tracy R. Slatyer*	2022 - 2024
Shira Jackson, New York University, *Advisor: Neal Weiner*	2021 - 2023
Giorgi Arsenadze, New York University, *Advisor: Joshua T. Ruderman*	2021 -
Wenzer Qin, MIT, *Advisor: Tracy R. Slatyer*	2020 - 2023
Cara Giovanetti, Princeton University, *Advisor: Ken van Tilburg*	2020 -
Patrick Fitzpatrick, MIT, *Advisor: Tracy R. Slatyer*	2019 - 2022
Gregory W. Ridgway, MIT, *Advisor: Tracy R. Slatyer*	2018 - 2022

Undergraduate Students

Mehmet Akharman, Boston University, *anticipated B.A. 2026*	2024 -
Andreas Tsantilas, New York University, *Advisor: Neal Weiner*	2022 - 2023
Noah Luch, Princeton University, *Advisor: Mariangela Lisanti*	2022 - 2023
Cara Giovanetti, Princeton University, *Advisor: Mariangela Lisanti*	2019 - 2020
Brodi D. Elwood, MIT, *Advisor: Matthew Evans*	2018
Cannon M. Vogel, MIT, *Advisor: Tracy R. Slatyer*	2017 - 2019
Shi-Fan Stephen Chen, MIT, *Advisor: Tracy R. Slatyer*	2016 - 2017

High School Students

Gabriel Mintzer, Research Science Institute, MIT, *Advisor: Tracy R. Slatyer*	2016

Professional Activities and Services

Peer Review *since 2019*

Physical Review Letters, Journal of High Energy Physics, Physical Review D, Physics Letters B, Journal of Cosmology and Astroparticle Physics, and The European Physical Journal C.

Boston University Physics Department

Member, Colloquium Committee	2024 -
Member, Graduate Programs Committee	2024 -
Member, New Initiatives and Searches Committee	2024 -
Member, Website, Social Media and Marketing Committee	2024 -

Conferences

Cosmological and Astrophysical Probes of New Physics, PCTS, Princeton	2022

Seminars

Funch, KICP	2023 - 2024
High-Energy Theory Seminar, NYU	2021 - 2022
BSM PANDEMIC Delta Series, Virtual	2021
Pheno & Vino Off-Shell, Princeton, Virtual	2020 - 2021
BSM PANDEMIC Double Feature, Virtual	2020

Pheno & Vino, Princeton	2019 - 2020
Beyond the Standard Model Seminar, MIT	2017 - 2018

Outreach

Presentation to Leonia High School, Leonia, NJ, USA, Online	2022
Presentation to The Bement School, Deerfield, MA, USA, Online	2022
Presentation to Milton Hershey School, Hershey, PA, USA, Online	2020