

Hongwan Liu

PERSONAL DATA

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ADDRESS The Department of Physics at Boston University
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Boston, MA 02215
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WEBSITE <https://hongwanliu.github.io>

EMPLOYMENT

2024 – Assistant Professor of Physics, **Boston University**

2023 – 2024 Fellow, **Kavli Institute for Cosmological Physics, University of Chicago**
Schramm Fellow in Theoretical Astrophysics, **Fermilab**

2019 – 2023 Postdoctoral Associate, **New York University**
Postdoctoral Associate, **Princeton University**

EDUCATION

2014 – 2019 Doctor of Philosophy in Physics, **Massachusetts Institute of Technology**
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

2018 – 2019 Visiting Graduate Student, **Institute for Advanced Study**
Advisor: Tracy R. Slatyer

2007 – 2011 Bachelor of Arts, **Cornell University**
Physics, *summa cum laude* | Mathematics, *cum laude*

RESEARCH INTERESTS

I search for physics beyond the Standard Model. My work focuses on *1)* the impact of new physics on the cosmic history of our Universe, *2)* the particle physics of dark matter, and *3)* new experimental and statistical methods to transform our search for new physics.

HONORS AND AWARDS

- 2023 **Schramm Fellowship in Theoretical Astrophysics**, Fermilab
- 2022 **Physics Magazine Focus**, *Dark Matter as an Intergalactic Heat Source*, based on Bolton et al., Phys. Rev. Lett. 129, 211102 (2022)
- 2022 **Physical Review Letters Editors' Suggestion** for Giovanetti et al., Phys. Rev. Lett. 129, 021302 (2022)
- 2021 **American Astronomical Society NOVA Research Highlight**, *Filling in the Blanks with Machine Learning*, based on Dropulic et al., ApJL 915, L14 (2021)
- 2019 **Andrew M. Lockett III Memorial Fund Award**, MIT Physics Department
- 2018 **PITT PACC Travel Award**, University of Pittsburgh PITT PACC
- 2016 **Henry Kendall Teaching Award**, MIT Physics Department
- 2016 **Physical Review D Kaleidoscope** for Liu et al., Phys. Rev. D 94, 063507 (2016)
- 2011 **Yennie Prize**, Cornell Physics Department

PUBLICATIONS AND PREPRINTS

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

- [27[†]] 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](#)
- [26[†]] 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](#)

PUBLICATIONS AND PREPRINTS (CONTINUED)

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

- [25] Hongwan Liu, Wenzer Qin, Gregory W. Ridgway and Tracy R. Slatyer, **Exotic Energy Injection in the Early Universe II: CMB Spectral Distortions and Constraints on Light Dark Matter**, *Physical Review D* 108, 043531 (2023), [arXiv:2303.07370](#)
- [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](#)

PUBLICATIONS AND PREPRINTS (CONTINUED)

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

- [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](#)

PUBLICATIONS AND PREPRINTS (CONTINUED)

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

**PhD thesis*.

- [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](#)
- [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

Mar 2023 **University of Delaware**, *Discovering the Particle Physics of Dark Matter with Cosmology*

INVITED SEMINARS

[†] *Upcoming.*

May 2024 **Stanford University**, SITP Seminar, *Fast and Differentiable Big-Bang Nucleosynthesis*

Apr 2024 **National University of Singapore**, *Discovering Dark Matter with Cosmology*

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

University of Oregon, Institute of Fundamental Sciences Seminar, *Fast and Differentiable Big-Bang Nucleosynthesis*

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

Fermilab, Theory Seminar, *Exotic Energy Injection in the Early Universe*

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

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

Hong Kong University of Science and Technology, IAS Program on Particle Theory, *Exotic Energy Injection in the Early Universe*

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

Nanjing Normal University, Particle Physics Online Seminar Series, *Cosmological Signatures of Dark Photons*

INVITED SEMINARS (CONTINUED)

- Mar 2023 **Boston University**, High-Energy Theory Talk, *Discovering the Particle Physics of Dark Matter with Cosmology*
- Mar 2023 **University of Delaware**, Particle Theory Research Talk, *New Signatures of Dark Matter Energy Deposition*
- Dec 2022 **Fermilab**, Cosmic Physics Center Seminar, *A Large New Physics Signal in the 21-cm Power Spectrum*
- Sep 2022 **Lawrence Berkeley National Laboratory**, Particle Theory Seminar, *A Stimulating Explanation of the Extragalactic Radio Excess*
- May 2022 **Boston University**, High-Energy Theory Seminar, *A Stimulating Explanation of the Extragalactic Radio Excess*
- Apr 2022 **Johns Hopkins University**, Theoretical Particle Physics Seminar, *A Stimulating Explanation of the Extragalactic Radio Excess*
- University of Southern California**, Cosmology Seminar, *A Stimulating Explanation of the Extragalactic Radio Excess*
- Mar 2022 **McGill Space Institute**, Astronomy Seminar, *A Stimulating Explanation of the Extragalactic Radio Excess*
- Dec 2021 **University of Maryland**, Elementary Particles Seminar, *Dark Photons and the Cosmic Radiation Background*
- Nov 2021 **Tsung-Dao Lee Institute/Shanghai Jiao Tong University**, DM+ ν Forum, *Low-Energy Signals from the Formation of Dark Matter-Nuclear Bound States*
- BSM PANDEMIC**, Virtual Seminar, *Low-Energy Signals from the Formation of Dark Matter-Nuclear Bound States*
- Cornell University**, Particle Theory Seminar, *Lyman-Alpha Constraints on Cosmic Heating from Dark Matter Annihilation and Decay*
- Oct 2021 **University of California, Berkeley**, 4D Seminar, *New Aspects of Vector-Portal Dark Matter*

INVITED SEMINARS (CONTINUED)

- May 2021 **University of California, Los Angeles**, TEPAPP Seminar, *New Aspects of Vector-Portal Dark Matter*
- Apr 2021 **Caltech**, High-Energy Physics Seminar, *Dark Photons and the Cosmic Radiation Background*
- University of Michigan**, Brown Bag Seminar, *Dark Photons and the Cosmic Radiation Background*
- Perimeter Institute**, Particle Physics Seminar, *Dark Photons and the Cosmic Radiation Background*
- Feb 2021 **Stanford University**, SITP Seminar, *Dark Photons and the Cosmic Radiation Background*
- DESY**, Theory Seminar, *New Pathways to the Relic Abundance of Vector-Portal Dark Matter*
- Jan 2021 **McDonald Institute**, McDonald Institute Seminar Series, *Lyman-Alpha Constraints on Cosmic Heating from Dark Matter Annihilation and Decay*
- Nov 2020 **Massachusetts Institute of Technology**, CTP LHC/DM/BSM/QCD Meeting, *Dark Photon Oscillations in Our Inhomogeneous Universe*
- Jun 2020 **Kavli Institute for Cosmological Physics, The University of Chicago**, KICP Seminar, *Dark Photon Oscillations in Our Inhomogeneous Universe*
- Dec 2019 **Nanyang Technological University**, Physics and Applied Physics Seminar, *Axions, Dark Matter and Light Polarization*
- Nov 2019 **Israeli Joint Particle Physics Meeting**, *Changing the History of the Universe During the Dark Ages*
- Dec 2018 **Fermilab**, Cosmic Physics Center Seminar, *From the Table-Top to the Cosmos: Searching High and Low for Dark Matter*
- Perimeter Institute**, Particle Physics Seminar, *Searching for Axion Dark Matter with Birefringent Cavities*

INVITED SEMINARS (CONTINUED)

- Dec 2018 **Princeton University**, Pheno & Vino, *From the Table-Top to the Cosmos: Searching High and Low for Dark Matter*
- Nov 2018 **New York University**, *From the Table-Top to the Cosmos: Searching High and Low for Dark Matter*
- Nov 2018 **The Ohio State University**, CCAPP Seminar, *DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection*
- Oct 2018 **Lawrence Berkeley National Laboratory**, LBNL Theory Seminar, *From the Table-Top to the Cosmos: Searching High and Low for Dark Matter*
- 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 **University of California, San Diego**, Particle Physics Seminar, *From the Table-Top to the Cosmos: Searching High and Low for Dark Matter*
- Brown University**, Astrophysics Seminar, *DarkHistory: A Code for Computing Ionization and Thermal Histories with Dark Matter Energy Injection*
- Sep 2018 **University of California, Irvine**, Joint Particle Seminar, *From the Table-Top to the Cosmos: Searching High and Low for Dark Matter*
- Harvard University**, Particle Physics In-House Luncheon, *Searching for Axion Dark Matter with Birefringent Cavities*
- May 2018 **Harvard-Smithsonian Center for Astrophysics**, Journal Club Seminar, *21-cm Implications for Dark Matter Annihilation and Decay*

CONFERENCES & WORKSHOPS

*Invited talk. †Upcoming.

- Jun 2024* **Kavli Institute for Theoretical Physics Workshop: Cosmic Signals of Dark Matter Physics**, *Fast and Differentiable Big-Bang Nucleosynthesis*, Santa Barbara, California, USA

CONFERENCES & WORKSHOPS (CONTINUED)

*Invited talk.

- Apr 2024* **ALPS 2024**, *Fast and Differentiable Big-Bang Nucleosynthesis*, Obergurgl, Austria
- Dec 2023* **2023 National Center for Theoretical Sciences Annual Theory Meeting**, *Cosmological Probes of Dark Photons*, Taipei, Taiwan
- Nov 2022* **New Physics from Galaxy Clustering**, *Cosmological Signatures of Dark Photons*, CERN, Meyrin, Switzerland
- May 2022* **Physics of this Universe**, *A Stimulating Explanation of the Extragalactic Radio Excess*, Baltimore, Maryland, USA
- Mar 2022* **Aspen Winter Conference: New Methods and Ideas at the Frontiers of Particle Physics**, *Dark Photons and the Cosmic Radiation Background*, Aspen, Colorado, USA
- Dec 2021* **AstroDark 2021**, *Ionization and Thermal Histories with Dark Matter Energy Injection*, Virtual
- Nov 2021* **Computational Tools for High Energy Physics and Cosmology**, *Dark-History: A Code for Computing Ionization and Thermal Histories with Exotic Energy Injection*, Virtual
- Aug 2021 **Aspen Summer: Dark Matter from the Laboratory to the Cosmos**, Aspen Center for Physics, Aspen, Colorado, USA
- Mar 2021* **Aspen Winter Conference: A Rainbow of Dark Sectors 2021**, *Cosmological Probes of Dark Matter Energy Deposition*, Virtual
- Jan 2020* **16th Rencontres du Vietnam: TMEX 2020**, *Axions and the Polarization of Light*, Quy Nhon, Vietnam
- Dec 2019 **TeVPA 2019**, *Reviving Millicharged Dark Matter for 21-cm Cosmology*, Sydney, Australia
- Jul 2019 **APS DPF Meeting 2019**, *New Aspects of Millicharged Dark Matter at 21-cm*, Boston, Massachusetts, USA

CONFERENCES & WORKSHOPS (CONTINUED)

*Invited talk.

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

TEACHING

Overall student evaluation ratings shown in parentheses.

Massachusetts Institute of Technology

Teaching Assistant 2017 Spring 8.323 **Relativistic Quantum Field Theory I** (6.4/7.0)

2016 Fall 8.033 **Relativity** (6.4/7.0)

2015 Fall 8.033 **Relativity** (6.9/7.0)

MENTORING

Graduate Students

- 2023 – **Tony Zilu Zhou**, NYU (Advisor: Neal Weiner)
- 2023 – **Xucheng Gan**, NYU (Advisor: Joshua T. Ruderman)
- 2022 – 2023 **Zachary Gelles**, Princeton (Advisor: Mariangela Lisanti)
- 2022 – **Yitian Sun**, MIT (Advisor: Tracy R. Slatyer)
- 2021 – 2023 **Shira Jackson**, NYU (Advisor: Neal Weiner)
- 2021 – **Giorgi Arsenadze**, NYU (Advisor: Joshua T. Ruderman)
- 2020 – 2023 **Wenzer Qin**, MIT (Advisor: Tracy R. Slatyer)
- 2020 – **Cara Giovanetti**, NYU (Advisor: Ken Van Tilburg)
- 2019 – 2022 **Patrick Fitzpatrick**, MIT (Advisor: Tracy R. Slatyer)
- 2018 – 2022 **Gregory W. Ridgway**, MIT (Advisor: Tracy R. Slatyer)

Undergraduate Students

- 2022 – 2023 **Andreas Tsantilas**, NYU (Advisor: Neal Weiner)
- 2022 – 2023 **Noah Luch**, Princeton (Advisor: Mariangela Lisanti)
- 2019 – 2020 **Cara Giovanetti**, Princeton (Advisor: Mariangela Lisanti)
- 2018 **Brodi D. Elwood**, MIT (Advisor: Matthew Evans)
- 2017 – 2019 **Cannon M. Vogel**, MIT (Advisor: Tracy R. Slatyer)
- 2016 – 2017 **Shi-Fan Stephen Chen**, MIT (Advisor: Tracy R. Slatyer)

High School Students

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

PROFESSIONAL ACTIVITIES & SERVICE

| | | |
|-----------------------------|-------------|---|
| <i>Peer Review</i> | 2019 – | Physical Review Letters, Journal of High Energy Physics, Physical Review D, Physics Letters B, Journal of Cosmology and Astroparticle Physics, The European Physical Journal C. |
| <i>Conference Organizer</i> | 2022 | Cosmological and Astrophysical Probes of New Physics, Princeton Center for Theoretical Physics, Princeton |
| <i>Seminar Organizer</i> | 2023 – 2024 | Funch, KICP |
| | 2021 – 2022 | High-Energy Theory Seminar, NYU |
| | 2021 | BSM PANDEMIC Delta Series, Virtual |
| | 2020 – 2021 | Pheno & Vino Off-Shell, Princeton, Virtual |
| | 2020 | BSM PANDEMIC Double Feature, Virtual |
| | 2019 – 2020 | Pheno & Vino, Princeton |
| | 2017 – 2018 | Beyond the Standard Model Seminar, MIT |

OUTREACH

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