Lina Necib

Kavli Institute for Astrophysics and Space Research
Massachusetts Institute of Technology
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Employment

2021– Present **Assistant Professor of Physics**
Massachusetts Institute of Technology

2020– 2021 **Postdoctoral Fellow**
Carnegie Observatories

2020– 2020 **University of California Presidential Fellow**
Department of Physics and Astronomy
University of California, Irvine

2017 – 2020 **Sherman Fairchild Postdoctoral Fellow**
Walter Burke Institute for Theoretical Physics
California Institute of Technology

Education

2012 – 2017 **Doctor of Philosophy**
Theoretical High Energy Physics
Advisor: Prof. Jesse Thaler
Thesis Title: Boosting Searches for Dark Matter
Massachusetts Institute of Technology

2008 – 2012 **Bachelor of Arts in Physics and Mathematics**
Summa CumLaude with distinction in Physics
Boston University

Awards

2023 **George E. Valley, Jr. Prize**
American Physical Society

2020 **Carnegie Postdoctoral Fellowship in Theoretical Astrophysics**
Carnegie Observatories

2020 **University of California Presidential Fellowship**
University of California Irvine

2017-2020 **Sherman Fairchild Postdoctoral Fellowship**
California Institute of Technology

2016 **Sergio Vazquez Prize**
Massachusetts Institute of Technology

2012 **Praecis Presidential Graduate Fellowship**
Massachusetts Institute of Technology

2012 **Alumni Prize for Excellence in Physics**
Boston University

2012 **Phi Beta Kappa**
Boston University

2011 **College Scholar**
Boston University

2009-2012 **Dean's List**
Boston University

Mentoring

Postdoctoral Associates

- *Dr. Nora Shipp*, Start date Fall 2021.

PhD Students

- *Tri Nguyen*, Expected graduation: Spring 2024.
- *Xiaowei Ou*, Expected graduation: Spring 2025.

Undergraduate Students

- *Kate Habich*, Fall 2021, Expected graduation: Spring 2022.
- *Peter M Berggren*, Spring 2022 & Summer 2022, Expected graduation: Spring 2025.
- *Hang Su*, Summer 2022 & Fall 2022, Expected graduation: Spring 2023.

High School Students

- *Michael Huang*, Summer 2022 & Fall 2022, Expected graduation: Spring 2023.

Publications

Student led papers are designated by underlying the student lead author. Author list in theoretical high energy physics is ordered alphabetically (not reflecting relative contributions to the paper), unless indicated otherwise with †. For alphabetically ordered papers, the lead author is designated by a ‡.

25†) *Tri Nguyen*, Siddharth Mishra-Sharma, Reuel Williams, **Lina Necib** — *Submitted to PRL* arXiv:2208.12825
Uncovering dark matter density profiles in dwarf galaxies with graph neural networks

24†) Nora Shipp, Nondh, Panithanpaisal, **Lina Necib**, Robyn Sanderson — *Submitted to ApJ* arXiv:2208.02255
Denis Erkal, Ting S. Li, Isaiah B. Santistevan, Andrew Wetzel, Lara R. Cullinane,
Alexander P. Ji, Sergey E. Koposov, Kyler Kuehn, Geraint F. ; Lewis; Andrew B. Pace; Daniel B. Zucker
Joss Bland-Hawthorn, Emily C. Cunningham, Stacy Y. Kim, Sophia Lilleengen, Jorge Moreno, Sanjib Sharma
Streams on FIRE: Populations of Detectable Stellar Streams in the Milky Way and FIRE

23†) *Xiaowei Ou*, **Lina Necib**, Anna Frebel — *Submitted to MNRAS* arXiv:2208.01056
Robust Clustering of the Local Milky Way Stellar Kinematic Substructures with Gaia eDR3

22†) Xuejian Shen, Philip F. Hopkins, **Lina Necib**, Fangzhou Jiang, — *Submitted to MNRAS* arXiv:2206.05327
Michael Boylan-Kolchin, Andrew Wetzel
Dissipative Dark Matter on FIRE: II. Observational signatures and constraints from local dwarf galaxies

21†) David Shih, Matthew R. Buckley, **Lina Necib**, John Tamanas — *MNRAS* **509** no.4, 5992/ arXiv:2104.12789
Via Machinae: Searching for Stellar Streams using Unsupervised Machine Learning

20†) Xuejian Shen, Philip F. Hopkins, **Lina Necib**, Fangzhou Jiang, Michael Boylan-Kolchin, Andrew Wetzel
Dissipative Dark Matter on FIRE: I. Structural and kinematic properties of dwarf galaxies
MNRAS **506** no.3, 4421/ arXiv:2102.09580

19†) **Lina Necib**, Tongyan Lin
Substructure at High Speed II: The Local Escape Velocity and Milky Way Mass with Gaia eDR3
ApJ **926** no.2, 189/ arXiv:2102.02211

18†) **Lina Necib**, Tongyan Lin
Substructure at High Speed I: Inferring the Escape Velocity in the Presence of Kinematic Substructure
ApJ **926** no.2, 188/ arXiv:2102.01704

17†) Laura J. Chang, **Lina Necib**
Dark Matter Density Profiles in Dwarf Galaxies: Linking Jeans Modeling Systematics and Observation.
MNRAS **507** no.4, 4715 arXiv:2009.00613

16) Joshua Berger‡, Yanou Cui, Matthew Graham, **Lina Necib**, Gianluca Petrillo, Dane Stocks, Yun-Tse Tsai, Yue Zhao.
Prospects for Detecting Boosted Dark Matter in DUNE through Hadronic Interactions.
Phys.Rev.D **103** no.9, 095012/ arXiv:1912.05558

15†) **Lina Necib**, Bryan Ostdiek, Mariangela Lisanti, Timothy Cohen, Marat Freytsis, Shea Garrison-Kimmel.
Chasing Accreted Structures within Gaia DR2 using Deep Learning.
ApJ **903** no.1, 25/ arXiv:1907.07681

14†) **Lina Necib**, Bryan Ostdiek, Mariangela Lisanti, Timothy Cohen, Marat Freytsis, Shea Garrison-Kimmel, Philip F. Hopkins, Andrew Wetzel, Robyn Sanderson.
Evidence for a Vast Prograde Stellar Stream in the Solar Vicinity.
Nature Astronomy (2020)/ arXiv:1907.07190

13†) Bryan Ostdiek, **Lina Necib**, Timothy Cohen, Marat Freytsis, Mariangela Lisanti, Shea Garrison-Kimmel, Andrew Wetzel, Robyn E. Sanderson, Philip F. Hopkins.
Cataloging Accreted Stars within Gaia DR2 using Deep Learning.
A&A **636** A75/ arXiv:1907.06652

12†) **Lina Necib**, Mariangela Lisanti, Shea Garrison-Kimmel, Andrew Wetzel, Robyn Sanderson, Philip F. Hopkins, Claude-André Faucher-Giguère, Dušan Kereš.
Under the Firelight: Stellar Tracers of the Local Dark Matter Velocity Distribution in the Milky Way.
ApJ **883** no.1, 27/ arXiv:1810.12301

11†) **Lina Necib**, Mariangela Lisanti, Vasily Belokurov.
Inferred Evidence for Dark Matter Kinematic Substructure with SDSS-Gaia.
ApJ **874** no.3, 22/ arXiv:1807.02519

10) Frédéric A. Dreyer‡, **Lina Necib**, Gregory Soyez, Jesse Thaler.
Recursive Softdrop.
JHEP **1806** 093/arXiv:1804.03657

9) Jonah Herzog-Arbeitman, Mariangela Lisanti, **Lina Necib**‡.
The Metal-Poor Stellar Halo in RAVE-TGAS and its Implications for the Velocity Distribution of Dark Matter.
JCAP **1804** 052/arXiv:1708.03635

8) Gordan Krnjaic‡, Pedro A. N. Machado, **Lina Necib**.
Distorted Neutrino Oscillations From Ultralight Scalar Dark Matter.
Phys.Rev. D **97** no.7, 075017 / arXiv:1705.06740

7) Jonah Herzog-Arbeitman, Mariangela Lisanti, Piero Madau, **Lina Necib**[‡].
Empirical Determination of Dark Matter Velocities using Metal-Poor Stars.
Phys.Rev.Lett **120** no.4, 041102/ arXiv:1704.04499

6[†]) **Lina Necib**, Jarrett Moon, Taritree Wongjirad, Janet Conrad.
Boosted Dark Matter at Neutrino Experiments.
Phys.Rev. D **95** no.7, 075018/ arXiv:1610.03486

5) Ian Moult, **Lina Necib**[‡], Jesse Thaler.
New Angles on Energy Correlation Functions.
JHEP **1612** 153/ arXiv:1609.07483

4) Mariangela Lisanti, Siddharth Mishra-Sharma[‡], **Lina Necib**, Benjamin R. Safdi.
Deciphering Contributions to the Extragalactic Gamma-Ray Background from 2 GeV to 2 TeV.
ApJ **832** no.2, 117/ arXiv:1606.04101

3) Nicolas Bernal, **Lina Necib**[‡], Tracy R. Slatyer.
Spherical Cows in Dark Matter Indirect Detection.
JCAP **1612** no. 030/ arXiv:1606.00433

2) Nayara Fonseca, **Lina Necib**[‡], Jesse Thaler.
Dark Matter, Shared Asymmetries, and Galactic Gamma Ray Signals.
JCAP **1602**, no. 052/ arXiv:1507.08295

1) Kaustubh Agashe, Yanou Cui, **Lina Necib**[‡], Jesse Thaler.
(In)direct Detection of Boosted Dark Matter.
JCAP **1410**, no. 062/ arXiv:1405.7370

N-th Author Papers

10) Philip F. Hopkins, Andrew Wetzel, ..., **Lina Necib**, et al.
FIRE-3: Updated Stellar Evolution Models, Yields, & Microphysics and Fitting Functions for Applications in Galaxy Simulations
Submitted to MNRAS arXiv:2203.00040

9) Henrique Reggiani, Alexander P. Ji, Kevin C. Schlaufman, Anna Frebel, **Lina Necib**, Tyler Nelson, Keith Hawkins, Jhon Yana Galarza
The Chemical Composition of Extreme-Velocity Stars
Accepted to AJ arXiv:2203.16364

8) Daniel McKeown, James S. Bullock, Francisco J. Mercado, Zachary Hafen, Michael Boylan-Kolchin, Andrew Wetzel, **Lina Necib**, Philip F. Hopkins, Sijie Yu
Amplified J-factors in the Galactic Center for velocity-dependent dark matter annihilation in FIRE simulations
MNRAS **513** no.1, 55 arXiv:2111.03076

7) Arka Banerjee, Kimberly K. Boddy, ...,**Lina Necib**, et al.
Snowmass2021 Cosmic Frontier White Paper: Cosmological Simulations for Dark Matter Physics
arXiv:2203.07049

6) Shin'ichiro Ando, Sebastian Baum, ...,**Lina Necib**, et al.
Snowmass2021 Cosmic Frontier: Synergies between dark matter searches and multiwavelength/multimessenger astrophysics
arXiv:2203.06781

5) Anirudh Chiti, Anna Frebel, Joshua D. Simon, Denis Erkal, Laura J. Chang, **Lina Necib**, Alexander P. Ji, Helmut Jerjen, Dongwon Kim, John E. Norris
An Extended Halo Around an Ancient Dwarf Galaxy.
Nature Astronomy (2021) arXiv:2012.02309

4) Carine Babusiaux, Maria Bergemann, Adam Burgasser, ..., **Lina Necib**, et al.
The Detailed Science Case for the Maunakea Spectroscopic Explorer
arXiv:1904.04907

3) Keith Bechtol, Alex Drlica-Wagner, Kevork N. Abazajian, ..., **Lina Necib**, et al.
Dark Matter Science in the Era of LSST
arXiv:1903.04425

2) Keith Bechtol, Adam S. Bolton, Jo Bovy, ..., **Lina Necib**, et al.
Astrophysical Tests of Dark Matter with Maunakea Spectroscopic Explorer arXiv:1903.03155

1) Alex Drlica-Wagner, Yao-Yuan Mao, ..., **Lina Necib**, et al.
Probing the Fundamental Nature of Dark Matter with the Large Synoptic Survey Telescope arXiv:1902.01055

Colloquia

Tracing Dark Matter with Stars around the Milky Way — September 30, 2022
Dartmouth Physics Colloquium

Searching for the Dark with the Light: Stars as Tracers of Dark Matter — March 31, 2022
MIT Physics Colloquium

Tracing Dark Matter with Stars — October 2021
Brown University Physics Colloquium

Tracing Dark Matter with Stars — October 2021
University of Heidelberg Colloquium

Tracing Dark Matter with Stars — September 2021
Boston University Physics Colloquium

Tracing Dark Matter with Stars — June 2021
Carnegie Observatories Colloquium

Tracing Dark Matter with Stars — February 2021
Southern Methodist University Physics Colloquium

Dark Matter in the Era of *Gaia* — October 2020
University of Indiana Physics Colloquium

Dark Matter in the Era of *Gaia* — September 2020
Emory University Physics Colloquium

Dark Matter in the Era of *Gaia* — July 2020
KIPAC Stanford Astrophysics Colloquium

Dark Matter in the Era of *Gaia* — December 2019
Carnegie Observatories Colloquium

Dark Matter in the Era of *Gaia* — September 2019
MIT Astronomy Colloquium

Dark Matter in the Era of *Gaia* — May 2019
California Institute of Technology Physics Colloquium

Seminar Talks

Tracing Dark Matter with Stars — April, 21, 2022
Brookhaven National Laboratory

Tracing Dark Matter with Stars — February 2022
University of California Berkeley/LBNL seminar

Tracing Dark Matter with Stars — November 2021
Kavli IPMU, University of Tokyo

Tracing Dark Matter with Stars — October 2021
Harvard University

Tracing Dark Matter with Stars, Part II — June 2021
SLAC

Tracing Dark Matter with Stars — March 2021
TRIUMF

Tracing Dark Matter with Stars — February 2021
SLAC

Tracing Dark Matter with Stars — January 2021
Queen University

Tracing Dark Matter with Stars — December 2020
University of Texas Austin

Dark Matter in the Era of *Gaia* — December 2020
Tsung-Dao Lee Institute

Dark Matter in the Era of *Gaia* — October 2020
Colorado University, Boulder

Tracing Dark Matter with Stars — September 2020
Virgina Tech

Tracing Dark Matter with Stars — July 2020
Fermilab

Dark Matter in the Era of *Gaia* — April 2020
University of California Irvine

Dark Matter in the Era of *Gaia* — January 2020
University of Surrey

Dark Matter in the Era of *Gaia* — October 2019
Perimeter Institute

Dark Matter in the Era of *Gaia* — October 2019
Harvard University

Dark Matter in the Era of *Gaia* — September 2019
Boston University

Properties of Dark Matter in the Era of *Gaia* — September 2019
LHC Results Forum

Dark Matter in the Era of *Gaia* — September 2019
Fermilab

Dark Matter in the Era of *Gaia* — September 2019
Texas A&M

Dark Matter in the Era of *Gaia* — July 2019
Ohio State University

Dark Matter in the Era of *Gaia* — May 2019
Los Alamos National Laboratory

The Stellar Local Velocity Distribution and its Implications for Dark Matter — April 2019
California Institute of Technology

Dark Matter in Disequilibrium and Implications for Direct Detection — March 2019
University of California Irvine

Dark Matter in Disequilibrium and Implications for Direct Detection — January 2019
SLAC

Dark Matter in Disequilibrium and Implications for Direct Detection — December 2018
University of California Santa Barbara

Dark Matter in Disequilibrium and Implications for Direct Detection — December 2018
John's Hopkins University

Dark Matter in Disequilibrium and Implications for Direct Detection — December 2018
University of Maryland

Dark Matter in Disequilibrium and Implications for Direct Detection — November 2018
KICP, University of Chicago

Dark Matter in Disequilibrium and Implications for Direct Detection — November 2018
Lawrence Berkeley National Laboratory

Dark Matter in Disequilibrium and Implications for Direct Detection — October 2018
Rutgers University

Dark Matter in Disequilibrium and Implications for Direct Detection — October 2018
University of Kentucky

Dark Matter in Disequilibrium and Implications for Direct Detection — September 2018
SuperCDMS Collaboration

Dark Matter in Disequilibrium: The Velocity Distribution — June 2018
Fermilab

Empirical Determination of the Dark Matter Velocity Distribution — May 2018
University of California San Diego

Empirical Determination of the Dark Matter Velocity Distribution — March 2018
Princeton University

Boosted Dark Matter in Neutrino Experiments — March 2018
Brookhaven National Laboratory

Empirical Determination of the Dark Matter Velocity Distribution — March 2018
Brookhaven National Laboratory

Empirical Determination of the Dark Matter Velocity Distribution — March 2018
New York University

Empirical Determination of the Dark Matter Velocity Distribution — March 2018
University of Michigan Ann Arbor

Empirical Determination of the Dark Matter Velocity Distribution — February 2018
Rutgers University

Empirical Determination of the Dark Matter Velocity Distribution — December 2017
University of California Irvine

Empirical Determination of the Dark Matter Velocity Distribution — November 2017
University of Oregon

Empirical Determination of the Dark Matter Velocity Distribution — November 2017
Boston University

Empirical Determination of the Dark Matter Velocity Distribution — October 2017
University of Illinois Urbana-Champaign

Empirical Determination of the Dark Matter Velocity Distribution — October 2017
University of California Santa Barbara

Empirical Determination of the Dark Matter Velocity Distribution — October 2017
California Institute of Technology

Using Simulations to Improve Dark Matter Searches — February 2017
Harvard University

Spherical Cows of Dark Matter Indirect Detection — November 2016
University of California Berkeley

Spherical Cows of Dark Matter Indirect Detection — October 2016
Harvard University

Boosted Dark Matter in Neutrino Experiments — October 2016
Harvard University

Spherical Cows of Dark Matter Indirect Detection — October 2016
Cornell University

Spherical Cows of Dark Matter Indirect Detection — September 2016
Princeton University

Boosted Dark Matter in Neutrino Experiments — June 2016
Tufts University

(In)Direct Detection of Boosted Dark Matter — April 2016
SLAC

Invited Conference Talks

Robust Clustering of Local Kinematic Stellar Structures with *Gaia* — July 29, 2022
Towards Real Time Galactic Dynamics, Leiden, Netherlands

Clustering Stellar Structures and Connections to Dark Matter — July 14, 2022
Summiting the Unknown, Seattle, WA, USA

Identifying Kinematic Substructure with Machine Learning — March 24, 2022
New Methods and Ideas at the Frontiers of Particle Physics, Aspen, CO, USA

Identifying Kinematic Substructure with Machine Learning — March 17, 2022
Nature of Dark Matter on Small Scales, Remote

Dark Matter in the Era of Simulations and Data — June 2021
CERN-CKC Theory Workshop, Jeju Island, South Korea — **Plenary-Remote**

Dark Matter in the Era of *Gaia* — March 2020
Exploring the Dark Side of the Universe, Pointe-A-Pitre, Guadeloupe — **Plenary-Remote**

Dark Matter in the Era of *Gaia* — January 2020
Theory Meets Experiment, Quy Nhon, Vietnam — **Plenary**

Dark Matter in the Era of *Gaia* — August 2019
Searching for new physics - Leaving no stone unturned!, Salt Lake City, UT, USA

Dark Matter in the Era of *Gaia* — June 2019
234th AAS Meeting, Saint Louis, MO, USA

The Stellar Local Velocity Distribution and its Implications for Dark Matter — April 2019
In the Balance: Stasis and Disequilibrium in the Milky Way, KITP, Santa Barbara, CA, USA

Dark Matter in Disequilibrium and its Implications on Direct Detection — October 2018
Interplay between Particle and Astroparticle Physics, Cincinnati, OH, USA

Reconstructing the Dark Matter Velocity Distribution from the Stars — August 2018
Galaxy Formation and Evolution in Southern California, Pasadena, CA, USA

Dark Matter in Disequilibrium and its Implications on Direct Detection — July 2018
Identification of Dark Matter, Providence, RI, USA — **Plenary**

Dark Matter in Disequilibrium: The Velocity Distribution — June 2018
Near Field Cosmology Workshop, Chicago, IL, USA

Light Dark Matter at Neutrino Detectors — October 2017
Light Dark World, Pittsburgh, PA, USA

Conference Talks

Empirical Determination of the Dark Matter Velocity Distribution — February 2018
UCLA Dark Matter, Los Angeles, CA, USA

Empirical Determination of Dark Matter Velocity Distribution — September 2017
Dark Matter of Southern California, Pasadena, CA, USA

Empirical Determination of Dark Matter Velocity Distribution — August 2017
TeVPA, Columbus, Ohio, USA

Constructing Stable Observables with Energy Correlation Functions — November 2016
Jet Substructure "Planning for the Future", Fermilab, USA

Spherical Cows of Dark Matter Indirect Detection — September 2016
TeVPA, CERN, Switzerland

Boosted Dark Matter in Neutrino Experiments — July 2016
Dark Side of the Universe, Bergen, Norway

Dark Matter, Shared Asymmetries, and Galactic Gamma Ray Signals — May 2016
Pheno Symposium, Pittsburgh, USA

(In)Direct Detection of Boosted Dark Matter — September 2015
TAUP, Torino, Italy

Public Talks

The Genealogy of the Milky Way and the Search for Dark Matter — March 23, 2021
Winter Aspen, Aspen, CO, USA

Chasing Dark Matter with the *Gaia* Enceladus — April 2019
Astronomy on TAP, Santa Barbara, CA, USA

Posters

Energy-Dependent Analysis of Unresolved Point Sources — November 2015
Fermi Symposium, Washington DC., USA

Proceedings

Kaustubh Agashe, Yanou Cui, Lina Necib, Jesse Thaler — Proceedings for TAUP 2015
(In)Direct Detection of Boosted Dark Matter — J.Phys.Conf.Ser. 718 (2016) no.4, 042041

Telescope and Computing Allocations

XSEDE/Bridges-2: GPUs — 2022
5,000 Node Hours (PI)

XSEDE/Stampede — 2022
52,000 Node Hours (PI)

Magellan/MIKE — Semester 2021A
High-resolution spectroscopy, 2 nights (PI)

Magellan/MIKE — Semester 2020B
High-resolution spectroscopy, 4 nights (PI)

Magellan/MIKE — Semester 2020A
High-resolution spectroscopy, 2 nights (co-PI)

Keck/HIRES — Semester 2020A
High-resolution spectroscopy, 1 night (PI)

XSEDE/Stampede — 2019
1,600 Node Hours (PI)

Teaching Experience: Professor

Physics I, 8.012, Lecturer *Fall 2022*
Physics I, 8.012, Recitation *Fall 2021*

Teaching Experience: Teaching Assistant

Supersymmetric Quantum Field Theory, 8.831	*Spring 2017*
Quantum Mechanics I, 8.04	*Fall 2013, 2016*
Physics I, 8.01L	*Fall 2015*
Graduate Quantum Mechanics, 8.231	*Fall 2014*
Quantum Mechanics III, 8.06	*Spring 2014, 2015, 2016*

Outreach

Physics in your native language video series	*2022*
Ga3da Falakia, Tunisian Podcast	*2022*
Organized Exhibit at Cambridge Science Festival	*October 2022*
Lecturer for Warrior Scholar Project	*07/20-21/2022*
Panelist for AstroCareers at the Museum of Science	*06/05/2022*
Luncheon with CCNY Physics Club	*04/14/2022*
Public Lecture at Aspen Winter Conferences	*03/23/2022*
Research Talk at CASSI - Carnegie Observatories	*08/06/2021*
Interview with The Cosmic Companion	*07/28/2020*
Skype a Scientist	*Spring 2020*
Mindscape Podcast with Sean Carroll	*05/11/2020*
Astronomy on TAP, Santa Barbara, CA	*04/03/2019*
High school summer research at Caltech	*Summer 2018*
"Science on Saturday", Cambridge, MA	*02/07/2015*

Service

Barrett Prize committee member	*2022*
Panelist on ERC Grant	*2022*
Panelist on DOE Grant	*2021*
Panelist on NSF CAREER Grant	*2021*
Referee for the Astrophysical Journal Letters (ApJL)	*Since 2021*
Referee for Journal of Cosmology and Astroparticle Physics (JCAP)	*Since 2019*
Referee for Monthly Notices of the Royal Astronomical Society (MNRAS)	*Since 2018*
Referee for Physics Review Letters (PRL)	*Since 2018*
Referee for Journal of High Energy Physics (JHEP)	*Since 2018*
Referee for Physics Review D (PRD)	*Since 2017*
Beyond the Standard Model Journal Club Organizer	*2015 - 2017*
Graduate Student Lunch Organizer	*2014 - 2015*
"Science on Saturday" event Organizer	*02/07/2015*