XUEJIAN(JACOB) SHEN

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Massachusetts Institute of Technology
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EDUCATION

California Institute of Technology Sept 2018 - June 2023
Ph.D., Physics
Academic and Research Advisor: Prof. Philip Hopkins
Thesis Title: Cosmic structure and galaxy formation in alternative dark matter

Peking University Sept 2014 - June 2018
B.S., Physics
Advisor: Prof. Fukun Liu
Thesis Title: Strengthened Kozai-Lidov Oscillation and Tidal Disruption Event Rate in Hierarchical SMBH Triplets

EMPLOYMENT

Postdoctoral Researcher Oct 2023 - present
Kavli Institute for Astrophysics and Space Research
Massachusetts Institute of Technology

SubMIT Project Team Oct 2023 - present
Department of Physics, Massachusetts Institute of Technology

Graduate Teaching & Research Assistant Jan 2018 - June 2023
California Institute of Technology

RESEARCH INTERESTS

Cosmological simulations of galaxy formation; The nature of dark matter; Formation and evolution of galaxies and supermassive black holes at high redshift

SUMMARY OF PUBLICATIONS

Total publications: **36**; First-author publications: **11** (see attached publication list)
Metrics: **>1000 citations**, **>500 first-author citations**, **h-index: 17**

AWARDS & FELLOWSHIPS

Neil Gehrels Prize Fellowship (declined) Univ. of Maryland 2022
KIPAC Fellowship (declined) Stanford, 2022
TCCAP Fellowship (declined) Univ. of Texas Austin, 2022
James A. Cullen Memorial Fellowship Caltech, 2022
Honored Graduate Peking University, 2018
Robin Li Fellowship Peking University, 2017
Meritorious Award MCM, 2017
HaiLiang Fellowship Peking University, 2016
GuangHua Fellowship Peking University, 2015

GRANTS

As Principal Investigator (PI)

JWST-AR-Theory (04814)	∼$300,000	10/2024 – 10/2025

TEACHING & ADVISING

Caltech Graduate Teaching Assistant	Computational Physics Lab Ph20/21/22
Caltech SURF program	Co-advisor of Gabriel Aguiar (Undergrad.)
Caltech SURF program	Co-advisor of Eitan Rapaport (Undergrad.)
MIT UROP program	Advisor of Evan Erickson (Undergrad.)
MIT UROP program	Advisor of Yongao Hu (Undergrad.)
MIT UROP program	Advisor of Hui Wang (Undergrad.)
MIT UROP program	Co-advisor of Vinh Tran (Undergrad.)
MIT UROP program	Co-advisor of Eidan Leonard (Undergrad.)
Harvard research program	Advisor of Charline Shen (Master)
MIT research program	Advisor of Zihao Wang (Undergrad.)
Lectures on Numeric Simulations	MIT Physics 8.902 Astrophysics II

SYNERGISTIC ACTIVITIES

Professional Services

- Journal Referee for Monthly Notices of the Royal Astronomical Society (MNRAS, since 2020), MNRAS Letters (since 2023), The Astrophysical Journal (ApJ, since 2022), ApJ Letters (since 2022), Scientific Reports (Since 2023), Physics Review Letters (PRL, since 2024), Physics Review D (PRD, since 2023)
- Oscii Bascii (& Grad student representative) of Theoretical AstroPhysics Including Relativity and Cosmology (TAPIR, 2019-2022), Caltech
- Local Organizing Committee (LOC) for the Galaxy Formation and Evolution in Southern California (GalFRESCA) workshop (2022)
- SubMIT project team member (since 2023), MIT

Outreach

- Speaker at Caltech Stargazing Lecture Series (2023)
- Organizer of Stargazing and Outreach Activities (2015-2018), Peking University

SELECTED TALKS

Invited talks:

- Challenges to galaxy formation models at the cosmic frontier	Univ. of Texas Austin, 08/2024
- Challenges to galaxy formation models at the cosmic frontier	Univ. of Cambridge, 06/2024
- The implication of UV variability for the bright galaxy abundance at cosmic dawn	Journal Club, Tsinghua Univ., 09/2023
- The implication of UV variability for the bright galaxy abundance at cosmic dawn	KIAA/DoA seminar, PKU, 09/2023
- Dark Matter: Elusive fibers of the Universe	Stargazing Lecture, Caltech, 05/2023
- New aspects about dark matter models beyond WIMP-like CDM	KIPAC tea talk, Stanford, 02/2023
- Alternative dark matter and structure formation	Obs. Cosmo. seminar, Caltech, 11/2021

Contributed talks:

- Early dark energy as a unified solution to the Hubble tension and early galaxy puzzles raised by JWST — KITP conference, 08/2024
- Insights on efficiency and variability of star-formation from radiation-hydro simulations — Santa Cruz Galaxy Formation workshop, 08/2024
- Challenges to galaxy formation models at the cosmic frontier — Journal Club, MIT, 04/2024
- Challenges to galaxy formation models at high redshifts — Univ. of Vienna, 02/2024
  Building Galaxies from Scratch
- Galaxy sizes during the epoch of reionization — Harvard CfA, 02/2024
- The implication of UV variability for the bright galaxy abundance at cosmic dawn — ITC luncheon, Harvard CfA, 10/2023
- Galaxy in the epoch of reionization in alternative DM — UCLA DM meeting, 03/2023
- Alternative dark matter in galaxy formation — Dark Cosmos seminar, Princeton, 10/2022
- Alternative dark matter in galaxy formation — Brown Bag lunch talk, MIT, 10/2022
- Alternative dark matter in galaxy formation — Harvard CfA, 10/2022
- Alternative dark matter in galaxy formation — FIRE seminar, 10/2022
- Dwarf galaxies in dissipative dark matter — GalFRESCA workshop, 09/2022
- High-redshift predictions from the Illustris-TNG simulations — MIT, 08/2019
- High-redshift predictions from the Illustris-TNG simulations — Caltech, 06/2019

PUBLICATIONS (FIRST-AUTHOR & PEER-REVIEWED)

See my NASA ADS bibliography for full information (ORCID **0000-0002-6196-823X**)

1. **Xuejian Shen**, Philip F. Hopkins, Lina Necib, Fangzhou Jiang, Michael Boylan-Kolchin, and Andrew Wetzel. Dissipative Dark Matter on FIRE. II. Observational Signatures and Constraints from Local Dwarf Galaxies. *ApJ*, 966(1):131, May 2024

2. **Xuejian Shen**, Huangyu Xiao, Philip F. Hopkins, and Kathryn M. Zurek. Disruption of Dark Matter Minihalos in the Milky Way Environment: Implications for Axion Miniclusters and Early Matter Domination. *ApJ*, 962(1):9, February 2024

3. **Xuejian Shen**, Josh Borrow, Mark Vogelsberger, Enrico Garaldi, Aaron Smith, Rahul Kannan, Sandro Tacchella, Jesús Zavala, Lars Hernquist, Jessica Y. C. Yeh, and Chunyuan Zheng. THESAN-HR: galaxies in the Epoch of Reionization in warm dark matter, fuzzy dark matter, and interacting dark matter. *MNRAS*, 527(2):2835–2857, January 2024

4. **Xuejian Shen**, Mark Vogelsberger, Michael Boylan-Kolchin, Sandro Tacchella, and Rahul Kannan. The impact of UV variability on the abundance of bright galaxies at $z \geq 9$. *MNRAS*, 525(3):3254–3261, November 2023

5. **Xuejian Shen**, Thejs Brinckmann, David Rapetti, Mark Vogelsberger, Adam Mantz, Jesús Zavala, and Steven W. Allen. X-ray morphology of cluster-mass haloes in self-interacting dark matter. *MNRAS*, 516(1):1302–1319, October 2022

6. **Xuejian Shen**, Mark Vogelsberger, Dylan Nelson, Sandro Tacchella, Lars Hernquist, Volker Springel, Federico Marinacci, and Paul Torrey. High-redshift predictions from IllustrisTNG - III. Infrared luminosity functions, obscured star formation, and dust temperature of high-redshift galaxies. *MNRAS*, 510(4):5560–5578, March 2022

7. **Xuejian Shen**, Philip F. Hopkins, Lina Necib, Fangzhou Jiang, Michael Boylan-Kolchin, and Andrew Wetzel. Dissipative dark matter on FIRE - I. Structural and kinematic properties of dwarf galaxies. *MNRAS*, 506(3):4421–4445, September 2021

8. **Xuejian Shen**, Mark Vogelsberger, Dylan Nelson, Annalisa Pillepich, Sandro Tacchella, Federico Marinacci, Paul Torrey, Lars Hernquist, and Volker Springel. High-redshift JWST predictions from IllustrisTNG: II. Galaxy line and continuum spectral indices and dust attenuation curves. *MNRAS*, 495(4):4747–4768, July 2020

9. **Xuejian Shen**, Philip F. Hopkins, Claude-André Faucher-Giguère, D. M. Alexander, Gordon T. Richards, Nicholas P. Ross, and R. C. Hickox. The bolometric quasar luminosity function at z = 0-7. *MNRAS*, 495(3):3252–3275, January 2020

PUBLICATIONS (FIRST-AUTHOR & UNDER REVIEW)

1. **Xuejian Shen**, Mark Vogelsberger, Michael Boylan-Kolchin, Sandro Tacchella, and Rohan P. Naidu. Early Galaxies and Early Dark Energy: A Unified Solution to the Hubble Tension and Puzzles of Massive Bright Galaxies revealed by JWST. *arXiv e-prints*, page arXiv:2406.15548, June 2024

2. **Xuejian Shen**, Mark Vogelsberger, Josh Borrow, Yongao Hu, Evan Erickson, Rahul Kannan, Aaron Smith, Enrico Garaldi, Lars Hernquist, Takahiro Morishita, Sandro Tacchella, Oliver Zier, Guochao Sun, Anna-Christina Eilers, and Hui Wang. The THESAN project: galaxy sizes during the epoch of reionization. *arXiv e-prints*, page arXiv:2402.08717, February 2024

PUBLICATIONS (CO-AUTHORED & PEER-REVIEWED)

1. Aidan Leonard, Stephanie O'Neil, **Xuejian Shen**, Mark Vogelsberger, Olivia Rosenstein, Haotian Shangguan, Yuanhong Teng, and Jiayi Hu. Varying primordial state fractions in exo- and endothermic SIDM simulations of Milky Way-mass haloes. *MNRAS*, 531(1):1440–1453, June 2024

2. Enrico Garaldi, Rahul Kannan, Aaron Smith, Josh Borrow, Mark Vogelsberger, Rüdiger Pakmor, Volker Springel, Lars Hernquist, Daniela Galárraga-Espinosa, Jessica Y. C. Yeh, **Xuejian Shen**, Clara Xu, Meredith Neyer, Benedetta Spina, Mouza Almualla, and Yu Zhao. The THESAN project: public data release of radiation-hydrodynamic simulations matching reionization-era JWST observations. *MNRAS*, 530(4):3765–3786, June 2024

3. Caleb Gemmell, Sandip Roy, **Xuejian Shen**, David Curtin, Mariangela Lisanti, Norman Murray, and Philip F. Hopkins. Dissipative Dark Substructure: The Consequences of Atomic Dark Matter on Milky Way Analog Subhalos. *ApJ*, 967(1):21, May 2024

4. Takahiro Morishita, Massimo Stiavelli, Ranga-Ram Chary, Michele Trenti, Pietro Bergamini, Marco Chiaberge, Nicha Leethochawalit, Guido Roberts-Borsani, **Xuejian Shen**, and Tommaso Treu. Enhanced Subkiloparsec-scale Star Formation: Results from a JWST Size Analysis of 341 Galaxies at z = 5 - 14. *ApJ*, 963(1):9, March 2024

5. Thomas K. Waters, Colton Peterson, Razieh Emami, **Xuejian Shen**, Lars Hernquist, Randall Smith, Mark Vogelsberger, Charles Alcock, Grant Tremblay, Matthew Liska, John C. Forbes, and Jorge Moreno. Gas Morphology of Milky Way–like Galaxies in the TNG50 Simulation: Signals of Twisting and Stretching. *ApJ*, 961(2):193, February 2024

6. Guochao Sun, Claude-André Faucher-Giguère, Christopher C. Hayward, and **Xuejian Shen**. Seen and unseen: bursty star formation and its implications for observations of high-redshift galaxies with JWST. *MNRAS*, 526(2):2665–2672, December 2023

7. Guochao Sun, Claude-André Faucher-Giguère, Christopher C. Hayward, **Xuejian Shen**, Andrew Wetzel, and Rachel K. Cochrane. Bursty Star Formation Naturally Explains the Abundance of Bright Galaxies at Cosmic Dawn. *ApJ*, 955(2):L35, October 2023

8. Philip F. Hopkins, Ethan O. Nadler, Michael Y. Grudić, **Xuejian Shen**, Isabel Sands, and Fangzhou Jiang. Novel conservative methods for adaptive force softening in collisionless and multispecies N-body simulations. *MNRAS*, 525(4):5951–5977, November 2023

9. Philip F. Hopkins, Alexander B. Gurvich, **Xuejian Shen**, Zachary Hafen, Michael Y. Grudić, Shalini Kurinchi-Vendhan, Christopher C. Hayward, Fangzhou Jiang, Matthew E. Orr, Andrew Wetzel, Dušan Kereš, Jonathan Stern, Claude-André Faucher-Giguère, James Bullock, Coral Wheeler, Kareem El-Badry, Sarah R. Loebman, Jorge Moreno, Michael Boylan-Kolchin, and Eliot Quataert. What causes the formation of discs and end of bursty star formation? *MNRAS*, 525(2):2241–2286, October 2023

10. Sandip Roy, **Xuejian Shen**, Mariangela Lisanti, David Curtin, Norman Murray, and Philip F. Hopkins. Simulating Atomic Dark Matter in Milky Way Analogs. *ApJ*, 954(2):L40, September 2023

11. Fangzhou Jiang, Andrew Benson, Philip F. Hopkins, Oren Slone, Mariangela Lisanti, Manoj Kaplinghat, Annika H. G. Peter, Zhichao Carton Zeng, Xiaolong Du, Shengqi Yang, and **Xuejian Shen**. A semi-analytic study of self-interacting dark-matter haloes with baryons. *MNRAS*, 521(3):4630–4644, May 2023

12. Razieh Emami, Lars Hernquist, Mark Vogelsberger, **Xuejian Shen**, Joshua S. Speagle, Jorge Moreno, Charles Alcock, Shy Genel, John C. Forbes, Federico Marinacci, and Paul Torrey. On the Robustness of the Velocity Anisotropy Parameter in Probing the Stellar Kinematics in Milky Way-Like Galaxies: Takeaway from TNG50 Simulation. *ApJ*, 937(1):20, September 2022

13. Rahul Kannan, Aaron Smith, Enrico Garaldi, **Xuejian Shen**, Mark Vogelsberger, Rüdiger Pakmor, Volker Springel, and Lars Hernquist. The THESAN project: predictions for multitracer line intensity mapping in the epoch of reionization. *MNRAS*, 514(3):3857–3878, August 2022

14. Huangyu Xiao, **Xuejian Shen**, Philip F. Hopkins, and Kathryn M. Zurek. SMBH seeds from dissipative dark matter. *J. Cosmol. Astropart. Phys.*, 2021(7):039, July 2021

15. Razieh Emami, Lars Hernquist, Charles Alcock, Shy Genel, Sownak Bose, Rainer Weinberger, Mark Vogelsberger, **Xuejian Shen**, Joshua S. Speagle, Federico Marinacci, John C. Forbes, and Paul Torrey. Inferring the Morphology of Stellar Distribution in TNG50: Twisted and Twisted-stretched Shapes. *ApJ*, 918(1):7, September 2021

16. Philip Mocz, Anastasia Fialkov, Mark Vogelsberger, Fernando Becerra, **Xuejian Shen**, Victor H. Robles, Mustafa A. Amin, Jesús Zavala, Michael Boylan-Kolchin, Sownak Bose, Federico Marinacci, Pierre-Henri Chavanis, Lachlan Lancaster, and Lars Hernquist. Galaxy formation with BECDM - II. Cosmic filaments and first galaxies. *MNRAS*, 494(2):2027–2044, May 2020

17. Mark Vogelsberger, Dylan Nelson, Annalisa Pillepich, **Xuejian Shen**, Federico Marinacci, Volker Springel, Rüdiger Pakmor, Sandro Tacchella, Rainer Weinberger, Paul Torrey, and Lars Hernquist. High-redshift JWST predictions from IllustrisTNG: dust modelling and galaxy luminosity functions. *MNRAS*, 492(4):5167–5201, March 2020

18. Yunchong Wang, Mark Vogelsberger, Dandan Xu, **Xuejian Shen**, Shude Mao, David Barnes, Hui Li, Federico Marinacci, Paul Torrey, Volker Springel, and Lars Hernquist. Early-type galaxy density profiles from IllustrisTNG - II. Evolutionary trend of the total density profile. *MNRAS*, 490(4):5722–5738, October 2019

19. Mark R. Lovell, Jesús Zavala, Mark Vogelsberger, **Xuejian Shen**, Francis-Yan Cyr-Racine, Christoph Pfrommer, Kris Sigurdson, Michael Boylan-Kolchin, and Annalisa Pillepich. ETHOS - an effective theory of structure formation: predictions for the high-redshift Universe - abundance of galaxies and reionization. *MNRAS*, 477(3):2886–2899, July 2018

PUBLICATIONS (CO-AUTHORED & UNDER REVIEW)

1. Sandip Roy, Xuejian Shen, Jared Barron, Mariangela Lisanti, David Curtin, Norman Murray, and Philip F. Hopkins. Aggressively-Dissipative Dark Dwarfs: The Effects of Atomic Dark Matter on the Inner Densities of Isolated Dwarf Galaxies. *arXiv e-prints*, page arXiv:2408.15317, August 2024

2. Desika Narayanan, Daniel P. Stark, Steven L. Finkelstein, Paul Torrey, Qi Li, Fergus Cullen, Micheal W. Topping, Federico Marinacci, Laura V. Sales, Xuejian Shen, and Mark Vogelsberger. The Ultraviolet Slopes of Early Universe Galaxies: The Impact of Bursty Star Formation, Dust, and Nebular Continuum Emission. *arXiv e-prints*, page arXiv:2408.13312, August 2024

3. Robert Feldmann, Michael Boylan-Kolchin, James S. Bullock, Onur Çatmabacak, Claude-André Faucher-Giguère, Christopher C. Hayward, Dušan Kereš, Alexandres Lazar, Lichen Liang, Jorge Moreno, Pascal A. Oesch, Eliot Quataert, **Xuejian Shen**, and Guochao Sun. Elevated UV luminosity density at Cosmic Dawn explained by non-evolving, weakly-mass dependent star formation efficiency. *arXiv e-prints*, page arXiv:2407.02674, July 2024

4. Isabel S. Sands, Philip F. Hopkins, **Xuejian Shen**, Michael Boylan-Kolchin, James Bullock, Claude-Andre Faucher-Giguere, Francisco J. Mercado, Jorge Moreno, Lina Necib, Xiaowei Ou, Sarah Wellons, and Andrew Wetzel. Confronting the Diversity Problem: The Limits of Galaxy Rotation Curves as a tool to Understand Dark Matter Profiles. *arXiv e-prints*, page arXiv:2404.16247, April 2024

5. Cian Roche, Michael McDonald, Josh Borrow, Mark Vogelsberger, **Xuejian Shen**, Volker Springel, Lars Hernquist, Ruediger Pakmor, Sownak Bose, and Rahul Kannan. Brightest Cluster Galaxy Offsets in Cold Dark Matter. *arXiv e-prints*, page arXiv:2402.00928, February 2024

CONFERENCE PROCEEDINGS

1. Thomas Waters, Colton Peterson, Razieh Emami, **Xuejian Shen**, Lars Hernquist, Randall Smith, Mark Vogelsberger, Charles Alcock, Grant Tremblay, Matthew Liska, John Forbes, and Jorge Moreno. Gas Morphology of Milky Way-like Galaxies in the TNG50: Signals of Twisting and Stretching. In *American Astronomical Society Meeting Abstracts*, volume 55 of *American Astronomical Society Meeting Abstracts*, page 279.02, January 2023

2. **Xuejian Shen**, Philip Hopkins, Lina Necib, Fangzhou Jiang, Michael Boylan-Kolchin, and Andrew Wetzel. Dissipative Dark Matter on FIRE: Structural and kinematic properties of dwarf galaxies and observational constraints. In *American Astronomical Society Meeting #240*, volume 54 of *American Astronomical Society Meeting Abstracts*, page 347.06, June 2022