

James M. Sullivan, Ph.D.

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Current Position

Brinson Prize Fellow

Hosted at the Center for Theoretical Physics - a Leinweber Institute
Massachusetts Institute of Technology (MIT)

Research Interests

Large-scale structure cosmology, primordial physics, the intergalactic medium, computational methods.

Education

- 2018-2024 PhD in Astrophysics, UC Berkeley
- 2018-2019 MA in Astrophysics, UC Berkeley
- 2014-2018 BS in Physics, UT Austin
- BS in Pure Mathematics, UT Austin
- BS in Astronomy¹, UT Austin

Grants, honors & awards

- 2024 Brinson Prize Fellowship [\$360,000]
Graduate:
- 2023 Department of Energy Office of Science Graduate Student Research (SCGSR) Award (HEP) [~\$43,000]
- 2023-2026 PI of DOE Mission Science (HEP) ERCAP Award (3x renewal + 1 doubling of “Data-driven Differentiable Linear Cosmology”)
- 2022 PI of NERSC ASCR ERCAP Exploratory Award (“Data-driven Differentiable Linear Cosmology”)
- 2018-2022 Department of Energy Computational Sciences Graduate Fellowship (CSGF) [~\$200,000]

¹with Certificate in Scientific Computing & Data Science

- 2018 National Science Foundation Graduate Research Fellowship (GRFP, *declined*) [~\$150,000]
Undergraduate:
- 2018 Dean's Honored Graduate
- 2017 Center for Astrophysics | Harvard & Smithsonian Summer REU Intern (SAO NSF REU)
- 2017-2018 Astronaut Scholar [~\$26,000]

Publications

LEAD AUTHOR

- 2025 - **JMS**, Uroš Seljak “Local Primordial non-Gaussianity from Time Evolution”, (Physical Review D, 112, 083522), [arXiv:2503.21736](#)
- **JMS**, Carolina Cuesta-Lazaro, Mikhail M. Ivanov, Yueying Ni, Sowndak Bose, Boryana Hadzhiyska, César Hernández-Aguayo, Lars Hernquist, Rahul Kannan, “High-redshift Millenium and Astrid galaxies in effective field theory at the field level”, (Physical Review D, 112, 083521), [arXiv:2505.03626](#)
- 2024 - **JMS**, Shi-Fan Chen “Local Primordial non-Gaussian Bias at the Field Level”, *JCAP*, 3, 2025, [arXiv:2410.18039](#)
- 2023 - **JMS**, Tijan Prijon, Uroš Seljak, “Learning to Concentrate: Multi-tracer Forecasts on Local Primordial Non-Gaussianity with Machine-Learned Bias”, *JCAP*, 8, 4, [arXiv:2303.08901](#)
- **JMS**, JD Emberson, Salman Habib, Nicholas Frontiere, “Improving initialization and evolution accuracy of cosmological neutrino simulations”, *JCAP*, 6, 3, [arXiv:2302.09134](#)
- 2021 - **JMS**, Uroš Seljak, Sukhdeep Singh, “An Analytic Hybrid Halo + Perturbation Theory Model for Small-scale Correlators: Baryons, Halos, and Galaxies”, *JCAP*, 11, 26, [arXiv:2104.10676](#)
- 2020 - **JMS**, Sarafina Nance, J. Craig Wheeler, “The Betelgeuse Project III: Constraints from Rotation”, *ApJ*, 905, 128
- 2019 - **JMS**, Alexander Wiegand, Daniel Eisenstein, “The clustering of galaxies in the SDSS-III Baryon Oscillation Spectroscopic Survey: evolution of higher-order correlations demonstrated with Minkowski functionals”, *MNRAS*, 485, 2
- 2018 - **JMS**, Shingo Hirano, Volker Bromm, “Minimum star-forming halo mass in axion cosmology”, *MNRAS Letters*, 481L, 69

PRIMARY AUTHORSHIP

- 2025 - Roger de Belsunce, **JMS**, Patrick McDonald, “Lyman- α Forest Skew Spectra”, [arXiv:2510.23597](#)

MENTORED STUDENT-FIRST AUTHOR

- 2025 - Divij Sharma, **JMS**, Kazuyuki Akitsu, Mikhail Ivanov, “Equilateral non-Gaussian bias at the field level”, [arXiv:2511.14677](#)

OTHER AUTHOR

- 2026

- Shion Andrew et al., (inc. **JMS**) “Fast radio burst dispersion is an unbiased tracer of matter on large scales”, [arXiv:2604.25828](#)
- Mikhail M. Ivanov, **JMS**, et al., “Reanalyzing DESI DR1: 4. Percent-Level Cosmological Constraints from Combined Probes and Robust Evidence for the Normal Neutrino Mass Hierarchy”, [arXiv:2601.16165](#)
- 2025 - Michael W. Toomey, Ellie Hughes, Mikhail M. Ivanov, **JMS**, “Kinetic Mixing and the Phantom Illusion: Axion–Dilaton Quintessence in Light of DESI DR2”, [arXiv:2511.23463](#)
- Roger de Belsunce, Mikhail Ivanov, **JMS**, Kazuyuki Akitsu, Shi-Fan Chen, “Modeling the Cosmological Lyman– α Forest at the Field Level”, [arXiv:2507.00284](#)
- 2023 - Jaime Ruiz-Zapatero et al. (inc. **JMS**), “Limberjack.jl”, The Open Journal of Astrophysics, 7, I, II
- Andrina Nicola et al. (inc. **JMS** & LSST DESC Collaboration), “Galaxy bias in the era of LSST: perturbative bias expansions”, JCAP, 2024, 2
- 2018 - Sarafina Nance, **JMS**, Manuel Diaz, J. Craig Wheeler, “The Betelgeuse Project II: asteroseismology”, MNRAS, 479, 1
- 2017 - Shingo Hirano, **JMS**, & Volker Bromm, “First star formation in ultralight particle dark matter cosmology”, MNRAS Letters, 473, 1
- J. Craig Wheeler et al. (inc. **JMS**), “The Betelgeuse Project: constraints from rotation”, MNRAS, 465, 3

NON-ASTRO/PHYSICS ARTICLES

- **JMS**, Uroš Seljak “Deterministic Langevin Unconstrained Optimization with Normalizing Flows”, [arXiv:2310.00745](#)
- **JMS**, Collin Weir, Austin Reichert, R. Todd Evans, W. Cyrus Proctor, Nicholas Thorne, “Student Cluster Competition 2017, Team University of Texas at Austin/Texas State University: Reproducing Vectorization of the Tersoff Multi-Body Potential on the Intel Skylake and NVIDIA V100 Architectures”, *Special edition of Parallel Computing*, [arXiv:1808.07027](#)

Teaching & Advising

TEACHING

- 2026 Led MIT Independent Activities Period (**IAP**) seminar activity: “[The Leapfrog Language of Theoretical Physics](#)” [Awarded an IAP \$500 mini grant]
- 2025 Instructor for **BBB** (Associate degree-granting partnership inside MA and ME state prisons)
 - [Fall 2025 Python TA]
- 2022-2023 STEM Faculty at [Mount Tamalpais College](#) (Accredited Associate degree-granting institution in San Quentin State Prison)
 - [Spring 2023 Statistics Co-instructor]
 - [Fall 2022 Physics I with Lab Co-instructor]
 - [Spring 2022 Intermediate Algebra Co-instructor]
- 2018 UCB Graduate Student Instructor (ASTRON CIO)
- 2016-2018 UT Freshman Research Initiative (FRI) Mentor
- 2016 UT Physical Sciences Learning Assistant

STUDENTS ADVISED

Graduate:

- **Ryan Raikman** (MIT) - Spring 2025 → (w. Mikhail Ivanov, Kiyoshi Masui)

- **Divij Sharma** (MIT) - Fall 2024 → (w. Mikhail Ivanov)

Project: *Non-local Primordial non-Gaussian Bias*

(Result: Journal publication - Sharma, Sullivan, Akitsu & Ivanov 2025)

- **Ellie Hughes** (MIT) - Fall 2024 → (w. Mikhail Ivanov, Michael Toomey)

Undergraduate:

- **Ben Pennell** (CITA SURF, U Toronto) - Summer 2023 - Fall 2024 (remote w. Zack Li)

Project: *Cosmological Ionization History with Neural Ordinary Differential Equations*

Now: PhD student at MPIA (Heidelberg)

- **Tijan Prijon** (UC Berkeley, U Lubljana) - Fall 2022 - Spring 2023 (w. Uroš Seljak)

Project: *Machine-Learned Bias for Local Primordial Non-Gaussianity*

Now: Masters student at ETH Zurich

High School:

- **Siddhi Kochar** (MIT RSI) - Summer 2026

Selected Talks

(Since 2023, ★ = invited talks)

2026

- Advancing Field-level and Simulation-based Inference for Cosmology

★ From Pen and Paper to Petaflops: Cosmology's 30-Year Transformation

★ Berkeley Cosmology Seminar, "Spilling Spectroscopic Survey Secrets with Perturbative Bias Phenomenology"

★ BU High Energy Seminar

2025

★ MIT-Tufts Cosmology Seminar, "Precision pursuits in physical cosmology with galaxy surveys"

- Galileo Galilei Institute for Theoretical Physics workshop on New Physics from Galaxy Clustering, "High-redshift galaxy bias for stage-5 spectroscopic surveys"

- Aspen Summer Workshop on Lyman Alpha Emitters and Lyman Break Galaxies as Cosmological Tracer Populations, "High-redshift Millenium and Astrid galaxies in effective field theory at the field level" (Lightning talks)

- Toronto Workshop on Cosmology from Lyman Break Galaxies, "Toward a Model of LBG Clustering from Cosmological Hydrodynamical Simulations"

2024

- New Physics from Galaxy Clustering III, "How the trees lean: Toward Lyman-alpha forest skew spectra"

★ CraigFest 2024, "Time-evolving dark energy and statistical features of DESI Year 1 Baryon Acoustic Oscillation and Type Ia SNe datasets"

2023

- Sexten Conference on New Strategies for Extracting Cosmology From Future Galaxy Surveys: 2nd edition, “Field level bias modeling, time evolution, and local primordial non-Gaussianity”
- Higgs Centre for Theoretical Physics meeting on Theoretical Modeling of Large-Scale Structure of the Universe, “Field level bias modeling, assembly bias, and primordial non-Gaussianity”
- Spec-S5 Fundamental Physics from Future Spectroscopic Surveys Berkeley meeting, “Leveraging the b_ϕ dimension of multi-tracer”
- ★ BCCP Seminar, “Local Primordial Non-Gaussianity in Galaxy Surveys”
- IAP/CCA Debate 2, “Embedding Neural Networks in ODEs to Learn Linear Cosmological Physics”
- ★ Yale Cosmology Seminar, “Galaxies Remember Inflation: Early Universe Physics with Large-scale Structure”
- ★ MPA Cosmology Seminar, “Galaxies Remember Inflation: New Aspects of Local Primordial Non-Gaussianity in Galaxy Surveys”
- ★ IAS/Princeton Cosmology Lunch, “New Aspects of Local Primordial Non-Gaussianity in Galaxy Surveys”
- ★ KICP Astro Series, “Galaxies Remember Inflation: Early Universe Physics with Large-scale Structure”
- ★ Stanford KIPAC Cosmology Seminar, “Large-scale Structure Remembers Inflation: New Aspects of Local Primordial Non-Gaussianity in Galaxy Surveys”
- ★ [CfA Seminar](#), “New Aspects of Local Primordial Non-Gaussianity in Galaxy Surveys”
- ★ [CMB-S4 Collaboration Meeting](#), parallel session, “Fast exploration of BSM models with Bolt.jl”
- Benasque [Understanding Cosmological Observations](#), organized session on PNG + Large-scale Systematics, and High-dimensional Data Analysis
- ★ SPHEREx Cosmology Group, “Learning to Concentrate: Multi-tracer Forecasts on Local Primordial Non-Gaussianity with Machine-Learned Bias”
- Sexten Conference on [New Strategies for Extracting Cosmology From Future Galaxy Surveys](#), “Bias Methods for Primordial non-Gaussianity”
- [SIAM OP23](#), “Deterministic Langevin Optimization”

Service & Outreach

MIT:

- Lead organizer for [Aspen Winter Conference](#) on “Fundamental Physics from the Primordial Era with Galaxy Surveys” (2027)
- MIT CTP-LI [Fanyi Zhao Award](#) (2026, for promoting scientific and social connection)
- [MIT/Tufts Cosmology Seminar](#) Organizer (2026-2027)
- MIT [Nuclear & Particle Theory Colloquium](#) Committee (2026)
- Teacher for [SPARK MIT](#) (2026)

- Created CTP-LI Coffee Breaks Community-building activity (2026) [Winner of MIT School of Science Quality of Life Grant \$1,000]
- [MIT Physics Values](#) Committee Postdoctoral Member (2025, 2026→)
- Mentor for MIT [RSI](#) high-school summer program (2026)
- MIT IAIFI Junior Investigator (2025→)
- Physics/AI Panelist for [SPLASH MIT](#) (2025)
- MIT IAIFI Community Forum Board Member (Fall 2025, Spring 2026)
- MIT IAIFI Speaker Selection committee (2025, 2026)
- MIT IAIFI ECEC committee (Spring 2025)
- MIT Cosmo Coffee Organizer (2024, 2025, 2026)
- MIT Dark Matter Journal Club Organizer (2024)
- Reviewer for JCAP, A&A

UC Berkeley:

- Berkeley Cosmology Journal Club Organizer (2024)
- Berkeley Physics Directed Reading Program Mentor (2024)
- Reviewer for the Berkeley Scientific Journal (Undergraduate-run science journalism publication, 2024)
- Berkeley Physics Directed Reading Program mentor, Inflationary Cosmology (2024)
- UC Berkeley Astronomy Department Faculty Search Graduate Representative (2023)
- Astrobites Author (2019-21, [14 articles](#)), and Editorial co-chair (2021, edited 100+ submissions).
- UC Berkeley Astronomy Department Representative for facilitating the Respect is a Part of Research Sexual Violence and Sexual Harassment prevention training (2022, 2023)
- UC Berkeley Prospective Graduate Student Visit Committee Chair (2022) [3/3 admitted students attending accepted offer that year]
- Math & Physical Sciences Scholars Undergraduate Mentor (2022)
- POWER Bay Area Outreach Mentor (2021)
- Teacher for SPLASH Berkeley (2021, 2022, 2023, 2024)
- Astronomy Scholars Undergraduate Mentor (2021)
- Compass Undergraduate Mentor (2019)
- Compass Lecture “Fuzzy Dark Matter” (2019)

References

[Uroš Seljak](#): UC Berkeley & Lawrence Berkeley National Laboratory

[Mikhail Ivanov](#): Massachusetts Institute of Technology

[Martin White](#): UC Berkeley & Lawrence Berkeley National Laboratory

[Salman Habib](#): Argonne National Laboratory, UChicago, & Northwestern