

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, 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]
2023-2025 PI of DOE Mission Science (HEP) ERCAP Award (2x renewal/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]
2018 National Science Foundation Graduate Research Fellowship (GRFP, *declined*) [~\$150,000]

¹with Certificate in Scientific Computing & Data Science

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

JOURNAL ARTICLES (LEAD AUTHOR)

- 2025 - **JMS**, Uroš Seljak “Local Primordial non-Gaussianity from Time Evolution”, (Physical Review D), [arXiv:2503.21736](#)
- **JMS**, Carolina Cuesta-Lazaro, Mikhail M. Ivanov, Yueying Ni, Sownak 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), [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

JOURNAL ARTICLES (OTHER AUTHOR)

- 2025 - 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, 1, 11
- 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](#)

Selected Talks

(★ = invited talks)

2025:

- 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” (Lightening 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”
- Cosmology on the Adriatic: From PT to AI, “Split Gong Session: 2 Points on Local PNG”
- 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”
- Fundamental Physics from Future Spectroscopic Surveys, “Leveraging the b_ϕ dimension of multi-tracer”
- BCCP Seminar, “Local Primordial Non-Gaussianity in Galaxy Surveys”

2023:

- 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 (also flash talk)
- ★ 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”
- Cosmology from Home 2023, “Learning Linear Cosmological Physics”
- SIAM OP23, “Deterministic Langevin Optimization”
- 2022:**
- ★ Montreal Astromerique Speaker Series, “Accelerating Cosmological Inference with Gradients and Surrogate Models”
- DoE CSGF Program Review, “Computational Aspects of Computational Cosmology” (Exiting fellow talk)
- Cosmology From Home, “Bolt.jl - the Differentiable Boltzmann Solver”
- 2021:**
- ★ DESI GGL Telecon, “Halo-Zel’dovich Perturbation Theory”
- ★ ANL CPAC Journal Club, “Halo-Zel’dovich Perturbation Theory”
- ★ University of Arizona Cosmology group meeting (TACOS), “Halo-Zel’dovich Perturbation Theory”

POSTERS

- Cosmology on the Steep Rise Sesto Workshop 2025 (Bolzano, IT), “Lyman- α Forest Skew Spectra”
- Flatiron Institute Cosmic Connections Workshop 2023 (New York, NY), “Learning to Concentrate: Multi-tracer Forecasts on Local Primordial Non-Gaussianity with Machine-Learned Bias”
- Computational Science Graduate Fellowship Program Review 2021 (virtual), “Halo-Zel’dovich Perturbation Theory”
- 2021 NeurIPS Differentiable Programming workshop, “Gradients of the Big Bang: Solving the Einstein-Boltzmann Equations with Automatic Differentiation”
- Computational Science Graduate Fellowship Program Review 2019 (Arlington, VA), “Neutrinos in HACC”
- American Astronomical Society Meeting 2018 (Washington, D.C.), “Redshift Evolution of Non-Gaussianity in Cosmic Large-scale Structure”

Teaching & Advising

TEACHING

- 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 C10)
- 2016-2018 UT Freshman Research Initiative (FRI) Mentor
- 2016 UT Physical Sciences Learning Assistant

STUDENTS ADVISED

Undergraduate:

- **Ben Pennell** (U Toronto, CITA SURF) - Summer 2023 - Fall 2024 (w. Zack Li)
Project: *Cosmological Ionization History with Neural Ordinary Differential Equations*
Now: PhD student at MPIA (Heidelberg)
- **Tijan Prijon** (U Ljubljana, BCCP) - Fall 2022 - Spring 2023 (w. Uroš Seljak)
Project: *Machine-Learned Bias for Local Primordial Non-Gaussianity*
Now: Masters student at ETH Zurich

Service & Outreach

- MIT IAIFI Junior Investigator (2025, 2026)
- IAIFI Speaker Selection committee (2025)
- IAIFI ECEC committee (2025)
- MIT Cosmo Coffee Organizer (2024, 2025)
- MIT Dark Matter Journal Club Organizer (2024)
- Reviewer for A&A
- 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)
- Berkeley Racial Justice Book Club Facilitator (2020)
- Compass Undergraduate Mentor (2019)
- Compass Lecture “Fuzzy Dark Matter” (2019)

References

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

[Mikhail Ivanov](#): Center for Theoretical Physics, Massachusetts Institute of Technology

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

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