Sky Cao

CONTACT INFORMATION

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RESEARCH INTERESTS

Probability, analysis, stochastic geometric analysis – in particular, Yang–Mills, singular SPDE, random surfaces.

EMPLOYMENT

University of Pennsylvania

Assistant Professor, Department of Statistics and Data Science, The Wharton School, July 2026 - current

Massachusetts Institute of Technology

NSF Postdoctoral Fellow and C.L.E. Moore Instructor, July 2023 - June 2026

Institute for Advanced Study

Member, School of Mathematics, September 2022 - June 2023

EDUCATION

Stanford University

Ph.D. in Statistics, June 2022

- Advisor: Sourav Chatterjee

University of California, Berkeley

B.A. in Mathematics, Computer Science, May 2017

- Highest honors in mathematics, highest distinction in general scholarship

PUBLICATIONS

Dynamical approach to area law for lattice Yang–Mills. (with Ron Nissim and Scott Sheffield) arXiv:2509.04688 To appear in *Proc. Amer. Math. Soc.*

Surface sums in two-dimensional large-N lattice Yang–Mills: Cancellations and explicit computation for general loops. (with Jacopo Borga and Jasper Shogren-Knaak) arXiv:2508.13827 Submitted.

Expanded regimes of area law for lattice Yang–Mills theories. (with Ron Nissim and Scott Sheffield) arXiv:2505.16585 Submitted.

Surface sums for lattice Yang–Mills in the large-N limit. (with Jacopo Borga and Jasper Shogren-Knaak) arXiv:2411.11676 Submitted.

Global well-posedness of the dynamical sine-Gordon model up to 6π. (with Bjoern Bringmann) arXiv:2410.15493 *Ann. Probab.* no. 3, 1564-1607, 2026.

Fractional Gaussian forms and gauge theory: an overview. (with Scott Sheffield) arXiv:1407.5598 *Front. Math.* **21**, 1–137, 2026.

Global well-posedness of the stochastic Abelian-Higgs equations in two dimensions. (with Bjoern Bringmann) arXiv:2403.16878 Submitted.

Random surfaces and lattice Yang-Mills. (with Minjae Park and Scott Sheffield) arXiv:2307.06790 *Comm. Amer. Math. Soc.* **5**, 774–896, 2025.

A para-controlled approach to the stochastic Yang-Mills equation in two dimensions. (with Bjoern Bringmann) arXiv:2305.07197. *Mem. Amer. Math. Soc.* **319** no. 1624, 2026.

Correlation decay for finite lattice gauge theories at weak coupling. (with Arka Adhikari) arXiv:2202.10375. *Ann. Probab.*, **53** no. 1, 140-174, 2025.

A state space for 3D Euclidean Yang-Mills theories. (with Sourav Chatterjee) *Comm. Math. Phys.*, **405** no. 3, 2024.

The Yang-Mills heat flow with random distributional initial data. (with Sourav Chatterjee) *Comm. Partial Diff. Eq.*, **48** no. 2, 209-251, 2023.

Correlations with tailored extremal properties. (with Peter J. Bickel) arXiv:2008.10177

Wilson loop expectations in lattice gauge theories with finite gauge groups. *Comm. Math. Phys.*, **380**, 1439–1505, 2020.

Central limit theorems for combinatorial optimization problems on sparse Erdős-Rényi graphs. *Ann. Appl. Probab.*, **31** no. 4, 1687-1723, 2021.

Invited Talks

Six lecture minicourse on Yang–Mills: random surface approach, Peking summer program in probability (June 2026)
Statistical Mechanics and Singular SPDEs, Institute of Mathematical Sciences, NUS (May 2026)
Statistical Mechanics of Lattice Systems, Brin Center, UMD (March 2026)
Columbia University Colloquium (January 2026)
UPenn Wharton Statistics seminar (January 2026)
Stanford University Statistics seminar (January 2026)
Johns Hopkins University Colloquium (December 2025)
Indiana University Bloomington Colloquium (December 2025)
University of Georgia Colloquium (December 2025)
UC Berkeley Guest Lecture Series (December 2025)
LSU Colloquium (December 2025)
SLMath workshop: Recent trends in stochastic partial differential equations (November 2025)
Caltech Colloquium (November 2025)
Cornell University Colloquium (November 2025)
Northeastern graduate research seminar (October 2025)
Princeton Analysis Seminar (September 2025)
HIM Workshop: Gauge theories and spin systems: Yang-Mills theory, continuous symmetry, and disorder (July 2025)
FRG Workshop "New Challenges in the Derivation and Dynamics of Quantum Systems" at UMass Amherst (June 2025)
University of Toronto Geometric Structures Laboratory seminar (May 2025)
MIT Probability seminar (May 2025)
Chinese Academy of Sciences seminar on stochastic analysis (Apr 2025)
Peking University Probability seminar (Apr 2025)
Spring AMS Sectional (April 2025)
UMD Probability seminar (January 2025)
Penn Probability and Combinatorics Seminar (December 2024)

UCLA Probability seminar (December 2024)
Brown Probability seminar (November 2024)
One World IAMP Mathematical Physics seminar (September 2024)
IAS Analysis and Mathematical Physics seminar (May 2024)
Statistical physics and random surfaces workshop, Oberwolfach (May 2024)
Webinar on stochastic analysis, Beijing Institute of Technology (April 2024)
University of Rochester Probability seminar (March 2024)
Harvard Probability seminar (March 2024)
MIT Probability seminar (March 2024)
Fields Institute, four lecture mini course on Yang–Mills (February 2024)
Stanford University Probability seminar (January 2024)
Webinar on stochastic analysis, Beijing Institute of Technology (September 2023)
IAS School of Mathematics Members Colloquium (March 2023)
Courant Probability & Mathematical Physics Seminar (December 2022)
Texas Tech Probability, Differential Geometry, and Mathematical Physics Seminar (November 2022)
UW Madison Probability Seminar (November 2022)
Random Geometry and Statistical Physics Workshop (October 2022)
Cornell Probability Seminar (May 2022)
MIT Probability Seminar (April 2022)
LU–NU–UMN Joint Probability Seminar (April 2022)
Percolation Today Seminar (March 2022)
UChicago Probability & Statistical Physics Seminar (March 2022)
University of Victoria Dynamics & Probability Seminar (March 2022)
ICL Stochastic Analysis Seminar (February 2022)
UCLA Probability Seminar (January 2022)
UC Davis Mathematical Physics & Probability Seminar (December 2021)
IISA 2021 Conference (May 2021)
Stanford Probability Seminar (June 2020)
Berkeley Probability Seminar (February 2020)

Contributed Talks

Northeast Probability Seminar (November 2021)
Bernoulli IMS One World Symposium (August 2020)

Honors and Awards

2026	Honorable mention, Bernoulli Society New Researcher Award
2023	US Junior Oberwolfach Fellow
2022	US Junior Oberwolfach Fellow
2022	Probability Theory Dissertation Award, Department of Statistics, Stanford University
2021	IISA Student Paper Competition Winner
2017	Dorothea Klumpke Roberts Prize

Teaching

Instructor

STAT9300401 Probability Theory. Fall 2026.
18.100B Real Analysis. Spring 2026.
18.S995 Topics in Analysis. Two week minicourse on singular stochastic partial differential equations. Fall 2025.
18.676 Stochastic Calculus. Spring 2025.
Stats 302: Probability Qualifying Exam Workshop. Summer 2019.

TA

18.100B Real Analysis. Spring 2026.
18.01A/02A Single and Multivariable Calculus. Fall 2025.
18.821 Project Laboratory in Mathematics. Fall 2024.
SLMath summer school on Stochastic Quantization. Summer 2024.
Stats 310A: Theory of Probability I. Fall 2021, Fall 2020, Fall 2019.
Stats 310B: Theory of Probability II. Winter 2020.
Stats 310C: Theory of Probability III. Spring 2020.
Stats 318: Modern Markov Chains. Spring 2021.
Stats 219: Stochastic Processes. Winter 2021.
Stats 217: Introduction to Stochastic Processes I. Winter 2018.
Stats 116: Theory of Probability. Spring 2019, Summer 2018.
Stats 60: Introduction to Statistical Methods: Precalculus. Summer 2021, Fall 2018, Fall 2017.

Service

Organization

MIT-Princeton Yang–Mills learning seminar, Fall 2025.
MIT probability seminar, 2023-now.
IAS probability seminar, 2022-2023.

Advising

MIT undergraduate major advisor to six students.

Referee/quick opinion

Advanced Nonlinear Studies, Annales Henri Lebesgue, AHP, AOAP, AOP, CAMS, CMP, ECP, EJP, IDAQP, IMRN, JFA, JLMS, JMP, JSP, Inventiones, Peking Math Journal, PMP, Proc. Roy. Soc. Edinburgh, TAMS.

Committees

ICM TV committee