SUMAN S. KULKARNI

sumank@sas.upenn.edu

EDUCATION

University of Pennsylvania September 2021 – Present
Ph.D. student in Physics
Advisor: Prof. Dani S. Bassett

Indian Institute of Science Education and Research Pune 2016 – 2021
B.S.–M.S. in Physics

PUBLICATIONS & PREPRINTS

(* denotes co-first author)

1. **Suman S. Kulkarni**, Jason Z. Kim, Panos Fotiadis, Fabio Pasqualetti and Dani S. Bassett. Quantifying the cost of network computations to unpack structure–function relationships in the brain. arXiv:2607.29537

2. Leo Chambers, **Suman S. Kulkarni**, Karen E. Daniels, Erin G. Teich and Dani S. Bassett. Network control of granular materials. Submitted to *Physical Review E*

3. Xueyan Feng*, **Suman S. Kulkarni***, Michael S. Dimitriyev, Dani S. Bassett, Randall D. Kamien, Edward L. Thomas and Gregory M. Grason. Topological and morphological signatures of disorder in block copolymer sponge networks. arXiv:2605.12889. Under Review at *Science Advances*.

4. Linus Chen-Plotkin, **Suman S. Kulkarni** and Dani S. Bassett. Predictability and Statistical Memory in Classical Sonatas and Quartets. arXiv:2509.24172. Under revision in *Physical Review E*

5. **Suman S. Kulkarni**, Christopher W. Lynn, Mason A. Porter and Dani S. Bassett. Ising dynamics on multilayer networks with heterogeneous layers. arXiv:2509.20216. Under revision in *Physical Review E*.

6. **Suman Kulkarni** and Dani S. Bassett. Towards principles of brain network organization and function. *Annual Reviews of Biophysics (2025).*

7. **Suman Kulkarni**, Sophia U. David, Christopher W. Lynn and Dani S. Bassett. Information content of note transitions in the music of J. S. Bach. *Physical Review Research* 6, 013136 (2024) **(Editors' Suggestion, Featured in Physics)**.

8. **Suman Kulkarni** and Deepak Dhar. Finite-size scaling functions of the phase transition in the ferromagnetic Ising model on random regular graphs. *Journal of Statistical Mechanics* 023209 (2022).

9. **Suman Kulkarni** and Collin D. Capano. Reliability of parameter estimates in the first observing run of Advanced LIGO. *Physical Review D* 103, 104002 (2021).

10. Aanjaneya Kumar, **Suman Kulkarni** and M. S. Santhanam. Extreme events in stochastic transport on networks. *Chaos: An Interdisciplinary Journal of Non-linear Science* 30, 043111 (2020).

MANUSCRIPTS IN PREPARATION

(* denotes co-first author)

1. Christoffer G. Alexanderssen, **Suman S. Kulkarni**, Jessica Davis, Sebastian N. Roemer-Cassiano, Nicolai Franzmeier, Alessandro Vespignani and Dani S. Bassett. Activity-dependent epidemic spreading on multiscale brain networks predicts Alzheimer's disease progression [2026]

2. **Suman S. Kulkarni**, Fariba Karimi, Dani S. Bassett and Erin G. Teich. Advances in the Sociophysics of Scientific Inquiry. Essay in revision at *Physical Review Letters* [2026]

3. Isabella Llano, Kat Hefter, **Suman S. Kulkarni**, Diana I. Tamir, and Dani S. Bassett, Subacute effects of a DMT and harmine meditation retreat on the brain's control energy landscape. [2026]

4. Isabella Stallworthy*, **Suman S. Kulkarni***, Matthew Cieslak, Theodore D Satterthwaite and Dani S. Bassett. Network control of dynamics on networks constructed from white matter tracts over development. [2026]

MEDIA

Information content of note transitions in the music of J. S. Bach
Interview and popular summary featured in *Scientific American* (link), *New Scientist* (link), *Physics Magazine* (link), *Science & Vie* (link), *German Public Radio* (link), *Penn Today* (link).

COMMENTARIES AND OTHER ARTICLES

Suman Kulkarni and Dani S. Bassett. Deciphering the Blueprint of the Fruit Fly's Brain, *Physics* 17, 136 (2024).

RESEARCH EXPERIENCE

University of Pennsylvania 2022 - Present
Graduate Research Assistant with Prof. Dani S. Bassett
– Network control theory to elucidate structure-function relationships in the brain.
– Role of network structure in dynamical processes on multilayer networks.
– Network theory and geometry to analyze network phases in soft matter.

Indian Institute of Science Education and Research, Pune 2020 - 2021
Master's Thesis Research with Prof. Deepak Dhar
Theoretical and numerical analysis of statistical physics models on locally tree-like graphs.

Max Planck Institute for Gravitational Physics Summer 2019, 2020
DAAD-WISE Research Scholar with Dr. Collin Capano and Prof. Badri Krishnan
Bayesian parameter estimation of black hole mergers using LIGO data.

Indian Institute of Science Education and Research, Pune 2018-2019
Undergraduate Research Assistant with Prof. M. S. Santhanam and Aanjaneya Kumar
Extreme events in dynamical processes on networks.

HONORS AND AWARDS

Graduate Student Speaker Award Winner, American Physical Society 2026
American Physical Society Division on Statistical and Nonlinear Physics.

Quad Fellowship Finalist 2023, 2024

Finalist for the Quad Fellowship, an initiative by the governments of Australia, India, Japan, and the United States.

Werner B. Teutsch Prize, University of Pennsylvania 2022

"Awarded annually by the Department of Physics, University of Pennsylvania to the graduate student who, by their performance in the first year, shows the most promise for outstanding achievement in research."

DAAD-WISE Research Scholarship 2019

Scholarship granted to fund a research project in Germany.

Delegate at the Asian Science Camp 2017

Represented India as a delegate at the Asian Science camp held in Malaysia.

CNR Rao Education Foundation Prize, IISER Pune 2017

Best academic performance at IISER Pune.

Kishore Vaigyanik Protsahan Yojana 2016

Fellowship awarded by the Government of India to pursue an undergraduate degree in basic science.

National Talent Search Examination 2014

Scholarship awarded by the Government of India.

PRESENTATIONS

Introduction to research in network science for soft & living matter June 2026

Presentation to undergraduate summer research scholars, Wellesley College

Quantifying the cost of network computations for structure–function relationships in the brain May 2026

Statistical Physics, Information & Networks lab, Yale University

Quantifying the cost of computations on networks March 2026

American Physical Society March Meeting 2026

Neural computation through the lens of control theory Aug 2025

Jayaraman and Hermundstad labs, HHMI Janelia Research Campus

Information content of note transitions in music composed by J. S. Bach May 2025

Computational Machinery of Cognition lab, TU Dresden

Control theory and network computation March 2025

American Physical Society March Meeting 2025

Geometry and Topology of imperfect gyroids networks in soft matter Nov 2024

Alan Schoen's 100th birth anniversary conference, Osaka, Japan

Information content of note transitions in music composed by J. S. Bach Nov 2024

Music Cognition lab, Princeton University

Information content of note transitions in music composed by J. S. Bach 2023

28th International Conference on Statistical Physics, StatPhys28

Information content of note transition networks in music 2023
American Physical Society March Meeting 2023

Reliability of parameter estimates in Advanced LIGO 2020
Max Planck Institute for Gravitational Physics, Hannover, Germany

MENTORSHIP EXPERIENCE

Leo Chambers, Postbaccalaureate Research Assistant Fall 2025 – Present
Research topic: Control of dynamics on networks

Jin Jiang, Master's Research Assistant Fall 2025 – Present
Project title: Using white matter bundle data to explore network properties of the brain

Linus Chen-Plotkin, High School Research Assistant Summer 2024 – Fall 2025
Project title: Data analysis of note transitions in music

TRAVEL SUPPORT

University of Pennsylvania, President Gutmann Leadership Award 2024
University of Pennsylvania, Graduate Student Assembly Research Student Travel Award 2023
International Conference on Statistical Physics Travel Award 2023
University of Pennsylvania, School of Arts and Sciences Travel Grant 2023, 2024

ACADEMIC SERVICE

Conference for Undergraduate Women in Physics 2024
Organizer and volunteer for the APS Conference for Undergraduate Women in Physics held at University of Pennsylvania in January 2024.

Soft Matter and Biological Physics Meeting Organizer 2022 – 2025
Organized weekly cross-departmental meetings for researchers in soft matter and biological physics at University of Pennsylvania.

Academic journal referee 2022–Present
Proceedings of the National Academy of Sciences (PNAS), Physical Review Research, Physical Review B.

TEACHING EXPERIENCE

Mathematical Methods for Physicists Fall 2023
Curiosity: Ancient and modern thinking about thinking Spring 2023
Introductory mechanics and electromagnetism laboratory Fall 2021 & Spring 2022