



Shamit Kachru

Professor of Physics and Director, Stanford Institute for Theoretical Physics

Bio

BIO

My past research has used the ideas and techniques of quantum field theory and string theory to address questions in theoretical cosmology, condensed matter physics, particle physics, mathematical physics, and quantum gravity. Highlights of my past research include:

- The discovery of string dualities with 4d $N=2$ supersymmetry, and their use to find exact solutions of gauge theories (with Cumrun Vafa)
- The construction of the first examples of AdS/CFT duality with reduced supersymmetry (with Eva Silverstein)
- Foundational papers on string compactification in the presence of background fluxes (with Steve Giddings and Joe Polchinski)
- Basic models of cosmic acceleration in string theory (with Renata Kallosh, Andrei Linde, and Sandip Trivedi)
- First computation of the non-Gaussianity in general single field inflation (with Xingang Chen, Min-xin Huang, and Gary Shiu)
- Developing the framework underlying holography for non-relativistic field theories, relevant for modeling quantum matter at finite density (with Xiao Liu and Michael Mulligan)
- Simple and tractable models of non-Fermi liquids (with Liam Fitzpatrick, Jared Kaplan, and Sri Raghu)

In addition to continuing research in areas closely related to those above, my present research is increasingly focused on a new (for me) endeavor: applying the approaches and ideas of theoretical physics to questions in evolutionary biology and eco-evolutionary dynamics. My first publications in this area will appear in spring 2019, and I have started accepting students with primary interests in this direction.

For details about my present and former students, please see the “Research and Scholarship” link in my full Stanford profile.

ACADEMIC APPOINTMENTS

- Professor, Physics
- Member, Bio-X

ADMINISTRATIVE APPOINTMENTS

- Department Chair, Stanford Physics, (2018- present)
- Wells Family Director, Stanford Institute for Theoretical Physics, (2017- present)
- Professor of Physics, Stanford University, (1999- present)
- KITP Member and Visiting Professor, UCSB, (2009-2010)
- Member, Institute for Advanced Study, (1999-2000)

HONORS AND AWARDS

- Simons Investigator Award, Simons Foundation (2017 -)
- SQuaRE grant, "Moonshine and string theory", American Institute of Mathematics (2016-)
- Plenary Speaker, International Congress of Mathematical Physics, International Association of Mathematical Physics (2015)
- Distinguished Visiting Research Chair, Perimeter Institute (2014-)
- Outstanding Young Investigator, ACIPA (2008)

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BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Scientific Advisory Committee, Kavli Institute for Theoretical Science (KITS), Beijing (2019 - present)
- Editorial Board, Research in Mathematical Sciences (2015 - present)
- Scientific Advisory Committee, Perimeter Institute (2015 - 2019)
- Advisory Board, Kavli Institute for Theoretical Physics (KITP), Santa Barbara (2014 - 2017)
- External Organizer, ICTP Spring School (2007 - 2010)
- Member, Aspen Center for Physics (2006 - 2015)

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PROFESSIONAL EDUCATION

- Ph.D., Princeton University , Physics (1994)
- A.B., Harvard University , Physics (1990)

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My recent research has involved three directions:

— Mathematical aspects of string theory, with a focus on interplay between BPS state counts, physics of black holes, and number theory.

— Quantum field theory and condensed matter physics, with a particular interest in the emergence of non-Fermi liquid states of matter.

— Theoretical biology, with a focus on evolution and ecology. This is a new initiative for me. My first papers in this area will appear in late 2018, and I have started accepting students with a primary interest in this area.

I typically work with a small number of graduate students and SITP postdocs. I've also taken undergraduate researchers for summer or thesis projects. My students have gone on to various interesting places after leaving Stanford.

Present and former PhD Advisees:

Brandon Rayhaun (current student)

Xinghe Li (current student)

Richard Nally (current student)

Max Zimet (current student, to Harvard in Fall 2019)

Nathan Benjamin (now Fellow, Princeton Center for Theoretical Science)
Natalie Paquette (now Burke Fellow at Caltech)
Dan Whalen (now at Renaissance Technologies)
Huajia Wang (KITP postdoc, to faculty at Kavli Institute for Theoretical Sciences in 2019)
Sarah Harrison (to Harvard postdoc, now joint math/physics faculty at McGill)
Dusan Simic (to KITP postdoc)
Mike Mulligan (to MIT postdoc, now faculty at UC Riverside)
Wu-yen Chuang (to Rutgers postdoc, now mathematics faculty at National Taiwan University)
Alexander Giryvets (now Vice-President at Morgan Stanley)
Xiao Liu (to Perimeter Institute postdoc, now faculty at UESTC)
Liam McAllister (to Princeton postdoc, now Cornell faculty)
John McGreevy (to Princeton postdoc, now UCSD faculty)
Michael Schulz (to Caltech postdoc, now Bryn Mawr faculty)

Present and former undergraduate research students:

George Hulsey (summer 2018)
Sungyeon Yang (summer 2018)
Newton Cheng, 2017-18 (to graduate school at UC Berkeley)
Tudor Ciobanu, 2017-18 (to graduate school at Stony Brook)
Ethan Sussman, 2016-18 (to graduate school in mathematics at MIT)
Preethi Pallegar, 2015-16 (now in graduate school at Princeton)
Marc Robbins, 2015 (now in graduate school at Illinois)
Zhiming Wang, 2015 (now in graduate school at Princeton)
Temple He, 2009-10 (now in graduate school at Harvard)
Daniel Balick, 2005-06 (UCSB PhD in theoretical biology, now at Harvard)
Christopher Beem, 2005-06 (Berkeley PhD in string theory, now faculty at Oxford)
Dan Wohns, 2005-06 (Cornell PhD in string theory, now at Perimeter)

Teaching

COURSES

2018-19

- Foundations of Modern Physics: PHYSICS 70 (Aut)

2017-18

- Partial Differential Equations of Mathematical Physics: PHYSICS 111 (Aut)

2016-17

- Mathematical Methods of Physics: PHYSICS 112 (Win)

2015-16

- Mathematical Methods of Physics: PHYSICS 112 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Divy Murli

Postdoctoral Faculty Sponsor

Ronak Soni, Wenzhe Yang

Doctoral Dissertation Advisor (AC)

Bryce Bagley, Brandon Rayhaun, Milind Shyani

Postdoctoral Research Mentor

Wenzhe Yang

Publications

PUBLICATIONS

- **Gravity duals of Lifshitz-like fixed points** *PHYSICAL REVIEW D*
Kachru, S., Liu, X., Mulligan, M.
2008; 78 (10)
- **Observational signatures and non-Gaussianities of general single-field inflation** *JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS*
Chen, X., Huang, M., Kachru, S., Shiu, G.
2007
- **Towards inflation in string theory** *JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS*
Kachru, S., Kallosh, R., Linde, A., Maldacena, J., McAllister, L., Trivedi, S. P.
2003
- **de Sitter vacua in string theory** *PHYSICAL REVIEW D*
Kachru, S., Kallosh, R., Linde, A., Trivedi, S. P.
2003; 68 (4)
- **Hierarchies from fluxes in string compactifications** *PHYSICAL REVIEW D*
Giddings, S. B., Kachru, S., Polchinski, J.
2002; 66 (10)

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