Brandon Rayhaun

Curriculum Vitæ

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Education

Stanford University, Stanford, CA
PhD in Physics, 2016 – present
PhD advisor: Shamit Kachru

University of Chicago, Chicago, IL
MS in Physical Sciences, 2015 – 2016
Master's thesis advisor: Jeffrey Harvey
BS in Mathematics, Minor in Physics, 2011 – 2015
Phi Beta Kappa (junior year), dean's list, general university honors

Publications

Two New Avatars of Moonshine for the Thompson Group
With J. Duncan and J. Harvey. (arXiv: [2202.08277])

Modular Products and Modules for Finite Groups
With J. Duncan and J. Harvey. (arXiv: [2202.08271])

Higher-Form Subsystem Symmetry Breaking and Fracton Phase Transitions
With D. Williamson. (arXiv: [2112.12735])

An Overview of Penumbral Moonshine
With J. Duncan and J. Harvey. (arXiv: [2109.09756])

Fractons and Exotic Symmetries from Branes
With H. Geng, S. Kachru, A. Karch, and R. Nally. *Fortschr. Phys.* 2021, 2100133. doi:10.1002/prop.202100133. (arXiv: [2108.08322])

Conformal Field Theories with Sporadic Group Symmetry
With J. Bae, J. A. Harvey, K. Lee, and S. Lee. *Commun. Math. Phys.* (2021). doi:10.1007/s00220-021-04207-7. (arXiv: [2002.02970])

Kitaev's Quantum Double Model as an Error Correcting Code
With S. Cui, D. Ding, X. Han, G. Penington, D. Ranard, and Z. Shangnan. *Quantum* 4 (2020): 331. doi:10.22331/q-2020-09-24-331. (arXiv: [1908.02829])

Attractive Strings and Five-Branes, Skew-Holomorphic Jacobi Forms and Moonshine
With M. Cheng, J. Duncan, S. Harrison, J. Harvey, and S. Kachru. *J. High Energ. Phys.* **07**, 130 (2018). doi:10.1007/JHEP07(2018)130. (arXiv: [1708.07523])

Simulating Tactile Signals from the Whole Hand with Millisecond Precision[1]
H. P. Saal, B. P. Delhaye, B. C. Rayhaun, & S. J. Bensmaia. *Proceedings of the National Academy of Sciences*, 2017, 114 (28) E5693-E5702. doi:10.1073/pnas.1704856114

Traces of Singular Moduli and Moonshine for the Thompson Group[2]
With J. Harvey. *Communications in Number Theory and Physics*, Vol. 10, Num. 1, pp. 23-62 (2016). doi:10.4310/CNTP.2016.v10.n1.a2. (arXiv: [1504.08179])

[1] Chicago Biomedical Consortium article
[2] Quanta Magazine article

Selected Research Talks (since graduate school)

Moonshine, old and new Spring 2022
Jefffest, University of Chicago
on work with J. A. Harvey et. al.

Fractons: Perspectives from Quantum Information Theory, Condensed Matter Physics, and High Energy Physics
Particle Theory Seminar, University of Washington, Spring 2022
on work with H. Geng, S. Kachru, A. Karch, R. Nally, and D. Williamson.
Quantum Fields and Strings Seminar Series, Perimeter Institute, Fall 2021
on work with H. Geng, S. Kachru, A. Karch, R. Nally, and D. Williamson.

Fractons: a view from string theory Fall 2021
Patrick Hayden group meeting, Stanford University
on work with H. Geng, S. Kachru, A. Karch, and R. Nally.

Chiral algebras with exceptional finite symmetry groups Spring 2021
Number Theory, Strings, and Quantum Physics Conference, IPMU,
on work with J-B. Bae, J. A. Harvey, K. Lee, and S. Lee.

Conformal field theories with exceptional symmetry Spring 2020
Seminar, University of Vienna,
on work with J-B. Bae, J. A. Harvey, K. Lee, and S. Lee.

Chiral algebras with exceptional symmetry Winter 2020
Gong Show, Modularity in Quantum Systems, UCSB,
on work with J-B. Bae, J. A. Harvey, K. Lee, and S. Lee.

Conformal field theories with exceptional symmetry Winter 2020
SITP seminar, Stanford University,
on work with J-B. Bae, J. A. Harvey, K. Lee, and S. Lee.

Penumbral moonshine Fall 2019
AMS Fall Sectional Meeting, Binghamton University,
on work with J. F. R. Duncan and J. A. Harvey.

Thompson and Penumbral Moonshine Summer 2018
Moonshine conference, Erwin Schrodinger Institute,
on work with J. F. R. Duncan and J. A. Harvey.

Skew-holomorphic moonshine Fall 2016
Stanford Institute for Theoretical Physics, Stanford University,
on work with J. F. R. Duncan and J. A. Harvey.

Teaching Assistantships

PHYSICS 131, Quantum Mechanics II, Stanford University Spring 2022
PHYSICS 130, Quantum Mechanics I, Stanford University Winter 2018, 2019 & 2022
PHYSICS 112, Mathematical Methods for Physics, Stanford University Winter 2020
PHYSICS 212, Graduate Statistical Mechanics, Stanford University Fall 2019
PHYSICS 231, Graduate Quantum Mechanics II, Stanford University Spring 2019
PHYSICS 70, Modern Physics, Stanford University Fall 2018 & Fall 2020
PHYSICS 65, Quantum and Thermal Physics, Stanford University Spring 2018
PHYSICS 111, Partial Diff. Eqs. of Mathematical Physics, Stanford University Fall 2017
PHYSICS 44, Electricity & Magnetism Lab, Stanford University Spring 2017
MATH 131-132, Calculus I-II, University of Chicago Fall 2014 – Winter 2015

Computer skills

Fluent: Sage, Python, C, Haskell, GAP, Elm, LaTeX, MATLAB, Mathematica
Basic knowledge: html, Awk, COSY Infinity

Reviewer

Journal of High Energy Physics, Communications in Number Theory and Physics, Proceedings of the American Mathematical Society

Selected Event Participation (since graduate school)

New Connections in Number Theory and Physics 2022
Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom

Bootstrap Yearly Collaboration Meeting 2022
Universidade do Porto, Porto, Portugal

JeffFest 2022
University of Chicago, Chicago, Illinois

Simons Collaboration on Ultra Quantum Matter, Annual Meeting 2022
Simons Foundation, New York, New York

Number theory, strings, and quantum physics 2021
IPMU, Tokyo, Japan

Modularity in Quantum Systems 2020
University of California, Santa Barbara, Santa Barbara, California

Ultra Quantum Matter Summer School (TA and participant) 2020
Perimeter Institute, Waterloo, Ontario

Bootstrap School 2020
Harvard University, Boston, Massachusetts

AMS Fall Eastern Sectional Meeting 2019
Binghamton University, Binghamton, New York

TASI - The Many Dimensions of Quantum Field Theory 2019
University of Colorado Boulder, Boulder, Colorado

Chiral Algebras for the 21st Century 2019
UC Davis, Davis, California

Conference on Number Theory, Geometry, Moonshine & Strings III 2019
Simons Foundation, New York, New York

Moonshine Workshop 2018
Erwin Schrodinger International Institute for Mathematics and Physics, Vienna, Austria

Bootstrap School 2018
Caltech, Pasadena, California

SoCal Grad Strings and Fields 2018
UCSB, Santa Barbara, California

AIM SQuaRE: Indefinite theta functions and moonshine 2018
American Institute of Mathematics, San Jose, California
with J. Duncan, M. Griffin, J. Harvey, and M. Mertens

Conference on Number Theory, Geometry, Moonshine & Strings II 2018
Simons Foundation, New York, New York

Google X meeting regarding quantum gravity, information, and computation 2017
Google X, Mountain View, California

Conference on Number Theory, Geometry, Moonshine & Strings 2017
Simons Foundation, New York, New York

Spring School on Super String Theory and Related Topics 2016
International Center for Theoretical Physics, Trieste, Italy