Raghav G. Jha

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EMPLOYMENT

• **Jefferson National Lab (JLab)** *September 2022 - today*
Postdoctoral Researcher Staff Newport News, VA, USA

• **Perimeter Institute for Theoretical Physics** *September 2019 - August 2022*
Postdoctoral Fellow Waterloo, ON, Canada

EDUCATION

- **Ph.D. Physics**, Syracuse University, NY, USA *August 2013 - May 2019*
- **M.Sc. Physics**, St. Xavier's College & Bose Institute, Kolkata, INDIA *August 2011 - May 2013*
- **M.S. in Nanomaterials**, Sorbonne Université, Paris, FRANCE *September 2010 - July 2011*
- **B.Sc. Physics (Honours)**, St. Stephen's College, Delhi, INDIA *July 2007 - May 2010*

PUBLICATIONS

[Google Scholar, iNSPIRE, ORCID]
(Authors are mostly listed in alphabetical order)

35. *On Ising model in magnetic field on the lattice*
(in review)
arXiv:2504.18744
Raghav G. Jha

34. *Real-Time Scattering in Ising Field Theory using Matrix Product States*
(in review)
arXiv:2411.13645
Raghav G. Jha, Ashley Milsted, Dominik Neuenfeld, John Preskill, Pedro Vieira

33. *Quantum computation of $SU(2)$ lattice gauge theory with continuous variables*
(in review)
arXiv:2410.14580
Victor Ale, Nora Bauer, **Raghav G. Jha**, Felix Ringer, George Siopsis

32. *Sparsity dependence of Krylov state complexity in the SYK model*
(in review)
arXiv:2407.20569
Raghav G. Jha, Ranadeep Roy

31. *Thermal state preparation of the SYK model using a variational quantum algorithm*
(in review)
arXiv:2406.15545
Jack Araz, **Raghav G. Jha**, Felix Ringer, Bharath Sambasivam

30. *SU(2) principal chiral model with tensor renormalization group on a cubic lattice*
arXiv:2406.10081, Phys. Rev. D **110**, 034519 (2024)
Shinichiro Akiyama, **Raghav G. Jha**, Judah Unmuth-Yockey

29. *Phase diagram of generalized XY model using tensor renormalization group*
arXiv:2404.17504, Phys. Rev. D **110**, 034504 (2024)
Abhishek Samlodia, Vamika Longia, **Raghav G. Jha**, Anosh Joseph

28. *Hamiltonian simulation of minimal holographic sparsified SYK model*
arXiv:2404.14784, Nucl. Phys. B 1012 (2025) 116815
Raghav G. Jha

27. *Tensor renormalization group study of 3D principal chiral model*
arXiv:2312.11649, PoS LATTICE2023 (2023) 355
Shinichiro Akiyama, **Raghav G. Jha**, Judah Unmuth-Yockey

26. *Nonperturbative phase diagram of two-dimensional $\mathcal{N} = (2, 2)$ super-Yang–Mills*
arXiv:2312.04980, Phys. Rev. D **110**, 054507 (2024)
Navdeep S. Dhindsa, **Raghav G. Jha**, Anosh Joseph, David Schaich

25. *Sachdev-Ye-Kitaev model on a noisy quantum computer*
arXiv:2311.17991, Phys. Rev. D **109**, 105002 (2024)
Muhammad Asaduzzaman, **Raghav G. Jha**, Bharath Sambasivam

24. *Continuous variable quantum computation of the O(3) model in 1+1 dimensions*
arXiv:2310.12512, Phys. Rev. A **109**, 052412 (2024)
Raghav G. Jha, Felix Ringer, George Siopsis, Shane Thompson

23. *Toward quantum computations of the O(3) model using qumodes*
arXiv:2308.06946, PoS LATTICE2023 (2023) 230
Raghav G. Jha, Felix Ringer, George Siopsis, Shane Thompson

22. *GPU-Acceleration of Tensor Renormalization with PyTorch using CUDA*
arXiv:2306.00358 , Computer Physics Communications 294 (2024) 108941
Raghav G. Jha, Abhishek Samlodia

21. *Notes on Quantum Computation and Information*
arXiv:2301.09679
Raghav G. Jha

20. *Supersymmetric Wilson loops on the lattice in the large N limit*
Eur. Phys. J. Spec. Top. 232:355–358 (2023)
Raghav G. Jha

19. *Non-perturbative phase structure of the bosonic BMN matrix model*
arXiv:2201.08791, JHEP 05 (2022) 169
Navdeep S. Dhindsa, **Raghav G. Jha**, Abhishek Samlodia, Anosh Joseph, David Schaich

18. *Thermal phase structure of dimensionally reduced super-Yang–Mills*
arXiv:2201.03097, PoS LATTICE2021 (2022) 187
David Schaich, **Raghav G. Jha**, Anosh Joseph

17. *Tensor renormalization of three-dimensional Potts model*
arXiv:2201.01789
Raghav G. Jha

16. *Introduction to Monte Carlo for Matrix Models*
arXiv:2111.02410, SciPost Phys. Lect. Notes 46 (2022)
Raghav G. Jha

15. *Large-N limit of two-dimensional Yang–Mills theory with four supercharges*
arXiv:2109.01001, PoS LATTICE2022 (2022) 433
Navdeep S. Dhindsa, **Raghav G. Jha**, Anosh Joseph, David Schaich

14. *Tensor renormalization group study of the 3d $O(2)$ model*
arXiv:2105.08066, Phys. Rev. D 104, 094517 (2021)
Jacques Bloch, **Raghav G. Jha**, Robert Lohmayer, Maximilian Meister

13. *Three-dimensional super-Yang–Mills theory on the lattice and dual black branes*
arXiv:2010.00026, Phys. Rev. D 102, 106009 (2020)
Simon Catterall, Joel Giedt, **Raghav G. Jha**, David Schaich, Toby Wiseman

12. *Positive geometries for all scalar theories from twisted intersection theory*
arXiv:2006.15359, Phys. Rev. Research 2, 033119 (2020)
Nikhil Kalyanapuram, **Raghav G. Jha**

11. *Critical analysis of two-dimensional classical XY model*
arXiv:2004.06314, J. Stat. Mech. (2020) 083203
Raghav G. Jha

10. *Thermal phase structure of a supersymmetric matrix model*
arXiv:2003.01298, PoS LATTICE2019 (2020) 069
David Schaich, **Raghav G. Jha**, Anosh Joseph

9. *Finite N unitary matrix models*
arXiv:2003.00341
Raghav G. Jha

8. *Tensor renormalization group study of the non-Abelian Higgs model in two dimensions*
arXiv:1901.11443, Phys. Rev. D 99, 114507 (2019)
Alexei Bazavov, Simon Catterall, **Raghav G. Jha**, Judah Unmuth-Yockey

7. *Lattice quantum gravity with scalar fields*
arXiv:1810.09946, PoS LATTICE2018 (2019) 043
Raghav G. Jha, Jack Laiho, Judah Unmuth-Yockey

6. *The properties of D1-branes from lattice super Yang–Mills theory using gauge/gravity duality*
arXiv:1809.00797, PoS LATTICE2018 (2019) 308
Raghav G. Jha

5. *Removal of the trace mode in lattice $\mathcal{N} = 4$ super Yang-Mills theory*
arXiv:1808.04735, Phys. Rev. D 98, 095017 (2018)
Simon Catterall, Joel Giedt, **Raghav G. Jha**

4. *Nonperturbative study of dynamical SUSY breaking in $\mathcal{N}$ = (2, 2) Yang-Mills*
arXiv:1801.00012, Phys. Rev. D 97, 054504 (2018)
Simon Catterall, **Raghav G. Jha**, Anosh Joseph

3. *Truncation of lattice $\mathcal{N} = 4$ super Yang-Mills*
EPJ Web of Conferences 175, 11008 (2018)
Simon Catterall, Joel Giedt, **Raghav G. Jha**

2. *Testing the holographic principle using lattice simulations*
arXiv:1710.06398, EPJ Web of Conferences 175, 08004 (2018)
Raghav G. Jha, Simon Catterall, David Schaich, Toby Wiseman

1. *Testing holography using lattice super-Yang-Mills on a 2-torus*
arXiv:1709.07025, Phys. Rev. D 97, 086020 (2018)
Simon Catterall, **Raghav G. Jha**, David Schaich, Toby Wiseman

TALKS/LECTURES

48. *Quantum gravity on noisy quantum computers* | APS Global Summit, Anaheim, CA, USA | March 17, 2025

47. *Probing Fundamental Physics in the Age of Quantum Information Processing* | University of Tennessee Knoxville, USA | March 13, 2025

46. *Real-time scattering in Ising field theory* | Brookhaven National Laboratory, Upton, NY, USA | February 13, 2025 [Slides]

45. *Krylov complexity for quantum chaos on quantum computer* (KC for QC on QC) | CFNS Workshop, Stony Brook University, NY, USA | February 12, 2025

44. *Scattering in Ising field theory* | UC Berkeley/lbnl Nuclear Theory Seminar, Berkeley, CA, USA [Online] | January 29, 2025 [Slides]

43. *Probing fundamental physics in a new era of computation* | University of Miami, USA | January 22, 2025

42. *State preparation and operator growth of SYK model on IBM quantum computer* | Tensor Network 2024 workshop, Ishikawa, Japan [Online] | November 17, 2024 [Slides]

41. *Thermal state preparation and dynamics of random all-to-all fermionic model* | C2QA meeting, Massachusetts Institute of Technology, Boston, USA | July 17, 2024 [Slides]

40. *SYK model on a noisy quantum computer - dynamics and state preparation* | Mandelstam Institute for Theoretical Physics (MITP) and the National Institute for Theoretical and Computational Sciences (NITheCS), Johannesburg, South Africa [Online] | May 07, 2024 [YouTube]

39. *Introduction to tensor networks for classical computing of spin systems and gauge theories* | Set of four lectures at 14th Jo'burg School on String theory at University of Pretoria, South Africa[Online] | April 29-30 and May 02, 2024 [YouTube]

38. *Quantum computing for quantum many-body systems* | William & Mary, Williamsburg, USA | April 17, 2024 [Slides]

37. *Approaches to universal quantum computing for spin and gauge models* | University of Iowa [Online] | April 16, 2024 [Slides]

36. *Random dense Hamiltonians on current noisy quantum computers* | University of Maryland, USA | March 28, 2024 [Slides]

35. *Extracting Physics with IBM's 127-qubit quantum processor* | Jefferson Lab, VA, USA | March 13, 2024 [Slides]

34. *Real-time dynamics of SYK model on a noisy quantum computer* | Workshop on 'Toward quantum simulation of gauge/gravity duality and lattice gauge theory' | March 05, 2024 [Slides]

33. *SYK model on a noisy quantum computer* | Indian Institute of Science, Bangalore, India [Online] | February 06, 2024 [Slides] [YouTube]

32. *Quantum Computation of the $O(3)$ model using qumodes* | Contributed Talk at Lattice 2023 at Fermilab, USA | August 02, 2023 [Slides]

31. *Computation with Quantum Mechanics* | Set of two lectures at Quantum Computing Bootcamp 2023, Jefferson Lab, USA | June 20, 2023 [Resource]

30. *Can quantum computation improve our understanding of quantum fields?* | Set of two lectures at HUGS 2023 Summer School, Jefferson Lab, USA | June 7, 2023 [YouTube, Part 1] [Part 2]

29. *Non-linear sigma models using quantum computation* | C2QA Theory and Software Retreat, New York City, USA | May 30, 2023 [Slides]

28. *Introduction to Quantum Computing methods in Physics* | Tata Institute, Mumbai, India [Online] | April 27, 2023 [Slides] [YouTube]

27. *Aspects of classical and quantum computing of quantum many-body systems* | Ashoka University, Sonepat, India [Online] | February 10, 2023 [Slides]

26. *Classical computation using tensor networks and quantum computation with qubits and qumodes* | Jefferson Lab, USA | November 14, 2022 [Slides] [Video]

25. *Application of tensor methods to real-space renormalization and real-time study of field theories* | Brookhaven National Lab (BNL), USA [Online] | October 31, 2022 [Slides]

24. *New tools for old problems in spin and gauge models on the lattice* | IIT Hyderabad, India [Online] | October 12, 2022 [Slides]

23. *Some old problems on the lattice using tensors* | NUMSTRINGS 2022 , ICTS, Bangalore, India | August 26, 2022 [YouTube]

22. *Introduction to Quantum Computation using QISKIT* | Two lectures for Summer School 2022 at Rensselaer Polytechnic Institute, USA [Online] | June 22 and 23, 2022 [Lecture 1 & 2] [YouTube]

21. *New approach to continuous spin models in two and three dimensions* | Numerical Methods in Theoretical Physics conference, APCTP, Pohang, South Korea [Online] | May 17, 2022 [Slides] [YouTube]

20. *Holography with large matrices on the lattice* | Institute of Nuclear Sciences, Universidad Nacional Autónoma de México, Mexico City, Mexico | March 24, 2022 [Slides]

19. *Large N matrix models using Monte Carlo and Bootstrap* | University of Surrey, Surrey, UK [Online] | February 22, 2022 [Slides]

18. *Introduction to tensor networks and spin systems* | Azim Premji University, Bengaluru, India | January 11, 2022

17. *Tensor networks and spin models* | Indian Institute of Science Education and Research (IISER), Mohali, India | December 7, 2021 [Slides]

16. *Real-space tensor renormalization for spin models in three dimensions* | Perimeter Institute, Waterloo, Canada | November 19, 2021

15. *Solving matrix models at large and finite N* | Two lectures for Summer School 2021 at Rensselaer Polytechnic Institute, USA [Online] | June 28 and 29, 2021 [Lecture 1 & 2]

14. *Holographic gauge theories on the lattice* | Dublin Institute for Advanced Studies, Dublin, Ireland | June 23, 2021 [Slides] [YouTube]

13. *Old and new methods for new and old problems in Physics* | Indian Institute of Technology (IIT) Madras, India | March 8, 2021 [Slides]

12. *Probing holographic dualities with lattice supersymmetric Yang-Mills theories* | Massachusetts Institute of Technology, Boston, USA [Online] | February 25, 2021 [Slides] [YouTube]

11. *New tool for old problems - Tensor network approach to spin models and gauge theories* | University of Liverpool, Liverpool, UK [Online] | October 14, 2020 [Slides]

10. *Tensor Networks: Algorithm & Applications* | Two lectures for CyberTraining Summer School 2020 at Rensselaer Polytechnic Institute, USA [Online] | June 10 and 11, 2020 [Lecture 1 & 2] [Resource] [YouTube]

9. *Holographic aspects of supersymmetric gauge theories* | Perimeter Institute, Waterloo, Canada | October 4, 2019

8. *Numerical Approaches to Holography* | Ashoka University, Sonepat, India | August 28, 2019 [Slides]

7. *Numerical Approaches to Holography* | Indian Institute of Science Education and Research (IISER) Mohali, India | August 8, 2019

6. *Holographic dualities and tensor renormalization group study of gauge theories* | Perimeter Institute, Waterloo, Canada | March 11, 2019 [Video (PIRSA, 19030108)]

5. *Supersymmetry breaking and gauge/gravity duality on the lattice* | University of Colorado Boulder, USA | April 6, 2018 [Slides]

4. *Recent results from lattice supersymmetry in $2 \leq d < 4$ dimensions* | ICTS, Bangalore, India | January 31, 2018 [YouTube]

3. *Testing gauge/gravity duality using lattice simulations* | Contributed Talk at Lattice 2017 Granada, Spain | June 22, 2017 [Slides]

2. *Testing holography through lattice simulations* | Yukawa Institute for Theoretical Physics, Kyoto, Japan | April 4, 2017 [Slides]

1. *Supersymmetry on the lattice* | April Meeting 2016 - Salt Lake City, Utah, USA | April 17, 2016 [Slides]

TEACHING EXPERIENCE

- Recitation Instructor for PHY 216 (General Physics II for Honors and Majors) [Evaluation report] and Grader for PHY 662 (Quantum Mechanics II) Spring 2019
- Recitation Instructor for PHY 215 (General Physics I for Honors and Majors) and Grader for PHY 312 (Relativity & Cosmology) Spring 2018
- Grader for PHY 424 (Electromagnetism) and PHY 360 (Waves and Oscillations) Fall 2016
- Recitation Instructor for PHY 212 General Physics II Spring 2016
- Grader for PHY 641 (Statistical Mechanics) and PHY 731 (Electromagnetic theory) Fall 2015
- Recitation Instructor for PHY 211 General Physics I Fall 2014
- Recitation Instructor for PHY 211 General Physics I [Evaluation report] Spring 2014
- Lab Instructor for PHY 101 General Physics Fall 2013

AWARDS

- Henry Levinstein Fellowship for Outstanding Senior Graduate Student - Department of Physics, Syracuse University [USD 2000] 2017
- College of Arts and Sciences Fellowship for best performance in Graduate Courses - Syracuse University [USD 1700] 2014
- CSIR/UGC-NET - Junior Research Fellowship (JRF) by Government of India 2013
- Erasmus Mundus Scholarship for pursuing M.S at Sorbonne Université [EUR 12000] 2010
- National Top 25 Students (out of 5153 students) in National Graduate Physics Examination (NGPE) conducted by Indian Association of Physics Teachers (IAPT) 2009
- KVPY (Kishore Vaigyanik Protsahan Yojana) Scholarship by Department of Science & Technology, Government of India [about USD 3500 in two years] 2008
- Merit certificate by University of Delhi (11^{th} in the university out of $\approx$ 1200 students) 2008
- NIUS (National Initiative on Undergraduate Sciences) Fellowship by Tata Institute of Fundamental Research (TIFR), Mumbai 2008

PROFESSIONAL SERVICES AND COMPUTING GRANTS

- Referee for Nature npj QI (Quantum Information), Physical Review A, Physical Review D, Physical Review Letters, Physical Review Research, European Physical Journal (EPJ), IOP Machine Learning: Science and Technology. *Total papers reviewed:* 10
- Chair of parallel session on 'Quantum Computation and Information' in the 40th Annual Lattice conference at Fermilab, USA [1 August 2023]
- Co-organizer of 'Quantum Computing Bootcamp' at Jefferson Lab, USA from June 20-30, 2023 funded by Quantum Horizons, Department of Energy (DOE).
- Quantum Fields and Strings Seminar Organizer at Perimeter Institute [January 2020 - March 2021].
- Awarded DiRAC computing grant in 2022 for $\approx$ 24M core-hours with David Schaich, Toby Wiseman, Anosh Joseph *and* USQCD computing grants of $\approx$ 12M core-hours on Fermilab pi0 machine each year in 2017 & 2018

MENTORING EXPERIENCE

1. Nikhil Kalyanapuram (Perimeter Scholar International (PSI) student at Perimeter Institute $\rightarrow$ PhD Penn State $\rightarrow$ Industry) 2019-2020
2. Navdeep S. Dhindsa (PhD IISER Mohali $\rightarrow$ Postdoc at IMSc, Chennai) 2020-2023
3. Vamika Longia (PhD student at IISER Mohali) 2021-2022
4. Abhishek Samlodia (BS-MS IISER Mohali $\rightarrow$ PhD candidate at Syracuse University) 2021-2024
5. Nikhil Bansal (BS-MS IISER Mohali $\rightarrow$ PhD candidate at University of Warwick)) 2022-2023

6. Shane Thompson (PhD University of Tennessee Knoxville → Postdoc at U.S. Naval Research Lab, Washington DC) 2023-2024

7. Bharath Sambasivam (PhD Syracuse University → Postdoc at Virginia Tech, USA) 2023-2024

8. Ranadeep Roy (PhD student at The Ohio State University) 2023-

9. Victor Ale (PhD student at University of Tennessee Knoxville) 2024-

10. Nora Bauer (PhD student at University of Tennessee Knoxville) 2024-

REFERENCES (IN ALPHABETICAL ORDER)

– Simon Catterall
Professor, Syracuse University, USA
[smcatter@syr.edu]

– Robert Edwards
Senior Staff, Theory Center, Jefferson Lab, USA
[edwards@jlab.org]

– John Preskill
Richard P. Feynman Professor of Theoretical Physics, California Institute of Technology, USA
[preskill@caltech.edu]

– David Schaich
Lecturer in Theoretical Particle Physics, University of Liverpool, Liverpool, UK
[david.schaich@liverpool.ac.uk]

– Pedro Vieira
Faculty at Perimeter Institute, Canada & ICTP-SAIFR, São Paulo, Brazil
[pedrogvieira@gmail.com]

– Toby Wiseman
Professor of Theoretical Physics, Imperial College, London, UK
[t.wiseman@imperial.ac.uk]

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