Raghav G. Jha

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Academic Employment

Jefferson National Lab (JLab), *Postdoctoral Researcher Staff* — *09/2022 - today*

Perimeter Institute for Theoretical Physics, *Postdoctoral Researcher* — *09/2019 - 08/2022*

Education

PhD Physics, Syracuse University, NY, USA — *08/2013 – 05/2019*

M.Sc Physics, St. Xavier's College & Bose Institute, Kolkata, India — *08/2011 - 05/2013*

M.S. in Nanomaterials, Sorbonne Université, Paris, France — *09/2010 - 07/2011*

B.Sc. Physics (Honors), St. Stephen's College, Delhi, India — *07/2007 - 05/2010*

Publications

[Google Scholar, iNSPIRE, ORCID]

1. *On Ising model in magnetic field on the lattice*
   arXiv:2504.18744
   Raghav G. Jha

2. *Finite-temperature phase diagram of the BMN matrix model on the lattice*
   arXiv:2412.13407, Phys. Rev. D **111**, 094516 (2025)
   Raghav G. Jha, Anosh Joseph, David Schaich

3. *Real-Time Scattering in Ising Field Theory using Matrix Product States*
   arXiv:2411.13645, Phys. Rev. Research **7**, 023266 (2025)
   Raghav G. Jha, Ashley Milsted, Dominik Neuenfeld, John Preskill, Pedro Vieira

4. *Quantum computation of $SU(2)$ lattice gauge theory with continuous variables*
   arXiv:2410.14580, JHEP **06** (2025) 084
   Victor Ale, Nora Bauer, Raghav G. Jha, Felix Ringer, George Siopsis

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

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

7. *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

8. *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

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

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

11. *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

12. *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

13. *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

14. *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

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

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

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

18. *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

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

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

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

22. *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

23. *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

24. *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

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

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

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

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

29. *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

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

31. *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

32. *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

33. *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

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

35. *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

36. *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

1. *Quantum gravity on noisy quantum computers* | APS Global Summit, Anaheim, CA, USA | March 17, 2025
2. *Probing Fundamental Physics in the Age of Quantum Information Processing* | University of Tennessee Knoxville, USA | March 13, 2025
3. *Real-time scattering in Ising field theory* | Brookhaven National Laboratory, Upton, NY, USA | February 13, 2025 [Slides]
4. *Krylov complexity for quantum chaos on quantum computer* (KC for QC on QC) | CFNS Workshop, Stony Brook University, NY, USA | February 12, 2025
5. *Scattering in Ising field theory* | UC Berkeley/LBNL Nuclear Theory Seminar, Berkeley, CA, USA [Online] | January 29, 2025 [Slides]
6. *Probing fundamental physics in a new era of computation* | University of Miami, USA | January 22, 2025
7. *State preparation and operator growth of SYK model on IBM quantum computer* | Tensor Network 2024 workshop, Ishikawa, Japan [Online] | November 17, 2024 [Slides]
8. *Thermal state preparation and dynamics of random all-to-all fermionic model* | C2QA meeting, Massachusetts Institute of Technology, Boston, USA | July 17, 2024 [Slides]
9. *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]
10. *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]
11. *Quantum computing for quantum many-body systems* | William & Mary, Williamsburg, USA | April 17, 2024 [Slides]
12. *Approaches to universal quantum computing for spin and gauge models* | University of Iowa [Online] | April 16, 2024 [Slides]
13. *Random dense Hamiltonians on current noisy quantum computers* | University of Maryland, USA | March 28, 2024 [Slides]
14. *Extracting Physics with IBM's 127-qubit quantum processor* | Jefferson Lab, VA, USA | March 13, 2024 [Slides]
15. *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]
16. *SYK model on a noisy quantum computer* | Indian Institute of Science, Bangalore, India [Online] | February 06, 2024 [Slides] [YouTube]
17. *Quantum Computation of the $O(3)$ model using qumodes* | Contributed Talk at Lattice 2023 at Fermilab, USA | August 02, 2023 [Slides]
18. *Computation with Quantum Mechanics* | Set of two lectures at Quantum Computing Bootcamp 2023, Jefferson Lab, USA | June 20, 2023 [Resource]
19. *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]

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

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

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

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

24. *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]

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

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

27. *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]

28. *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]

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

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

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

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

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

34. *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]

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

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

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

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

39. *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]
40. *Holographic aspects of supersymmetric gauge theories* | Perimeter Institute, Waterloo, Canada | October 4, 2019
41. *Numerical Approaches to Holography* | Ashoka University, Sonepat, India | August 28, 2019 [Slides]
42. *Numerical Approaches to Holography* | Indian Institute of Science Education and Research (IISER) Mohali, India | August 8, 2019
43. *Holographic dualities and tensor renormalization group study of gauge theories* | Perimeter Institute, Waterloo, Canada | March 11, 2019 [Video (PIRSA, 19030108)]
44. *Supersymmetry breaking and gauge/gravity duality on the lattice* | University of Colorado Boulder, USA | April 6, 2018 [Slides]
45. *Recent results from lattice supersymmetry in $2 \leq d < 4$ dimensions* | ICTS, Bangalore, India | January 31, 2018 [YouTube]
46. *Testing gauge/gravity duality using lattice simulations* | Contributed Talk at Lattice 2017 Granada, Spain | June 22, 2017 [Slides]
47. *Testing holography through lattice simulations* | Yukawa Institute for Theoretical Physics, Kyoto, Japan | April 4, 2017 [Slides]
48. *Supersymmetry on the lattice* | April Meeting 2016 - Salt Lake City, Utah, USA | April 17, 2016 [Slides]

Teaching

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

Awards

1. Henry Levinstein Fellowship for Outstanding Senior Graduate Student - Department of Physics, Syracuse University [USD 2000] 2017
2. College of Arts and Sciences Fellowship for best performance in Graduate Courses - Syracuse University [USD 1700] 2014
3. CSIR/UGC-NET - Junior Research Fellowship (JRF) by Government of India 2013

4. Erasmus Mundus Scholarship for pursuing M.S at Sorbonne Université [EUR 12000] 2010
5. National Top 25 Students (out of 5153 students) in National Graduate Physics Examination (NGPE) conducted by Indian Association of Physics Teachers (IAPT) 2009
6. KVPY (Kishore Vaigyanik Protsahan Yojana) Scholarship by Department of Science & Technology, Government of India [about USD 3500 in two years] 2008
7. Merit certificate by University of Delhi (11^{th} in the university out of $\approx$ 1200 students) 2008
8. NIUS (National Initiative on Undergraduate Sciences) Fellowship by Tata Institute of Fundamental Research (TIFR), Mumbai 2008

Professional Service and 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:* 11
- 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

- Nikhil Kalyanapuram (Perimeter Scholar International (PSI) student at Perimeter Institute $\rightarrow$ PhD Penn State $\rightarrow$ Industry) 2019-2020
- Navdeep S. Dhindsa (PhD IISER Mohali $\rightarrow$ Postdoc at IMSc, Chennai) 2020-2023
- Vamika Longia (PhD student at IISER Mohali) 2021-2022
- Abhishek Samlodia (BS-MS IISER Mohali $\rightarrow$ PhD candidate at Syracuse University) 2021-2024
- Nikhil Bansal (BS-MS IISER Mohali $\rightarrow$ PhD candidate at University of Warwick)) 2022-2023
- Shane Thompson (PhD University of Tennessee Knoxville $\rightarrow$ Postdoc at U.S. Naval Research Lab, Washington DC) 2023-2024
- Bharath Sambasivam (PhD Syracuse University $\rightarrow$ Postdoc at Virginia Tech, USA) 2023-2024
- Ranadeep Roy (PhD student at The Ohio State University) 2023-
- Victor Ale (PhD student at University of Tennessee Knoxville) 2024-
- Nora Bauer (PhD student at University of Tennessee Knoxville) 2024-

Professional References

- 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]