Raghav Govind Jha

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EMPLOYMENT

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

  Member of the Co-design Center for Quantum Advantage (C2QA) which is one of the five National Quantum Information Science (QIS) centers funded by the U.S. DOE (Department of Energy). One goal of this initiative is to co-design and develop quantum algorithms for near-term quantum hardware.

- **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*
  GPA: 3.86/4.0 Advisor: Simon Catterall
- **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

h-index: 11, Citations: 325+ [Google Scholar, iNSPIRE HEP, ORCID, arXiv]
(Authors are mostly listed in alphabetical order)

32. *Sparsity dependence of Krylov state complexity in the SYK model*
(*to submit, Phys. Rev. D*)
arXiv:2407.20569
Raghav G. Jha, R. Roy

31. *Thermal state preparation of the SYK model using a variational quantum algorithm*
(*in review, Phys. Rev. D*)
arXiv:2406.15545
J. Araz, **Raghav G. Jha**, F. Ringer, B. Sambasivam

30. *SU(2) principal chiral model with tensor renormalization group on a cubic lattice*
(*accepted in Phys. Rev. D*)
arXiv:2406.10081
S. Akiyama, **Raghav G. Jha**, J. U-Yockey

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

28. *Hamiltonian simulation of minimal holographic sparsified SYK model*
arXiv:2404.14784
Raghav G. Jha

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

26. *Phase diagram of two-dimensional $SU(N)$ super-Yang–Mills theory with four supercharges* (*accepted, Phys. Rev. D*)
arXiv:2312.04980
N. S. Dhindsa, **Raghav G. Jha**, A. Joseph, D. Schaich

25. *Sachdev-Ye-Kitaev model on a noisy quantum computer*
arXiv:2311.17991, Phys. Rev. D **109**, 105002 (2024)
M. Asaduzzaman, **Raghav G. Jha**, B. 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, F. Ringer, G. Siopsis, S. Thompson

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

22. *GPU-Acceleration of Tensor Renormalization with PyTorch using CUDA*
arXiv:2306.00358 , Computer Physics Communications 294 (2024) 108941
Raghav G. Jha, A. 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. (2023)
Raghav G. Jha

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

18. *Thermal phase structure of dimensionally reduced super-Yang–Mills*
arXiv:2201.03097
D. Schaich, **Raghav G. Jha**, A. 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
N. S. Dhindsa, **Raghav G. Jha**, A. Joseph, and D. Schaich

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

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

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

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
D. Schaich, **Raghav G. Jha**, A. 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)
A. Bazavov, S. Catterall, **Raghav G. Jha**, J. U-Yockey

7. *Lattice quantum gravity with scalar fields*
arXiv:1810.09946, PoS LATTICE2018 (2019) 043
Raghav G. Jha, J. Laiho, J. U-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)
S. Catterall, J 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)
S. Catterall, **Raghav G. Jha**, A. Joseph

3. *Truncation of lattice $\mathcal{N}$ = 4 super Yang-Mills*
EPJ Web of Conferences 175, 11008 (2018)
S. Catterall, J 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, S. Catterall, D. Schaich, T. Wiseman

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

TALKS/LECTURES

41. *Thermal state preparation and dynamics of random all-to-all fermionic model* (May 07, 2024) - Talk at Massachusetts Institute of Technology (MIT), C2QA meeting, Boston, USA

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

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

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

37. *Approaches to universal quantum computing for spin and gauge models* (April 16, 2024) - University of Iowa - Junior QuLat meeting [Online] [Slides]

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

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

34. *Real-time dynamics of SYK model on a noisy quantum computer* (March 05, 2024) - Workshop on 'Toward quantum simulation of gauge/gravity duality and lattice gauge theory', Queen Mary University of London, UK [Online] [Slides]

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

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

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

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

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

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

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

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

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

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

23. *Some old problems on the lattice using tensors* (August 26, 2022) at ICTS, Bangalore, India during NUMSTRINGS 2022 conference [YouTube]

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

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

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

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

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

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

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

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

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

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

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

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

10. *Tensor Networks: Algorithm & Applications* (June 10 and 11, 2020) - Two lectures for CyberTraining Summer School 2020 at Rensselaer Polytechnic Institute, USA [Online due to COVID-19 pandemic] [Lecture 1 & 2] [Resource] [YouTube]

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

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

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

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

5. *Supersymmetry breaking and gauge/gravity duality on the lattice* (April 6, 2018) at UC Boulder, Colorado, USA [Slides]

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

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

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

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

TEACHING EXPERIENCE

- Recitation Instructor for PHY 216 (General Physics II for Honors and Majors) 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 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 UPMC, University of Paris VI [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

TECHNICAL SKILLS

- **Programming and Softwares:** Python, Julia, Bash, CUDA, MATHEMATICA, LaTeX, PyTorch
- **Quantum Programming:** Qiskit (IBM), Cirq (Google), PennyLane, and Strawberry Fields (Xanadu)

PROFESSIONAL SERVICES AND COMPUTING GRANTS

- Referee for Nature npj QI (Quantum Information) (since 2024), Physical Review D, Physical Review Letters, and Physical Review Research (since 2020), European Physical Journal (EPJ) (since 2022), IOP Machine Learning: Science and Technology (since 2021). Total papers reviewed: 8
- 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 ≈ 24M core-hours with D. Schaich, T. Wiseman, A. Joseph *and* USQCD computing grants of ≈ 12M core-hours on Fermilab pi0 machine each year in 2017 & 2018 with S. Catterall, D. Schaich, and J. Giedt.

MENTORSHIP EXPERIENCE

1. Nikhil Kalyanapuram (Perimeter Scholar International (PSI) student at Perimeter Institute → PhD Penn State → Industry) [1 publication] 2019-2020

2. Navdeep S. Dhindsa (PhD IISER Mohali → Postdoc at IMSc, Chennai) [2 publications, 1 in preparation] 2020-2023

3. Vamika Longia (PhD student at IISER Mohali) [1 publication] 2021-2022

4. Abhishek Samlodia (IISER Mohali → PhD candidate at Syracuse University) [3 publications] 2021-

5. Nikhil Bansal (BS-MS IISER Mohali) [1 in preparation] 2022-2023

6. Shane Thompson (PhD University of Tennessee Knoxville → Postdoc at U.S. Naval Research Lab, Washington DC) [1 publication, 2 in preparation] 2023- 2024

7. Bharath Sambasivam (PhD Syracuse University → Postdoc at Virginia Tech, USA) [2 publications, 1 in preparation] 2023-

8. Ranadeep Roy (PhD student at The Ohio State University) [1 publication] 2023-

9. Victor Ale (PhD student at University of Tennessee Knoxville) [2 in preparation] 2024-

REFERENCES (IN ALPHABETICAL ORDER)

– SIMON CATTERALL
Professor, Syracuse University, USA [smcatter@syr.edu]

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

– JOHN PRESKILL
Richard P. Feynman Professor of Theoretical Physics, Caltech, USA [preskill@caltech.edu]

– GEORGE SIOPSIS
Professor, University of Tennessee Knoxville, USA [siopsis@tennessee.edu]

– 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]