Raghav Govind Jha

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EMPLOYMENT

• **Jefferson 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*
  Thesis title: Holography, large N, and supersymmetry on the lattice
  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

Total citations: 279, h-index: 11 [Google Scholar, iNSPIRE HEP]
(Authors are listed in alphabetical order)

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*
(Submitted to JHEP)
arXiv:2312.04980
N. S. Dhindsa, **Raghav G. Jha**, A. Joseph, D. Schaich

25. *A model of quantum gravity on a noisy quantum computer*
(Preparing to submit to Phys. Rev.)
arXiv:2311.17991
M. Asaduzzaman, **Raghav G. Jha**, B. Sambasivam

24. *Continuous variable quantum computation of the O(3) model in 1+1 dimensions*
(Submitted to Phys. Rev. A)
arXiv:2310.12512
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

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]

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]

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 introductory 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:** C/C++, Python, Julia, Matlab, Bash, CUDA, Mathematica, LaTeX, PyTorch, TensorFlow, SciKit-Learn, Keras, Pandas.
- **Quantum Programming:** QisKit (IBM), Cirq (Google), PennyLane, and Strawberry Fields (Xanadu)
- **Tools & OS:** Git, Jupyter, Google Colab, Linux, Mac OS, Windows

Professional Services and Grants

– 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).

– Referee for Physical Review D and Physical Review Letters (since 2020), European Physical Journal (EPJ) (since 2022), IOP Machine Learning: Science and Technology (since 2021). Total papers reviewed: 5

– 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 D. Schaich, T. Wiseman, A. Joseph

– Awarded USQCD computing grants of $\approx$ 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 Singh Dhindsa (PhD IISER Mohali → Postdoc at IMSc, Chennai, India) [2 publications] 2020-2023
3. Vamika Longia (PhD student at IISER Mohali) [1 manuscript in preparation] 2021-2022
4. Abhishek Samlodia (IISER Mohali → PhD candidate at Syracuse University) [2 publications] 2021-
5. Nikhil Bansal (BS-MS IISER Mohali) 2022-2023
6. Bharath Sambasivam (PhD student at Syracuse University) [1 publication] 2023-

References

– Simon Catterall - Professor, Syracuse University, NY, USA
smcatter@syr.edu

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

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

– Robert Edwards - Theory Center Senior Staff, Jefferson Lab
edwards@jlab.org

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

– George Siopsis - Professor, University of Tennessee Knoxville
siopsis@tennessee.edu

– A. P. Balachandran - Emeritus Professor of Physics, Syracuse University, NY, USA
aibalach@g.syr.edu

– Joel Giedt - Associate Professor, Rensselaer Polytechnic Institute, Troy, NY, USA
giedtj@rpi.edu

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