Madhav Sinha

Fourth year Graduate Student

Rutgers, The State University of New Jersey

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Education

Rutgers University, New Brunswick — *New Jersey, USA*

PhD Physics — *July 2020 - Present*

- GPA 4/4
- PhD advisor - Prof. Ananda Roy
- Completed Oral Qualifier and Core Courses.
- Advanced graduate courses - QFT 1 & 2, Differential Topology, Vertex Operator Algebra, Many Body Physics, Quantum Computing

Indian Institute of Science Education and Research (IISER), Pune — *Maharashtra, India*

Bachelor of Science and Master of Science (Dual Degree) - with Distinction — *July 2015 - May 2020*

- CGPA 9.1/10
- Master's Thesis at the Australian National University under Prof. Vladimir Bazhanov and Prof. Murray Batchelor
- In third and fourth year, elected advanced courses in Physics(including lab and computational physics) and Mathematics

Research Experience

Topological Defects in Rational Conformal Field theories and their Lattice realizations — *Rutgers University, New Brunswick*

Supervisor - Prof. Ananda Roy — *March 2022 - Present*

- Exploring Anyonic Chains and their connections with RSOS models and Category theory
- Investigation of Integrable Lattice constructions, their scaling limits and ab-initio lattice computations.
- Constructing Defect Hamiltonian for Minimal model CFTs
- Worked on Potts RSOS model with A. Roy, H. Saleur, F. Yan, L.G. Samuelsson
- Studying RG flows between Defect CFTs using lattice constructions with A. Roy, H. Saleur, T.S. Tavares.

Solvable Models and Mathematical Formulation of Conformal Field Theory — *Australian National University, Canberra*

Master's Thesis Project Supervisor - Prof. Vladimir Bazhanov, Co-Supervisor - Prof. Murray Batchelor, Home University Supervisor: Prof. Sunil Mukhi — *May 2019 - March 2020*

- Studied CFT and its connections with Statistical Mechanics
- Explored Integrability of exactly solvable models
- Worked on finding and classifying solutions of Vertex Models

Workshops/Conferences attended

- CMT/QFT Seminar at Institute for Advanced Study - **Talk**
- Integrable Systems seminar at University of Leeds - November 2023 - **Talk**
- Rutgers Center for Materials Theory Fall 2023 Symposium - September 2023 - **Poster**
- Young Researchers Integrability School and Workshop (YRISW), Durham - July 2023 - **Poster**
- Workshop on Conformal Bootstrap at GGI - Florence - October 2022
- New Jersey Quantum Matter and Information (NJQMI) Forum at Princeton - April 2022
- Boundaries and Defects in CFT and Holography held at Princeton - March 2022
- Quantum Fields, Geometry and Representation Theory 2021 at International Centre for Theoretical Sciences (ICTS) - July 2021 (ONLINE)
- Baxter 2020 at Australian National University - February 2020
- Workshop on Volume Conjecture and related topics in Knot Theory at IISER Pune - December 2018

Publications

All my publications can be found on Inspire

- Non-Chiral Vertex Operator Algebra Associated To Lorentzian Lattices And Narain CFTs - R.K. Singh, M. Sinha
- Lattice Realizations of Topological Defects in the critical (1+1)-d Three-State Potts Model - M.Sinha, F. Yan, L.G. - Sameuelsson, A. Roy, H. Saleur

Skills

Programming

- Python - used for research in PhD
- Fortran - used in Computational Physics course
- Wolfram Mathematica - used for research in Master's Thesis and in PhD

Scholarships

May 2019 - March 2020	Selected for Australian National University - Future Research Talent Award, for writing thesis at ANU
May 2017	Selected for Indian Academy of Sciences' Summer Research Fellowship Programme
August 2015 - July 2020	Qualified for Kishore Vaigyanik Protsahan Yojana (KVPY) scholarship which supports young scientists
2013 - 2015	Cleared the National Talent Science Examination which is an all India exam conducted by the government

Educational Achievements

- Awarded BS-MS degree with distinction from IISER Pune
- Among the top 100 in Maths National Eligibility Test(NET), exam for PhD admission in Math in India
- Received "O" Grade (given when one gets one of the highest marks in a course in IISER Pune) in Waves & Matter, Electrostatics, Physics Lab and Linear Algebra
- Was among 80 students selected in India by Indian Academy of Sciences, for Summer Research Fellowship Programme for Mathematics
- In the National Toppers list of National Graduate Physics Examination – 2016, conducted by Indian Association of Physics Teachers
- Secured 17th Rank in KVPY–SB 2015, an exam which consists of a written test and interview for 1^{st} year Indian students in Basic Sciences
- Qualified for a seat in Indian Institute of Technology (IIT) and cleared the Chennai Mathematics Institute Entrance test
- Among the Top 1% student in India, based on result in 12^{th} Class

Relevant Coursework

Physics	QFT 1 $\&$ 2, Nuclear and Particle Physics, General Relativity, Atomic and Molecular Physics, 4 courses on Physics Lab, Quantum Computing, Condensed Matter Physics, Computational Physics, Mathematical Methods Classical Mechanics, Electromagnetism, Statistical Mechanics and Quantum Mechanics (Basic and Advanced courses)
Mathematics	Vertex Operator Algebra, Differential Geometry, Algebraic Topology, Ordinary Differential Equation, Complex Analysis, Analysis on Manifolds,Real Analysis, Topology, Group Theory, Calculus (Single and Multi-Variable), Linear Algebra, Probability and Statistics

Other research experience

Knot Theory and Physics — *IISER Pune*

Winter and Semester Project with Prof. Rama Mishra — *December 2018 - April 2019*

- Studied Basics of Hyperbolic Geometry and Knot Theory
- Explored connections between Knot Theory and Physics such as Jones Polynomial, Temperley-Lieb Algebra, Particle Statistics, etc.

Three-Particle Bound States for One-Dimensional Quantum Particles — *University of Gottingen*

Summer Project with Prof. Karl-Henning Rehren — *May. 2018 - July 2018*

- Looked for solution to 1, 2 $\&$ 3 - particles in 1 dimensions under different potential
- Found solutions for 1 $\&$ 2 particles using transfer matrix
- Showed that Bethe-Ansatz does not work for 3 particles

Functional Analysis and Quantum Mechanics

IISER Pune

Semester Project with Prof. Anup Biswas

Jan. 2018 - Apr. 2018

- **Studied Functional Analysis from Introductory functional analysis with applications by Erwin Kreyszig**
- **Explored its connections with Quantum Mechanics, such as Riesz Representation Theorem, Spectral Theorem, etc.**

Topics in Real Analysis and Manifolds & PageRank Algorithm

TIFR-CAM Bangalore

Summer Research Fellow under Prof. Venky Krishnan at Tata Institute of Fundamental Research - Centre for Applicable Mathematics

May 2017 - June 2017

- **Studied advanced Topics in Real Analysis and basics of Manifolds**
- **Understood Google's PageRank Algorithm and its shortcomings**

Set Theory and Basics of Analysis

IISER Pune

Summer Project with Prof. Anindya Goswami

May 2016 - June 2016

- **Studied Basics of Zermelo–Fraenkel Set theory and Real Analysis**

Test Scores

GRE Physics Test	**990/990 - 95 percentile**
GRE General	**Total Score - 338/340 Quantitative - 170/170 (96 percentile); Verbal - 168/170 (98 percentile); AWA 4.0/6.0 (57 percentile)**
TOEFL IBT Test	**Total Score - 111/120 Reading - 30/30 Listening - 30/30 Speaking - 27/30 Writing - 24/30**