Sreeman Reddy Kasi Reddy

Curriculum vitae

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I am currently interested in doing research in quantum gravity, string theory, holographic dualities, quantum field theories (especially CFTs), and cosmology.

Education

Aug 2023–May 2024
Brandeis University
MS in Physics

Jul 2019–Apr 2023
Indian Institute of Technology Bombay (IIT Bombay)
B.Tech in Engineering Physics
CGPA: **9.03/10**
With **Honors** in Physics.

Key Projects

Oct 2023 - Present
Quantum covariant bit threads
Supervisor: Prof. Matthew Headrick, Dept. of Physics, Brandeis University
- Studied several papers about the bit thread formulation of holographic entanglement entropy, especially "Quantum bit threads" (2105.08072) and "Covariant bit threads" (2208.10507)
- Proposed a definition for "Quantum covariant bit threads" that unifies the quantum static version 2105.08072 with the classical covariant version 2208.10507 and showed that it has the expected properties.
- Currently in the middle of the proof that this definition is equivalent to the Quantum Extremal Surface (QES) prescription.

Oct 2023 - Present
Sparse Double-Scaled SYK
Supervisor: Prof. Brian Swingle, Dept. of Physics, Brandeis University
- Studied the chord diagram technique that can be used to solve Double Scaled SYK at all energy scales and λ.
- Studied the sparse version of SYK.
- Currently working on sparsifying the Double Scaled SYK. We are developing hyperchord diagram technique for calculating next-order corrections to sparse DSSYK, and I am also working on sparsifying $\mathcal{N} = 1$ and $\mathcal{N} = 2$ supersymmetric DSSYK.

Nov - Dec 2023
URL
Holographic description of M-theory
Supervisor: Prof. Daniel Jafferis, Dept. of Physics, Harvard University   Course Final Presentation
Course: String Theory
- Studied the duality between $AdS_4 \times S^7/\mathbb{Z}_k$ M-theory and the $\mathcal{N} = 6\ U(N)_k \times U(N)_{-k}$ super Chern–Simons theory (ABJM CFT).
- Gave a presentation focusing on the M2-brane construction and obtaining the gravity dual.

May-July 2022
Quantum Raychaudhuri Equation and its applications to cosmology
Supervisor: Prof. Saurya Das, Dept. of Physics and Astronomy, University of Lethbridge, Canada
- Studied a semi-classical gravity theory obtained by replacing classical geodesics in the Raychaudhuri equation with Bohmian trajectories.
- Studied a cosmological model within this theory where both dark matter and dark energy are unified into a dark Bose-Einstein condensate.
- Implemented a special case of this theory in CLASS and estimated the cosmological parameters by doing Monte Carlo sampling in Cobaya using Planck 2018 data to find out whether this model can explain the Hubble tension.

Aug - Dec 2022	**AdS/CFT correspondence and the information paradox** *Supervisor: Prof. Pichai Ramadevi, Dept. of Physics, IIT Bombay* ● Studied the AdS/CFT correspondence (with a focus on black hole thermodynamics) from a textbook by Năstase. ● Studied several review articles related to holographic entanglement entropy. ● Read recent papers on the resolution of the information paradox using the Island prescription.
Jun-Nov 2021 URL	**Black hole information paradox** *Supervisor: Prof. Vikram Rentala, Dept. of Physics, IIT Bombay* ● Studied quantum scalar field theory in curved spacetime and how it compares with QFT in flat spacetime. ● Reviewed the four laws of black hole mechanics and their similarity with thermodynamics and the Penrose process in a Kerr black hole. ● Studied the **Unruh effect**, which explains that the vacuum state of a Minkowski observer will be a thermal state as observed by a Rindler observer and how entanglement between the left and right Rindler wedges prevents a firewall at the Rindler horizon. ● Studied **Hawking radiation**, the conditions under which a black hole can be in stable or unstable equilibrium. ● Assuming that the evaporation is unitary, studied the characteristics of the **Page curve** using the **Page theorem**.

Academic Achievements

2022	Selected to the **Mitacs Globalink Research Internship Award** for a 12-week fully funded research internship in Canada
2019	Achieved **All India Rank 100** in IIT JEE Advanced among 200,000+ candidates
2019	Achieved **All India Rank 236** in IIT JEE Mains among 1,000,000+ candidates
2018	Was selected to the **Vijyoshi camp 2018** at IISc Bangalore through the KVPY-2017 exam conducted by the Department of Science and Technology

Other Projects

Apr 2022	**Higgs mechanism** *Supervisor: Prof. Urjit Yajnik, Dept. of Physics, IIT Bombay* Course Project ● Studied how abelian and non-abelian gauge bosons can become massive using a mechanism inspired from spontaneous symmetry breaking but the gauge symmetry is not broken. ● Studied how the theory is renormalizable even after gauge bosons acquire mass through Higgs mechanism using R_ξ gauges.
Nov-Dec 2020 URL	**Category theory applications in physics** *Supervisor: Prof. Vikram Rentala, Dept. of Physics, IIT Bombay* ● Studied basic concepts of category theory like functors, natural transformations, monoidal categories. ● Studied axiomatization of physical systems using strict monoidal categories. ● Investigated **FdHilb** category and studied **no-cloning, no-deleting theorems** in categorical quantum mechanics.

Technical Skills

Languages	Python, C++, SageMath, wxMaxima, Julia, Wolfram Language, Maple, HTML, Markdown
Packages	NumPy, SciPy, Matplotlib, CLASS, Cobaya, SageManifolds, GRTensorIII, ROOT
Other	LaTeX, Git, Jekyll, SolidWorks, AutoCAD

Key courses

Physics	String Theory, Conformal Field Theory, General Relativity, Elementary Particle Physics, Special Topics in Elementary Particle Physics, Specialized Topics in QFT and Beyond Standard Model Physics, Group Theory Methods, Quantum Mechanics I, Quantum Mechanics II, Quantum Mechanics III (relativistic quantum mechanics), Special Relativity, Electricity & Magnetism, Classical Mechanics, Statistical Physics, Thermal Physics, Introduction to Condensed Matter Physics, Nonlinear Dynamics
Maths	Complex Analysis, General Topology, Real Analysis, Basic Algebra, Calculus, Linear Algebra, Differential Equations
Other	Computer Programming and Utilization, Philosophy

Positions of Responsibility

Teaching Assistant

Nov 2020 -Jan 2021
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MA 109 - Calculus I, Dept. of Mathematics, IIT Bombay
- Responsible for conducting tutorial sessions every week for a batch of 40 students throughout the course and helping them clear conceptual doubts.
- Corrected all their answer sheets. Made solutions to questions every week for students. Apart from the tutorial sessions solved all their doubts throughout the course through online messaging.

June 2020 –May 2021

Convener, *Krittika, The Astronomy club of IIT Bombay, Institute Tech Council*
- Part of a team of 10, responsible for organising several institute-wide events such as lectures, workshops, group discussions, projects, interactive online activities including quizzes and trivia to foster enthusiasm in Astronomy and Cosmology in the institute.
- Helped in conducting the Krittika Python Tutorials, a novel initiative through which nearly 2000 students got an opportunity to learn basic astronomy and coding.
- Worked as a facilitator for the project Orbit Determination in Krittika Summer Projects. Helped 6 students to complete their project.

Extracurriculars

2020-Present

Physics Stack Exchange

≡ Kasi Reddy Sreeman Reddy
- Earned over 1,500 reputation on Physics Stack Exchange by answering physics questions.