Kasi Reddy Sreeman Reddy

Curriculum vitae

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IIT Bombay, Mumbai, India

My primary research interest is **string theory**. I am also interested in other areas of theoretical high energy physics and cosmology.

Education

2019–Present **Indian Institute of Technology Bombay (IIT Bombay)**
B.Tech in Engineering Physics
CPI-9.16/10
Pursuing **Honors** in Physics and a **Minor** in Mathematics.

Academic Achievements

2022 Selected to the **Mitacs Globalink Research Internship** for a 12-week 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 Kishore Vaigyanik Protsahan Yojana (KVPY-2017) exam conducted by the Department of Science and Technology

Projects

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.

Jun-Nov 2021 **Black hole information paradox**
Supervisor: Prof. Vikram Rentala, Dept. of Physics, IIT Bombay
URL
- 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 Penrose process in a Kerr black hole.
- Studied **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 **Page curve** using the **Page theorem**.

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 spontaneous symmetry breaking.
- Studied how the theory is renormalizable even after gauge bosons acquire mass through Higgs mechanism using R_ξ gauges.

Nov-Dec 2020 **Category theory applications in physics**
URL
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.

Mar-Apr 2021 **One-dimensional photonic bound states in the continuum**
URL
Supervisor: Prof. Anshuman Kumar, Dept. of Physics, IIT Bombay Course Project
- Studied bound states in the continuum (BICs) which emerge due to precise destructive interference of waves for an electron in an one-dimensional quantum well under an external magnetic field.
- Using the correspondence between the spin states of the above electron model and the polarisation states of an one dimensional photonic system made up of an anisotropic layer conjugated with a 1D photonic crystals consisting of alternating layers, found BICs for the photonic system.
- Calculated numerical values and generated graphs of several quantities such as transmittance, reflectance, Q factor, wave function using python for both the electron model and the photonic model.

Nov-Dec 2020 **Covid-19 analysis using a modified SEIR model**
URL
Supervisor: Prof. Amitabha Nandi, Dept. of Physics, IIT Bombay Course Project
- Studied the normal Susceptible-Exposed-Infected-Recovered (SEIR) model. Later used a modified model to incorporates the fact that asymptomatic or mildly symptomatic individuals play a significant role in the transmission of Covid-19.
- Generated different projections for India under different intervention parameters.
- By varying intervention parameters in the modified model we concluded that testing-quarantining is more efficient in controlling the pandemic than lockdowns.

April 2020 **Special and General Relativity**
URL
Guide: Summer of Science mentor under Maths and Physics Club, IIT Bombay
- Studied the principles of relativity. Started with Special Relativity and then read the mathematical prerequisites for General Relativity.
- Studied General Relativity till Schwarzschild metric and analyzed the properties of Schwarzschild black holes in Schwarzschild coordinates and Eddington–Finkelstein coordinates.

July 2020 **Orbit Determination**
Guide:Krittika summer projects mentor under Krittika Astronomy club of IIT Bombay
- Learnt basic numerical computing, converting between Altazimuth, Equatorial and Ecliptic Coordinates.
- Wrote code in Python which takes the right accession and declination at 3 points of an orbit as inputs and outputs the orbital elements and ephemeris for the required time interval.

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	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, Thermal Physics, Nonlinear Dynamics
Maths	Complex Analysis, General Topology, Real Analysis, Basic Algebra, Calculus, Linear Algebra
Other	Computer Programming and Utilization, Philosophy

** Courses to be completed by the end of Autumn 2022*

Positions of Responsibility

Teaching Assistant

Nov 2020 -Jan 2021 URL

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

- Reached over 18,000 people and earned over 1,400+ reputation on Physics Stack Exchange.