

# Kasi Reddy Sreeman Reddy

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I am interested in doing research in the fields of High Energy Physics(HEP) and Cosmology. Particularly I want to do research at scenarios where the quantum effects of gravity cannot be ignored.

## Education

2019–Present **Bachelor of Technology in Engineering Physics.**  
Indian Institute of Technology, Bombay (IIT Bombay), Mumbai, India  
CPI-9.08/10  
Pursuing an **Honors** in Engineering Physics and a **Minor** in Mathematics.

## Academic Achievements

- 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.
- 2017, 2018 Amongst the National top 1% in National Standard Examination in Astronomy (NSEA-2017) and National Standard Examination in Chemistry (NSEC-2018) and was selected for INAO-2018 and INChO-2019 conducted by HBCSE.

## Projects

- Jun-present **Black hole information paradox.**  
2021 *Supervisor: Prof. Vikram Rentala, Dept. of Physics*  
[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 in which a black hole can be in stable equilibrium with CMB and currently studying how black hole complementarity prevents the violation of unitarity.
- Mar-Apr 2021 **One-dimensional photonic bound states in the continuum.**  
[URL](#) *Supervisor: Prof. Anshuman Kumar, Dept. of Physics* 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 **Category theory applications in physics.**  
2020 *Supervisor: Prof. Vikram Rentala, Dept. of Physics*  
[URL](#)
  - 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.

Nov-Dec **Covid-19 analysis using a modified SEIR model.**

2020 *Supervisor: Prof. Amitabha Nandi, Dept. of Physics*

Course Project

- [URL](#)
- Studied the normal Susceptible-Exposed-Infected-Recovered (SEIR) model. Later used a modified model to incorporate 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 ascension and declination at 3 points of an orbit as inputs and outputs the orbital elements and ephemeris for the required time interval.

Autumn 2019 **Power Inverter.**

*Supervisor: Prof. Joseph John, Dept. of Electrical Engineering*

Course Project

- Implemented a modified 555 timer based astable multivibrator circuit to get equal high and low time.
- Integrated the circuit with BC457 (BJT) to obtain full cycle of 50Hz. The pulse high is obtained from 555 timer output and pulse low from inverted output (using BJT inverter)
- Generated time varying currents using IRFZ44 n-channel power MOSFETs and obtained ac voltage by passing time varying currents through 150-0-15 transformer.

## Other Projects

Autumn 2019 **Digital counter and object detector.**

Constructed a proximity sensor using LED-IR detector pair. Interfaced 7490 BCD counter to 7447A BCD-to-seven-segment decoder and LT-542 Common-anode Seven segment display to create a manual clock.

## Technical Skills

Languages Python, C++, SageMath, Wolfram Language, Maple, HTML, Markdown

Packages Numpy, Scipy, Matplotlib, SageManifolds, GRTensorIII, ROOT

Other  $\text{\LaTeX}$ , Git, Jekyll, SolidWorks, AutoCAD

## Key courses

Physics General Relativity, Quantum Mechanics I, II\*, Quantum Mechanics III\* (Introduction to quantum field theory), Special Relativity, Electricity & Magnetism, Classical Mechanics, Thermal Physics, Waves & Oscillations & Optics, Nonlinear Dynamics, Photonics\*, Data Analysis & Interpretation.

Maths Complex Analysis, General Topology, Real Analysis, Calculus, Linear Algebra, Basic Algebra\*.

Other Computer Programming and Utilization, Philosophy\*, Power Engineering - I, Introduction to Electrical Engineering Practice, Digital Systems.

\* Courses to be completed by the end of Autumn 2021-2022

## Positions of Responsibility

### Teaching Assistant.

Nov 2020-Jan 2021 *MA 109 - Calculus I, Dept. of Mathematics*

- [URL](#)
- 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 **Convener, Krittika, The Astronomy club of IIT Bombay, Institute Tech Council.**
- May 2021
- 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.