ADITHYA A RAO

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Education

- **5 years Integrated M.Sc** | *Physics*
  Sardar Vallabhbhai National Institute of Technology, Surat, India
  2019 - 2024 (expected)
  CGPA up to 9th (previous) semester - 9.75 /10

Conferences and Posters

○ **Estimating the Age of Universe via Interacting Tachyonic Scalar Field** (Poster)
  Presented at the XXV High Energy Physics Symposium 2022, Department of Atomic Energy - Board of Research in Nuclear Sciences, Govt. of India (DAE-BRNS) at the Indian Institute of Science Education and Research, Mohali, held during 12-16 December 2022.

Research Experience

- **Gribov Ambiguity and Stochastic Quantization**
  (Master's Thesis)
  [Aug 2023 - May 2024]
  Supervisor : Prof. Dr. Laurent Baulieu, Sorbonne University, Paris

  Abstract: The Gribov Ambiguity haunts the Faddeev Popov formulation of path integral for Yang-Mills theory. One possible resolution to this lies in the method of Stochastic Quantization, whereby one can construct a Quantum Yang-Mills theory devoid of the Gribov Copies. The thesis aims to investigate the problem itself, and also the various methods proposed by Zwanziger et. al. to possibly resolve the ambiguity and consistently construct a Quantum Yang-Mills Theory.

- **Banks-Fischler-Shenker-Susskind Model on the Lattice**
  [May 2023 - July 2023]
  Supervisor : Dr. habil. Georg Bergner, Friedrich-Schiller-Universität Jena, Germany

  Abstract: The BFSS model, also called the M(atrix) theory is conjectured to be dual to the type IIB string theory. Obtained by dimensional reduction of 9+1 dimensional supersymmetric Yang-Mills theory, this is expected to reproduce the theory of quantum gravity in the 11-dimensional space-time
  The initial study involved only the bosonic sector of the model, the temperature dependence of the energy of the system was obtained and verified.
  An anomalous behavior of gauge invariant 4-point correlators was observed, with possible indications of a violation of reflection positivity pointing toward the confinement of the glueballs.
  Further, the fermionic energy was computed on the lattice, and it was observed that the temperature dependence matched with the approximate energy formula obtained by the supersymmetric Ward identities.

- **Interacting Tachyonic Scalar Field as Dark Energy Candidate**(*Preprint*)
  [Aug 2022 - Dec 2022]
  Supervisor : Dr. Vikash K Ojha, Sardar Vallabhbhai National Institute of Technology, Surat, India.

  Abstract: The dark energy is modeled as a Tachyonic Scalar Field that interacts with the matter content of the universe, and the evolution of the various parameters, especially the functional form of scale factor and the Age of Universe is estimated.
  We obtained that the constraints on the coupling constant to be the same as the case when the interaction term is

different (Kundu, A. et.al "Interacting tachyonic scalar field." Communications in Theoretical Physics 73.2 (2021): 025402.)

The results have been presented at the XXV High Energy Physics Symposium 2022, and also have been communicated for publication.

- **Quantum Many-Body Phenomena and Tensor Networks**
  [Jul 2022 - Dec 2022]
  Supervisor : Dr. Deepak Vaid, National Institute of Technology Karnataka, India.

  Abstract: A brief study of Quantum Many-Body physics and Tensor Network methods to study such systems, with connection to Quantum Information.

- **Particle Dark Matter: Existence And Constraints**(*Certificate*)
  [May 2022 - Jul 2022]
  Supervisor : Dr. Ranjan Laha, Center for High Energy Physics, Indian Institute of Science, Bangalore, India.

  Abstract: An investigation of the necessity of Dark Matter in Cosmological Models and the Evidence for the Existence and Properties of Particle Dark Matter from Cosmological Observations.

- **Magnetic Monopoles** (*Report*)
  [Jan 2022 - Apr 2022]
  Supervisor : Dr. Vikash K Ojha, Sardar Vallabhbhai National Institute of Technology, Surat, India.

  Abstract: A two-potential formulation of the symmetric theory is found to be classically consistent in introducing magnetic source terms to Electrodynamics. The Lagrangian for a two-potential theory was constructed and Maxwell's equations with magnetic sources, and the Lorentz force equations for dyons were derived using Euler Lagrange equations.

- **Dynamical Symmetries of the Kepler System** (*Report*)
  [Aug 2021 - Dec 2021]
  Supervisor : Prof. K N Pathak, Sardar Vallabhbhai National Institute of Technology, Surat, India.

  Abstract: The SO(4) symmetry group of the Kepler system and its generators is studied. Observed that the nontrivial symmetry operations that modify the eccentricity of the elliptic orbit keeping the energy constant translate to simple rotations in a 4D space with non-trivially reparameterized time.

- **Lepton Oscillations** (*Report*)(*Certificate*)
  [Jun 2021 - Dec 2021]
  Supervisor : Prof. Srubabati Goswami, Senior Professor, Physical Research Laboratory (PRL), Ahmedabad, India.

  Abstract: Approached the question of why charged leptons do not oscillate, in connection to the flavor oscillations observed in the neutrinos. It was understood that the mass squared difference and the uncertainty principle quantify the coherence distance of the flavor superpositions, which turn out to be very small for the charged leptons, thus ruling out the possibility of experimental observation of oscillations.

- **Statistical and Thermodynamic properties of Quark Gluon Plasma** (*Report*)
  [Apr 2021 - Jun 2021]
  Supervisor : Dr. Arvind Kumar, Dr B R Ambedkar National Institute of Technology, Jalandhar, India.

  Abstract: Obtained a crude bound on the phase boundaries of the quark-gluon plasma via its statistical and thermodynamic properties while also addressing the question of the possibility of producing quark-gluon plasma in the laboratory.

Talks Delivered

○ **Effects of Extra Dimensions on Force Fields and Particles**
Delivered to physics and math undergraduate students as a part of the Quanta Seminar series conducted by the

Department of Physics, NIT Surat, on 27th August 2022.

Technical Skills

○ **Programming Languages:** C, C++, Python, Matlab, Fortran, Javascript, Julia

○ **Computer Algebra Systems:** Wolfram Mathematica, SymPy

○ **Data Handling and Analysis:** Fairly versed in data analysis methods using python.

○ **Softwares:** LaTeX, Microsoft Office

○ **Operating Systems:** Windows, Linux

○ **Other Technical Skills:** Fairly well-versed in web development using HTML, CSS and Javascript. Familiar with the use of git and GitHub.

Achievements and Honors

☐ Nominated by the Department of Science and Technology, Government of India as one of India's select representatives for consideration to attend the highly prestigious Lindau Nobel Laureate Meeting in Physics scheduled for July 2024.

☐ DAAD WISE fellow 2023 for a fully funded short-term project in Germany.

☐ Fellow of Summer Research Fellowship, awarded by the Indian Academy of Sciences (IAS) for undertaking a research project for a few prestigious students from all over the nation for the year 2021.

☐ Fellow of INSPIRE fellowship award, funded by Department of Science and Technology, Govt. of India, awarded to the top students of the country for pursuing higher education and research in pure sciences.

Outreach

○ **Ex-Head, Physics Club of NIT Surat**, a club actively conducting events to impart knowledge and inculcate interest in physics in the young minds and the general public. I was also the one who created the website for the club.

○ **Author, thehavok.com**, writing science articles to make the scientific jargon accessible to even a non-academic.

○ **Member Secretary, Departmental Library, Department of Physics, NIT Surat**

References

☐ Prof. Dr. Laurent Baulieu
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Sorbonne University, Paris, France
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☐ Dr. habil. Georg Bergner
Theoretical Physics Institute,
Friedrich Schiller Universität Jena, Germany
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☐ Dr. Vikash Kumar Ojha
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