Roshan Raj

Research Experiences- List of Publications, Projects & e-prints

Upto May 2024 (Chronologically)

1 Master's Dissertation

- Quantum and Classical Applications of Relativistic Relationship of Kinetic Energy and Momentum
  Supervisor: Dr. Vikash K Ojha, SVNIT-Surat; [Jul, 2023-May, 2024]–URL: G Drive
  Keywords: Reconstruction of Relativistic Quantum Theory, Relativistic Classical Physics.
  Brief: The thesis explores a new relativistic quantum wave equation based on a novel Hamiltonian. This Hamiltonian, derived from a classical relation involving relativistic kinetic energy and momentum, offers an alternative to Dirac's relativistic Hamiltonian. The proposed equation, a Weyl-like compact form, simplifies to non-relativistic Schrödinger and massless Klein-Gordan equations in respective limits. It addresses quantum potential problems, eliminates Klein's Paradox, and predicts changes in atomic and energy spectra with increasing Lorentz factor γ. Additionally, it determines second-order energy corrections for a relativistic anharmonic oscillator, aligning with established non-relativistic results. The thesis also extends this relation to classical relativistic theory, calculating the relativistic density of states and distribution functions. It suggests improvements to the relativistic Lagrangian for better non-relativistic limits, highlighting the mathematical and predictive potential of the theory.

Institute Mini-projects (Original)

(3) New light on the concepts of Observable and indeterminacy in the quantum realm
Guide: Dr. Vikash K Ojha, SVNIT-Surat– UG Project III, [Jul-Dec, 2022]–URL: G Drive
Keywords: Quantum to Classical Transition
Brief: I argue that observable parameters are crucial for any physical theory, and in quantum mechanics, the imaginary unit 'i' plays a vital role in transforming unobservables into observable complex quantities. In addition, we can have a nondeterministic classical form of the Born-Jordan quantum condition and, thus, a novel reinterpretation of the uncertainty principle.

(2) On the investigation of two non-neutral static bodies
Guide: Dr. Sharad K Yadav, SVNIT-Surat– UG Project II, [Jan-May, 2022]– DOI: arXiv.2209.10641
Keywords: Gravity and EM Unification
Brief: This work studies the statics of two charged bodies. It investigates net field strength, defines a function Y resembling a nuclear mass function, and suggests nature's preference for heavier objects at the positive charge centre. It also finds an expression for ellipse geometry and introduces 'quintessence' analogous to electric potential. Finally, it explores the constancy of a factor χ (chi).

(1) Dynamics of Two Objects Considering the Minimum Total Potential Energy Principle
Guide: Dr. Himanshu Pandey, SVNIT-Surat– UG Project I, [Jul-Dec, 2021]–DOI: 10.31219/osf.io/ukx9t
Keywords: Gravity and EM Unification
Brief: We proposed a process, namely, "absolute union", that explores two bodies' motion based on minimizing energy. Analyzing this ideal process suggests the existence of electric charges and gravity's alternative role. A

mass ratio of two bodies is found to be required to start the process of absolute union, and the law of inertia is explained.

Independent Works

(3) Obtaining the Klein-Gordon Wave Equation Without Using the Quantum Operators. OSF Preprints. 2023. DOI:10.31219/osf.io/6hmyf.
Keywords: Reconstruction and Foundations of Quantum Theory
Brief: We claim that Klein-Gordan (KG) equation should be termed as "Wave equation" and Schrödinger equation (also, Dirac's equation) is proposed to be called as "Governing law". The basis of categorisation is discussed. The obtained expression for massless particles is similar to the Maxwell wave equation.

(2) Reviewing Observables in Classical and Quantum Mechanics. OSF Preprints. 2023. DOI:10.31219/osf.io/p2ufx.
Keywords: Foundations of Quantum Theory
Brief: It presents the evolution of the quantum observables from their classical counterpart and distinctly analyses the meaning of observable in context to both the classical and the quantum realms, emphasising 1925's W. Heisenberg realization.

(1) An Open-ended Story on Quantization. OSF Preprints. 2023. DOI:10.31219/osf.io/92bvp.
Keywords: Foundations of Quantum Theory
Brief: To provide a write-up, impressing on the evolutionary track of quantization of physical quantities such as Energy, momentum, and angular momentum. Additionally, it addresses the question of which fundamental quantity is responsible for quantizing other derived quantities.

Short Write-Up

(2) The Circle: 7 different perspectives. Magazine (AMaThing 5.0). 2024. URL: G Drive
Brief: An exploration of the mathematical concept of a circle through various lenses of mathematical disciplines (geometry, algebraic topology, complex numbers, knot theory, etc.)

(1) The Coronal Heating Problem OSF Preprints. 2023. DOI: 10.31219/osf.io/63cag
Keywords: Solar Corona, Magnetic Reconnections
Brief: An overview of the Sun's atmospheric temperature inversion and detailing the recent developments in resolving the coronal heating problem.

2 Internships

[3] प्रमात्रिक गतिकी के चित्र [*The pictures of quantum dynamics* (Hindi)]
Guide: Dr. Vikash K Ojha, SVNIT, Surat, [May-Jul, 2022]–URL: G Drive
Brief: Physics Education for Hindi speaking readers. The work explores 3 quantum dynamics methods and explains analytical mechanics, quantum mechanics, and ontological view. It aims to aware the common public about basics of quantum dynamics and its historical context.

[2] The front-end development of a dummy e-commerce website
Guide: Dr. Santosh Prabhakar, Internship Studio, Pune, [Jun-Jul, 2020]
Brief: Learning included using HTML5, CSS3 frameworks and training for the web.

[1] Project, Building the student information management system using C language
Guide: Dr. Balu Parne, SVNIT, Surat, [Feb-May, 2020]
Brief: Learning included using C languages and its application in file handling.