Khushi Raj

Fourth year, BS-MS (integrated) IISER Berhampur

khushi23@iiserbpr.ac.in +91 6209797307 khushiraj3 khushiraj khushiraj-physics

Research Interest

- Quantum Information Theory
- Quantum Cryptography
- Quantum Foundations

Education

Indian Institute of Science Education and Research Berhampur *Sept 2023 – Present*

- BS-MS (Physics Major)
- CPI: 8.0/10

Relevant Coursework

- **Coursework and Labs in Physics:** Quantum Mechanics I, Quantum Mechanics II, Mathematical Methods I, Mathematical Methods II, Statistical Mechanics, Thermal Physics, Electromagnetism, Classical Mechanics, Waves and Optics, Optics Lab, Basic Electronics Lab.
- **Additional Coursework:** Mathematics, Computer and Data Science, Chemistry, Biology, Earth and Environmental Science, and Humanities and Social Science.
- **Other Certification:** Machine Learning Specialization by Andrew Ng (Coursera)

Research Experience

Prof. Ritabrata Sengupta (IISER Berhampur) *May 2026 – Present*

- Studied the theory of Mutually Unbiased Bases (MUBs) through the construction based on Weyl operators and maximal commuting classes of unitary operators, following the approach of Bandyopadhyay *et al.*
- Constructed complete sets of MUBs in prime and prime-power dimensions, and analyzed why this construction does not extend directly to composite dimensions.
- Investigated the operator-algebraic framework for MUBs presented by K. R. Parthasarathy in *On Estimating the State of a Finite Level Quantum System*, including the concepts of weakly and strongly mutually unbiased bases.
- Constructed and analyzed examples of weakly and strongly mutually unbiased bases, and studied Parthasarathy's characterization of MUBs using maximal abelian subspaces of matrix algebras.
- Continuing the project by studying further developments in the theory of mutually unbiased bases, with a prospective focus on constructions over p-adic fields.

Prof. Utpal Roy (IIT Patna) *Jun 2025 – July 2025*

- Studied the foundational concepts of quantum computation by completing the first four chapters of *Quantum Computation and Quantum Information* by Nielsen and Chuang.
- Learned Qiskit and implemented various quantum protocols to gain hands-on experience with quantum programming.
- Explored quantum machine learning, focusing on amplitude encoding techniques.

- Conducted an in-depth study of research papers on Quantum Key Distribution (QKD).
- Presented key findings and insights from the literature through multiple technical presentations.

Seminars Attended

Mathematics for Data Security (IIT Madras) *May 2025*

- Introduction to Lattice-Based Cryptography
- Decentralization, Distributed Trust, and Blockchain
- Distributed Graph Algorithms and Congestion
- Factoring, RSA Security, and Lattice Attacks

Skills

Programming Languages: Python, MATLAB, JavaScript, Qiskit

Tools and Technologies: Git and Github, Jupyter, SQL, Mongodb, PHP

Languages: English, Hindi