

KUNAL VERMA

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Interested in theoretical and computational condensed matter physics.

EDUCATION

Indian Institute of Science Education and Research, Mohali BS-MS Dual Degree, Physics Major Cumulative GPA: 9.52/10.0 (till Semester 8)	August 2018 - Present
Apeejay School, Sheikh Sarai, New Delhi All India Senior Secondary School Examination Percentage - 95.4% (CBSE)	April 2017 - March 2018
Apeejay School, Sheikh Sarai, New Delhi All India Secondary School Examination CGPA - 10.0 (CBSE)	April 2015 - March 2016

RESEARCH EXPERIENCE

4. **Exploring lattice gauge theories via quantum Monte Carlo** January 2022 - Present
Supervisor - Prof. Vijay B. Shenoy *Master's Thesis - IISc, Bengaluru*
 - Currently working on studies to explore the phases of *lattice gauge theories* using quantum Monte Carlo methods.
 - Preliminary work involved studying the classical Ising model in 2D and extracting critical exponents via finite-size scaling analysis.
3. **Numerical methods to evade sign problem in lattice QCD**  April 2021 - Sept 2021
Supervisor - Dr. Anosh Joseph *Summer Project - IISER Mohali*
 - *Complex Langevin* and the *Lefschetz Thimble* methods as primary candidates to deal with the “sign problem” (which makes application of standard Monte Carlo methods problematic) in Lattice QCD.
 - *Complex Langevin*: The field configuration is evolved according to a SDE and its equilibrium configuration is chosen as the sampling configuration.
 - *Lefschetz Thimbles*: new manifolds, equivalent to the original domain of integration, are found in the complexified space, along which the imaginary part of the action is constant and, therefore, the integral is (mostly) real.
2. **Gamma-ray spectroscopy to study decay processes**  December 2019
Supervisor - Prof. Rudrajyoti Palit *NIUS 16.2 Project - TIFR Mumbai*
 - Introduction to methods of radiation emission and detection, radiation-matter interaction, etc.
 - Methods of gamma ray detection using scintillation detectors and PMTs. Wrote a code for detection of peaks in a γ -ray spectrum.

1. Implementing Quantum State Tomography in IBM-Q

May 2019 - July 2019

Supervisor - Prof. Kavita Dorai

Summer Project - IISER Mohali

- Introduction to basics of *Quantum Computing* and physically realizing it using NMR.
- Explored algorithms for experimentally computing expectation values of operators, and performing Quantum State Tomography of mixed states to reconstruct the density matrix using IBM-Q.

PUBLICATIONS

1. Anosh Joseph, **Kunal Verma** (2022). *Sign Problem and Lefschetz Thimbles*. (Submitted)

TEACHING EXPERIENCE

PHY101-Mechanics Teaching Assistant, Spring Semester 2022 - IISER Mohali.

AWARDS

INSPIRE Scholar 2018-2023	SHE (Scholarship for Higher Education).
Certificate for Academic Excellence	for a 10.0 SPI in Semester 4, 6 and 7.
S.W.A.N Imaging Challenge 2019	Winner (Team), organized by RRI Bangalore.

WORKSHOPS/CONFERENCES

From Quantum Matter to Quantum Computers, 2022	MPI-PKS, Dresden.
Frustrated Metals and Insulators (Hybrid), 2022	ICTS, Bengaluru.
Shivalik HEPCATS meeting, Winter 2021	IISER Mohali.
Conference on QFTA 2019	IISER Mohali.
NIUS Physics 16.1 and 16.2 Camp	HBCSE, TIFR, Mumbai.
National Science (Vijyoshi) Camp 2018	IISER Bhopal.

TECHNICAL SKILLS

Computational Methods

Monte Carlo simulations, Path Integral (quantum) Monte Carlo, Molecular Dynamics simulations, numerical integration techniques.

Scientific Programming languages

Fluent in Python (scipy, numpy, matplotlib), *Intermediate* knowledge of C++, *Basic* knowledge of Fortran90, Mathematica.

ADVANCED COURSEWORK

Solid State Physics, Relativistic Quantum Mechanics and Quantum Field Theory (QFT-I), Nonlinear Dynamics and Chaos, Gravitation and Cosmology, Computational Physics (Fortran), Intro to Quantum Computing: Quantum Algorithms and Qiskit, Modelling Complex Systems, Machine Learning.