PRADYUMNA P BELGAONKAR

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EDUCATION

Indian Institute of Technology, Delhi   *Graduated: July 2020*
Bachelor of Technology, Engineering Physics   CGPA: 7.700/10, SGPA: 9.364/10

VVS Sardar Patel PU College   *Graduated: May 2016*
Class XII, Second year Pre University Examination   Percentage: 97.7%

School Vivekananda, Bengaluru.   *Graduated: March 2014*
Class X, Indian Certificate of Secondary Education (ICSE)   Percentage: 95%

SCHOLASTIC ACHIEVEMENTS

· Recommended for fellowship in Kishore Vaigyanik Protsahan Yojana (KVPY) programme in 2016 by Indian Institute of Sience, Bengaluru.
· Secured All India Rank 1601 in Joint Entrance Examination Advanced - 2016 among 178,000 candidates.

RESEARCH EXPERIENCE

Floquet Hofstadter Butterfly on Graphene lattice   Dec 2019 - Present
Advisor: Prof. Sankalpa Ghosh   *Department of Physics, IIT Delhi.*
· Extensively reviewed literature showcasing the emergence of quantum time crystals including the research paper "Quantum Time crystals" by Frank Wilczek (Phys. Rev. Lett. 109, 160401).
· Analyzed spontaneous breaking of time-translation symmetry in physically realizable Floquet systems such as the Discrete time crystal for atoms bouncing on an oscillating mirror, realized theoretically in the paper "Modeling spontaneous breaking of time-translation symmetry" by Krzysztof Sacha.
· Studied the Hofstadter butterfly problem in depth including the fractal nature of the spectrum and the diophantine equation which arises out of the magnetic translation symmetry.
· Extended my analysis to the periodically driven Hofstadter Butterfly system on a hexagonal lattice of graphene in the presence of applied circularly polarized light using Floquet Theory.
· Numerically obtained the Floquet Hofstadter Butterfly spectrum, using NumPy libraries in python.
· Numerically computed the topological invariants of the Floquet Hofstadter Butterfly model using the method described in the paper "Chern Numbers in Discretized Brillouin Zone: Efficient Method of Computing (Spin) Hall Conductances" by Takahiro Fukui, Yasuhiro Hatsugai and and Hiroshi Suzuki.
· Currently writing a journal paper analysing the results obtained through my research work.

Generalized Quantum Probabilities in Infinite Dimensional Spaces   July 2019 - Nov-2019
Advisor: Prof. V Ravishankar   *Department of Physics, IIT Delhi.*
· Worked on quantifying non-classicality in quantum mechanics using pseudo-projection operator.
· Numerically analyzed the joint probability function for an eigenstate of the simple harmonic oscillator.
· Analytically obtained the bounds on negative eigenvalues for the pseudo-projection operator.
· Analytically proved that the eigenfunctions of the pseudo-projection operators are non-localized.

Structural Illumination Microscopy   June 2018 - July 2018
Advisor: Prof. Joby Joseph   *Department of Physics, IIT Delhi.*
· Studied the method of enhancing the diffraction limited resolution of a microscope by retrieving the high spatial frequency information usually not captured by the traditional imaging system.
· Simulated the modulation of illumination pattern with a grating of high spatial frequency on Matlab.
· Computationally recovered the high frequency information using the knowledge of multiple modulation pattern on Matlab.

RELEVANT COURSES

Physics: Electrodynamics, Quantum Mechanics, Classical Mechanics, Mathematical Physics, Solid State Physics, Thermodynamics & Statistical Mechanics, Advanced Condensed Matter Theory, Advanced Statistical Mechanics, Applied Quantum Mechanics, General Relativity, Group Theory, Gauge Field Theories, Relativistic Quantum Mechanics, High Energy Physics, Computational Physics, Applied Optics, Semiconductors, Computational Imaging,

Other Sciences: Linear Algebra & Differential Equations, Calculus, Probability, Data Structures & Algorithms, Digital Electronics, Signals & Systems, Real and Complex Analysis

COURSE PROJECTS

Mirror Anomaly in Dirac Semimetals
PYL 740: Advanced Condensed Matter theory (Fall 2019)
· Reviewed the literature on Dirac Semimetals including the research paper "Mirror Anomaly in Dirac Semimetals" by A.A.Burkov (Phys. Rev. Lett. 120, 016603).
· Mathematically demonstrated the Mirror Anomaly using the Dirac Hamiltonian with higher order terms in the presence of magnetic field as done in the paper.

Angular Spectrum Propogation and Noise removal
PYL759: Computational Optical Imaging (Fall 2018)
· Computationally obtained the diffraction pattern observed at a distance from an illuminated square aperture using the method of Angular Spectrum Propagation.
· Used Wiener Filter to computationally de-blurr an image with uniform random noise.

Holography and Cost Function Optimization
PYL759: Computational Optical Imaging (Fall 2018)
· Recovered the image beam computationally at the hologram plane using the Fourier transform technique.
· De-blurred an image and obtained a sparse solution to a seystem of equations by minimizing the corresponding cost function numerically.

Shortest Path Navigation System
COL 106: Data Structures and Algorithms (Spring 2018)
· Realized a navigation system using a modified version of Dijkstra's Algorithm.
· Implemented a robust system of allowance for real-time updation of junctions and vertices.

Market Data Publisher
COL 106: Data Structures and Algorithms (Spring 2018)
· Implemented a system for real time broadcasting of stock prices for use in HFT environment.
· Used AVL tree based data structure for improving average case time complexity for look ups.

TECHNICAL SKILLS

Programming Languages	Python, C++, Java, MATLAB
Software Libraries/Packages	Numpy, SciPy

EXTRA-CURRICULAR ACTIVITIES

Volunteering
· Dedicated a total of 150 hours for social service through the National Service Scheme (NSS) during the period of undergraduate degree.
· Surveyed and created an online database of NGOs throughout India. Prepared a report containing a summary of various kinds of activities undertaken by these organizations. Analyzed the impact of factors such as availability of resources and the local tradition on these organisations.