

# Abhishek Jamunkar

BS MS DUAL DEGREE · AGE: 24 (MALE)

Deshpande wadi, Behind Society officer, Rajura, Chandrapur, Maharashtra, India

☐ (+91) 8308416352|

☐ [ab.jamunkar@gmail.com](mailto:ab.jamunkar@gmail.com) |

☐ Portfolio - [abhishekjamunkar.ninja](https://abhishekjamunkar.ninja)

*“Reality is just a set of beliefs; I believe.”*

## Research Interest

---

- Quantum Information Theory
- Quantum Optics
- Quantum Foundations
- Philosophy of Physics

## Projects

---

### Bell State Measurements in Quantum Information Theory and Quantum Foundations (MS Thesis)

*DIAT Pune, India*

SUPERVISOR: Prof. G Raghavan

*July, 2021 – April, 2022*

A Bell State Measurement is a two-photon measurement that lie at the heart of most protocols in Quantum Information Theory, Bell measurements are also helpful in deepening our understanding of Quantum Theory itself. In this master's thesis project, a detailed theoretical and experimental study of Bell State Measurements was undertaken. Further, one of the earliest foundational questions concerning quantum mechanics is why the quantum state is defined over a complex scalar field and not a real one. Is it possible to rule out 'real quantum mechanics' experimentally? Recent work suggests that a Bell State Measurement could provide an answer to this question provisional to certain assumptions. In the later part of the thesis, this question was taken up for investigation.

### Self-Certifying Quantum Random Number Generator

*DIAT Pune, India*

SUPERVISOR: Prof. G Raghavan

*Jan. 2022 – April, 2022*

Quantum Random Number Generators use random collapses of a wave-function to generate random numbers. In this project, I proposed an interferometric design for a QRNG that can also violate a Bell inequality, and hence, certify that the random numbers generated are quantum random. Currently, most of the QRNGs in the market only claim to be quantum random, they cannot prove that the numbers generated are generated purely from a quantum process and not a classical one. But this QRNG will certify that the numbers quantum random, adding to the unbreachable security.

### Entangled Photons Source Using Non-Linear BBO Crystal

*DIAT Pune, India*

SUPERVISOR: Prof. G Raghavan

*Feb. 2022 – April, 2022*

Entanglement is a non-classical resource that can allow us to accomplish marvellous tasks which are otherwise impossible to perform classically. In this experimental project, I created a source of entangled photons which were entangled in polarization degree of freedom. I incident a high intensity 405nm wavelength laser beam on a non-linear BBO crystal to obtain down-converted entangled photons. Their wavelength was 810nm and were collected using collimators and single photon detectors.

### Quantum State Tomography

*DIAT Pune, India*

SUPERVISOR: Prof. G Raghavan

*Sep. 2021 – Nov. 2021*

Quantum State Tomography is a methodology of experimental reconstruction of an unknown quantum state by projecting an ensemble of identically prepared states onto different basis choices. In this project, I wrote python codes to reconstruct an unknown density matrix from the experimentally obtained projection data..The codes are written for single photon and two photon QST and are available on my github account.

## Quantum Information and Noise

*IISER Pune, India*

SUPERVISOR: Dr. Bijakumar Agarwalla, Semester Project

*Jan 2020 - May 2020*

This was a semester project done on fundamentals of Quantum Information and Noise. This was the first time I was introduced to the field of Quantum Information and it has opened a gateway for me to understand and learn about Quantum Computation, Quantum Entanglement and Quantum Teleportation. It has also made me look at information from a new perspective; and that I believe it is only the beginning of something even more profound.

## Investigating Why Photons Cannot be Sharply Localized

*IISER Pune, India*

SUPERVISOR: Dr. Shovik Datta

*Nov. 2020 – Dec. 2020*

Photons are one of the most perplexing objects even today. Photon wave function has been a long-standing problem for physicist. In this research paper reading project, I explored why localization of photons is a difficult task. It turns out the root of the problem comes from the fact that localization of a photon requires localization of both electric and magnetic components of the photon. The electric and magnetic components are conjugate to each other like position and momentum of a quantum particle. It is possible to sharply localize only one of the variables. I also discovered that even partial localization of a photon is very fragile and is destroyed by time evolution. If we try using coherent states, some degree of localization is possible, but that too decays with the speed of light.

## Why Delayed Choice Experiments Do Not Imply Retro-Causality

*Nagpur, India*

*June. 2020 - Aug 2020*

This was a research paper reading project which I completed during Covid-19 lockdown. I learned about the Delayed Choice Experiment and the seemingly retro-causal effects demonstrated by it. I learned how this retro-causality is just a misinterpretation of the result and how we need be careful while interpreting Quantum Mechanics. This has helped me a lot in building a solid foundation of Quantum Mechanics and helped me avoid common traps of misconceptions which are still prevalent in public.

## Education

---

### **Indian Institute of Science Education and Research (IISER) Pune**

*Pune, India*

BS-MS DUAL DEGREE IN BASIC SCIENCE

*Aug. 2017 - May 2022*

- Major: Physics
- Minor: Chemistry

### **Dharampeth Science College**

*Nagpur, India*

MAHARASHTRA STATE BOARD OF SECONDARY AND HIGHER SECONDARY EDUCATION (MSBSHSE)

*March 2014 - March 2016*

- Ranked among top 2 percentile students
- Score: 79%
- Subjects: Physics, Chemistry, Mathematics, English, Hindi

### **Bhonsala Military School**

*Nagpur, India*

MAHARASHTRA STATE BOARD OF SECONDARY AND HIGHER SECONDARY EDUCATION (MSBSHSE)

*March 2014*

- **School topper**, Score: 91.8 %. Subjects: Science, Mathematics, Social Science, Economics, English, Hindi

## Coursework

---

### Advanced Courses

*IISER Pune*

*Aug. 2019 - Dec 2020*

- **Physics:** 1) Classical Mechanics 2) Electrodynamics  
3) Quantum Mechanics 4) Mathematical Methods in Physics  
5) Statistical Mechanics 6) Astronomy and Astrophysics  
7) Quantum Mechanics 2 8) Quantum Information  
9) Advanced Lab 10) Advanced Optics  
11) Computational Physics 12) Gravitation and Cosmology  
13) Group Theory in Physics 14) Experimental Physics  
15) Quantum Field Theory 15) Plasma Physics
- **Chemistry:** 1) Statistical Thermodynamics 2) Quantum Chemistry

### 3) Chemistry of Clean energy

- **Interdisciplinary:** 1) Data Science      2) Mathematical and Computational Biology  
3) Geofluid Dynamics   4) Isotope Geochemistry  
5) Development studies

### Introductory Course

*IISER Pune*

*Aug. 2014 - April 2016*

- **Physics:** Mechanics, Waves and Matter, Electricity and Magnetism, Quantum Physics, Physics Lab
- **Chemistry:** General Chemistry, Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Chemistry Lab
- **Biology:** Biology I and II, Ecology and Evolution, Biology of Systems, Biology Lab I, II and III
- **Earth and Climate Science:** Earth System I and II
- **Interdisciplinary Courses:** Optics, Mathematical Methods, Introduction to Computing Python
- **Humanities and Social Sciences:** Introduction to History of Science, Technology and Medicine, Critical Reading and Communication

## Skills

---

- Experimental skills in Quantum Optics lab: Can carefully handle optical components.  
Can setup a custom designed interferometer.  
Have built a photonic entanglement source.  
Have performed fundamental experiments like CHSH violation, Hong-Ou-Mandel effect.
- Computational skills: Quantum State Tomography (wrote algorithms for reconstruction of quantum state from measurement data).  
Python  
JavaScript  
Fortran
- Touch Typist (40+ wpm)

## Extra-curricular Activities

---

### Entrepreneurship & Innovation Cell

*IISER Pune*

CORE COMMITTEE MEMBER

- Co-ordinator of the Operations and Hospitality team of periodic events/workshop to inspire innovation and to build a successful and well-connected entrepreneurial community in IISER
- Organized TechStars Start-up Weekend 2017, Coffee with Start-up 2017 and Fuck up nights 2018

### Spread the Smile

*IISER Pune*

ACTIVE MEMBER

- A social initiative of IISER Pune to carry out scientific activities among underprivileged village students and to motivate them towards science

### Secondary Activities

- Learnt how to use Natural Language Processing transformer GPT – 2 using Google Colab
- Explored Generative art (uses algorithms to generate art)
- Learned Basics of 2D and 3D animations using Adobe suits and Blender
- Tried Cryptocurrency trading of Bitcoin and Sports Gambling (IPL)
- Explored the field of Affiliate marketing and tried Blogging

## Potential References

---

### **Prof. G Raghavan**

DIAT PUNE

- Director of School Of Quantum Technology, DIAT, Pune
- Email: go.raghavan@gmail.com