1 Introduction

"With the Google quantum supremacy paper, the claims that quantum computers can't possibly work keep on coming. It is becoming clear that reasoned arguments will not stop them. I don't think illogical poetry is going to work, either. But it's fun to write" $\sim$ Peter Shor.
Quantum information probably originated from the famous arguments between Einstein and Schrodinger on Entanglement. But it was only after 1985 that active research began in quantum information when scientists understood that nature holds immense computational power in resources like entanglement and the superposition principle. This power, if unearthed, could disrupt the entire technological ecosystem by challenging some of its strongest pillars like cryptography and supercomputing. But this incredible power comes with some flaws. Quantum information is more sensitive and hence more susceptible to noise or decoherence. This is the reason for much-raised suspicions against quantum supremacy. The usage of error correction and fault tolerance can circumvent this problem. This is one aspect of quantum information that I am most interested. I am interested in improving the technology for safer and more reliable quantum communication.

2 My Background in Quantum Information

As a teenager in class 9, I enjoyed coding patterns on computer and discussing about bizarre physics ideas like ultraviolet catastrophe and tachyons. This attachment with computer science and physics continued into my undergraduate career. I was blown away when I first encountered Quantum Mechanics and wondered how such an innocent-looking mathematical formalism would be so hard to conceptualize but would possess enormous predictive power at the subatomic level. So, I took the intermediate and advanced QM to get acquainted with the formalism. In my first two years, I was more into doing full-stack app development, learning and testing network protocols. I was the leader of the tech team of IISER Kolkata's annual science fest Inquivesta 2019. I also studied the theory of computation, algorithms, and classical cryptography from lecture series and have also taken a course in algorithm at IISER. By the end of the third year, I had a background in both quantum mechanics and computer science to better understand quantum information.
So, I started reading Nielsen and Chuang book on Quantum Computation and Quantum Information along with the lecture notes by Preskill for both had different approaches. While learning, I solved most of the problems given in Nielsen and Chuang and will be publishing its solution set online in the coming future. I joined the research group of the distinguished Prof. Guruprasad Kar at Indian Statistical Institute, Kolkata for discussions with experienced researchers. I studied about distinguishability of Bell States, hidden variable models, mixed state entanglement and shared randomness before my guide assigned me a project on proving the security of Quantum Key Distribution protocols. I then decided to study quantum noise, the actual setback to quantum supremacy as an independent study under Prof. Chiranjib Mitra, head of Quantum Information lab at IISER Kolkata. Along with quantum optics, I also learned about continuous variable quantum computation and master and langevin equations to model quantum noise. Apart from this, I am also doing a project at Indian Statistical Institute, Kolkata under Dr. Ramij Rahaman on device independepent quantum cryptography and random key generator and an informal

project on quantum error correction with a postdoctoral fellow at Grenoble Alpes, where I am analyzing different codes like topological codes, surface codes and polar codes. My half-yealy Master's thesis presentation was applauded by the panel for a very engrossing discussion and most importantly by my supervisor who remarked that I am working on a difficult area and although I had only limited discussions , I was able to solve the problem of entanglement purification through error correction.

3 Future Plan

I am very glad that Wisconsin Madison has initiated a special program dedicated for Quantum Information which, includes the Wisconsin Quantum Institute(WQI) and creation of Quantum Smart Workforce for encouraging quantum supremacy. I have gone through some of the works of Robert Joynt like "Designs and Redundant Syndrome Extraction for Quantum Error Correction"[1] and "Error Mitigation in Quantum Computers subject to Spatially Correlated Noise"[2]. I am also interested in the work of Mikhail A. Kats on basic problems in optical physics and fabrication of novel optical components as this concerns directly the problems I studied in continuous variable quantum computation. Along this line, I want to recognize more novel resources for quantum communication like memory, carrier, etc., and most importantly, inspect and model the noise it is susceptible to and then theoretically come up with efficient error-correcting code for such channels and try to implement it experimentally. I am also interested in developing frameworks like Bell non-locality for benchmarking quantum resources. For this, the advanced Quantum Computing course provided at Wisconsin will be very beneficial. I will also endeavour to have further discussions on my proposed thesis and relevant hot topics with the faculties. It is impressive how WQI has brought together distinguished scientists working on diverse fields like novel material design for Quantum Computing, Error Correction, Quantum Sensors etc and also initiated the creation of quantum smart workforce. This gives me confidence that the diverse but coherent approach I have employed to get into Quantum Information science as mentioned earlier will be given particular direction and will launch my career as a good researcher. My CV also shows that I have researched various fields, ranging from Raman spectroscopy to stochastic thermodynamics to numerical simulations, and then went on to narrowing my research interest which further solidifies my belief that the Wisconsin Quantum Institute will be a perfect place for me to do my graduate study and start my P.hD career.

1) V. N. Premakumar, Hele Sha, D. Crow, Eric Bach, Robert Joynt, arXiv:1907.04497, Quantum Information Processing 20, 84, (2020)
2) V. N. Premakumar, R. Joynt, arXiv: 1812:07076, submitted to Quant. Inf. Comp., 2019