Nitin Jha

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ABOUT ME

I am a second-year Ph.D. candidate at Kennesaw State University working on Quantum Networks and Quantum Communication.

WORK EXPERIENCE

Research assistant in university

Ashoka University (Department of Physics) [01/06/2022 – 31/08/2022]

City: Sonipat | **Country:** India | **Website:** https://www.ashoka.edu.in/department/department-of-physics/ | **Name of unit or department:** Physics - **Business or sector:** Professional, scientific and technical activities

To simulate various micromagnetic systems using the MuMax3 or OOMMF, and analyse the given data to make relevant inferences about multiple systems of interest, **Permalloys** of different dimensions.

Graduate Research Assistant

Kennesaw State University [01/08/2023 – Current]

Address: 1100 South Marietta Pkwy, 30060 Marietta (United States)

I am working as a Graduate Research Assistant under Dr. Abhishek Parakh in the Department of Computer Science at the College of Computing and Software Engineering (CCSE). I work on studying several quantum communication protocols and their performance over different channel noises.

EDUCATION AND TRAINING

Ph.D. Computer Science

Kennesaw State University [14/08/2023 – Current]

Address: 1100 South Marietta Pkwy, 30060 Marietta (United States) | **Website:** https://www.kennesaw.edu/

Bachelors of Science in Physics (Hons) (Cum Laude)

Ashoka University [10/08/2020 – 27/05/2023]

Address: Ashoka University, Plot No.2 Rajiv Gandhi Education City (India), 131029 Sonepat (India) | **Website:** https://www.ashoka.edu.in/ | **Field(s) of study:** Physics | **Final grade:** 3.69/ 4.0

High School

D.A.V Public School [01/03/2018 – 16/06/2020]

Address: NIT Campus, Banta Nagar Adityapur, Jamshedpur , 831014 Jamshedpur (India) | **Website:** https://davnitjsr.org/ | **Field(s) of study:** Natural sciences, mathematics and statistics | **Final grade:** 94.2 %

LANGUAGE SKILLS

Mother tongue(s): Hindi | English | Maithili

DIGITAL SKILLS

Matlab/Simulik / IBM-Q Experience and Qiskit (an open-source Quantum Computing framework)

Data Collection and Analysis

Data Gathering, Data Processing, Data Visualization, Data Analysis / Latex: advanced user / Programming: C, Java, Apex, Python, OCaml, OpenGL / Academic writing and editing

Compiling and Managing the Results

Microsoft Office, Microsoft Word, Microsoft Excel, Outlook, Facebook, Google / Basic graphic design - Canva / Laboratory Skills

PUBLICATIONS

[2024]

Effect of noise and topologies on multi-photon quantum protocols Quantum-augmented networks aim to use quantum phenomena to improve detection and protection against malicious actors in a classical communication network. This may include multiplexing quantum signals into classical fiber optical channels and incorporating purely quantum links alongside classical links in the network. In such hybrid networks, quantum protocols based on single photons become a bottleneck for transmission distances and data speeds, thereby reducing entire network performance. Furthermore, many of the security assumptions of the single-photon protocols do not hold up in practice because of the impossibility of manufacturing single-photon emitters. Multi-photon quantum protocols, on the other hand, are designed to operate under practical assumptions and do not require single photon emitters. As a result, they provide higher levels of security guarantees and longer transmission distances. However, the effect of channel and device noise on multiphoton protocols in terms of security, transmission distances, and bit rates has not been investigated. In this paper, we focus on channel noise and present our observations on the effect of various types of noise on multi-photon protocols. We also investigate the effect of topologies such as ring, star, and torus on the noise characteristics of the multi-photon protocols. Our results show the possible advantages of switching to multi-photon protocols and give insights into the repeater placement and topology choice for quantum-augmented networks.

Jha, N., Parakh, A., & Subramaniam, M. In Quantum Computing, Communication, and Simulation IV SPIE.

Link: https://doi.org/10.1117/12.3000586

[2024]

Joint encryption and error correction for secure quantum communication Secure quantum networks are a bedrock requirement for developing a future quantum internet. However, quantum channels are susceptible to channel noise that introduce errors in the transmitted data. The traditional approach to providing error correction typically encapsulates the message in an error correction code after encryption. Such separate processes incur overhead that must be avoided when possible. We, consequently, provide a single integrated process that allows for encryption as well as error correction. This is a first attempt to do so for secure quantum communication and combines the Calderbank-Shor-Steane (CSS) code with the three-stage secure quantum communication protocol. Lastly, it allows for arbitrary qubits to be transmitted from sender to receiver making the proposed protocol general purpose.

Jha, N., Parakh, A., & Subramaniam, M. (2024). Scientific Reports, 14(1), 24542.

Link: https://www.nature.com/articles/s41598-024-75212-8

CONFERENCES AND SEMINARS

[27/01/2024 – 01/02/2024] The Moscone Centre, San Francisco

SPIE Photonics West 2024 I presented my work titled *"Effects of noise and topologies on multi photon quantum protocols"* in the Quantum West 2024 Conference which comes under SPIE. Photonics West 2024.

Link: https://spie.org/conferences-and-exhibitions/photonics-west/attend#_=_

[15/09/2024 – 20/09/2024] Montreal, Quebec, Canada

IEEE Quantum Week 2024 I presented my work proposal on "A ML based approach to a quantum augmented HTTP protocol". The extended abstract is to be appear in the IEEE QCE24.

PROJECTS

[14/09/2023 – 01/01/2024]

Analysing Multi-photon Quantum-Protocols In this project, I simulated several Quantum Key Distribution (QKD) protocols such as three-stage, decoy-state, etc., over different topologies. I also implemented the multiphoton aspect of these protocols to estimate the change in performance for different network topologies.

[15/01/2024 – 14/05/2024]

Integrating Three-Stage QKD Protocol with Calderbank-Shor-Steane (CSS) Error Correction Code This is a theoretical study that aims to integrate the CSS code with the three-stage QKD protocol to increase the overall efficiency and security of the protocol under the presence of several quantum noises. This work was done towards my PhD Depth examination.

[01/2022 – 05/2022]

The Dynamics of a Chaotic Pendulum The project was done to explore the dynamics of a simple pendulum, and find the regimes of chaos by varying a particular parameter. The parameter that was varied for us was the amplitude of the driving force. The regions of chaos were identified using Bifurcation plots, and Poincaré sections. Further, the project also explored the presence of chaos as indicated by the Lyapunov exponent.

Link: https://github.com/ninjha252/Damped-Driven-Pendulum