Kundan Surse

Doctoral Researcher in Spin Quantum Computing

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Education

University Of New South Wales, Sydney — Feb 2025 – Present
Doctoral Researcher in Quantum Computing

Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram — July 2018 – Jun 2022
Bachelor of Technology in **Electronics and Communication Engineering** with specialization in **Avionics**, Major in **RF and Microwave Technology**. **CGPA** - 8.76/10

Sant Gadge Baba Amravati University, Maharashtra, India. — July 2016 – Jun 2018
Higher Secondary School (Electronics) **Percentage** - 85%

Deepchand Chaudhari Highschool, Maharashtra, India. — May 2016
Secondary School **Percentage** - 94%

Research Interest

Semiconductor Spin Qubits, Quantum Communication, Qubit-Quantum Network Interface, Active RF and Microwave Circuits, RFIC Technology.

Current Project

Engineering Spin-Photon Coupling in Semiconductor Spin Qubits Platform — Feb 2025 – Present
Prof. Rajib Rahman, UNSW Sydney

- Addressing challenges in **semiconductor spin qubits** to enhance spin-photon coupling mechanisms for scalable quantum information processing.
- Leveraging the strengths of spin qubits — **compatibility with CMOS technology** and **long coherence times** — while overcoming difficulties in interfacing with photonic modes.
- Developing and optimizing **spin-photon interfaces** using Electric Dipole Spin Resonance (EDSR) and Cavity Quantum Electrodynamics (cQED).
- Tackling key limitations such as **decoherence, coupling efficiency, and device scalability**.
- Aiming to advance **hybrid quantum systems**, where solid-state qubits are seamlessly networked via photonic channels for quantum communication and distributed quantum computing.

Work Experience

Indian Space Research Organization (ISRO) — Nov 2022 – Jan 2025
Scientist-SC at Space Application Center (SAC-ISRO), Ahmedabad.

- Contributed to the Indian Data Relay Satellite System (IDRSS) importation component in Indian Human Spaceflight program, focusing on design and testing of RF amplifiers, mixers, LNAs, and frequency multipliers for satellite communication systems.
- Played a key role in the Quantum Communication Satellite project, working on electro-optic control schemes and active quenching circuits for single-photon detection, enabling satellite-based quantum key distribution (QKD).
- Actively involved in the Technology Demonstration Project of Receive Active Beamforming RFIC at Ka Q-band for LEO Communications Satellite, developing LNAs, digital phase shifters, attenuators, and robust RFIC architectures in 130 nm CMOS technology.

Research Experience

Development of Electro-Optic Control for Miniaturised Satellite QKD Transmitter Aug 2023
Abhishek Khanna, Space Application Center (ISRO), Ahmedabad

- Worked on the development of a **Satellite-based Decoy enabled Quantum Key Distribution Transmitter**. To eliminate the use of eight lasers for generating four signal polarization states and four decoy polarization states, I incorporated the Mach-Zehnder Intensity Modulator (MZM) and Polarization Modulator (PM) scheme for the BB84 protocol.
- By incorporating decoy levels, the Photon Number Splitting (PNS) attack was eliminated, and with single laser operation, laser profile distinguishability was also avoided.
- Carried out system-level simulations in Optisystem Software and MATLAB, and validated results on an experimental setup using the IMC-1550-20-PM MZM device, including a study of its nonlinear operating points for bias stabilization.

Active Quenching Circuit for Avalanche Photo-Diode to Detect Single Photons for QKD Experiment
Prof. R. P. Singh, Physical Research Laboratory, Ahmedabad

- Contributed to the development of a high-frequency active quenching circuit to increase the key rate in QKD experiments. It was designed to detect 100 MHz single-photon signals with high accuracy.
- Addressed challenges of high-voltage/high-frequency transistor operation and parasitic effects that limited performance at 100 MHz.
- Targeted the design with GaN transistors and optimized the circuit to achieve stable operation.

Receive Active Beamforming RFIC at Ka & Q-band for LEO Communications Satellite Jan 2023
Space Application Center (ISRO), Ahmedabad

- Contributed to the Technology Demonstration Project of an 8-channel Receive Active Beamforming RFIC at Ka & Q-band for LEO communication satellites, which integrated LNAs, digital phase shifters, digital attenuators, and power dividers in a 130 nm SBC13s4 foundry process (TowerJazz).
- Investigated robust architectures of digital phase shifters, LNAs, and digital attenuators to meet radiation-hardened and fault-tolerant design requirements.
- Implemented and tested serial-to-parallel (SIPO) digital logic circuits to operate 8 channels of 6-bit digital phase shifters and 6-bit digital attenuators.

Development of Third harmonic feedback enabled T/R module for far field WPT application Jun 2022
Dr. Chinmoy Saha, IIST Thiruvananthapuram.

- This is the Bachelors thesis spanned over 1 year resulting in a significant thesis of about 72 pages which has been awrded the S grade (10/10) Highest attainable grade.
- In this project I designed the T/R module architecture for feedback enabled far-field wireless power transfer at 2.4 GHz to demonstrate the capabilities of 28GHz. Here, the T/R module transmit the power at 2.45 GHz and receives the feedback power at 7.35 GHz for direction estimation and precise alignment between the T/R module and the power seeking node (PSN).
- Third harmonic feedback enabled tracking is investigated for tracking the PSN and beam alignment to eliminate alignment loss and to increase overall efficiency. It can also be adopted in a moving receiver as well as multi-receiver environment.
- This T/R module architecture incorporates digital phase shifter and power amplifier in transit path at 2.45 GHz and gain block, digital attenuator, analog phase shifter along with RF power detector in receive path at 7.35 GHz. System level simulation is performed in SystemVue software and T/R module is designed in Advanced Design Software (ADS) by Keysight.

Dual-Band Shared Aperture Antenna (SAA) Array for Feedback-Enabled WPT Application Jun 2022
Dr. Chinmoy Saha, IIST Thiruvananthapuram.

- Designed a novel dual-band shared aperture antenna (SAA) array radiating at 2.45 GHz and 7.35 GHz in CST Microwave Studio. In order to make a compact design with low mutual coupling, a shared aperture antenna (SAA) configuration is employed. For miniaturising the antenna structure a patch radiating at 7.35 GHz is placed inside the loop antenna radiating at 2.45 GHz.

- This antenna array exhibits gains of 8.832 and 15.58 dBi at 2.45 GHz and 7.35 GHz respectively with efficiencies of −2.312 dB and −1.131 dB. Both the loop and patch array are fed by coaxial feed for the ease of integration with back-end electronics.

Academic Achievement

2022 IEEE AP-S Undergraduate Summer Research Scholarship May 2022
Dr. Chinmoy Saha, IIST Thiruvananthapuram.

- 2022 IEEE Antennas and Propagation Society's Summer Research Scholarship is awarded for the project proposal "T/R Module Development for Far Field Wireless Power Transfer at 28 GHz" by IEEE Antennas and Propagation Society.
- The highly competitive international recognition carries a scholarship of 3000 USD and invitation to present the work in 2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting held in Portland, OR, USA in July, 2023.
- This project aims to deliver power efficiently to the power seeking node (PSN) with eliminating pointing loss using third harmonic receiver tracking system. The novel idea of efficiently using third harmonic receiver tracking technology for far filed wireless power transfer made the recipient of this recognition.

Department of Space (DoS Govt. of India) Assistanceship July 2018 - Jun 2022
IIST Thiruvananthapuram.

- Recipient of Department of Space (DoS Govt. of India) Assistanceship in all the Eight semesters.
- Department of Space, Govt. of India provide assistanceship to the meritorious students of IIST Thiruvananthapuram who maintain GPA above 7.5/10 in all the semester. Which supports all tuition fees with book grants, mess & accommodation charges.

IEEE APS and MTTS Kerala Chapter Best Thesis Award 2022 Dec 2022
Dr. Chinmoy Saha, IIST Thiruvananthapuram.

- This Award is awarded by the by IEEE APS and MTTS conference held in Thiruvananthapuram, India to the Btech thesis titled Design and development of T/R module for far field wireless power transfer.

SAMADHAN 2020 - MHRD mega online Challenge March 2020
Dr. Immanuel Raja, IIST Thiruvananthapuram.

- For LiFi-enabled ECG front-end project, shortlisted in top 15 teams from Educators and researcher Group allover India on Track-2 for MHRD mega online Challenge SAMADHAN 2020.
- This was a team project, in which I developed the ECG front-end to efficiently acquire ECG signal with minimum distortions.

Joint Entrance Examination (JEE Advance) May 2018

- Ranked 4525^{th} nationwide amongst 10 lakh students in Joint Entrance Examination for IITs.

INSPIRE Scholarship April 2018

- Innovation in Science Pursuit for Inspired Research - Scholarship for Higher Education (INSPIRE-SHE) is awarded to the student who stands in top 1 % of Higher Secondary School Board Examination. Which valued at Rs. 80,000 per year for five years.
- I stand in top 1 % in Higher Secondary Examination, which made me eligible for this scholarship.

Publications

Conference Paper :

Design of T/R module for far field WPT application with third harmonic receiver tracking system 2023
Kundan Surse, Gopika R., Chinmoy Saha, Yahia M M Antar.
The article got published in 2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (USNC-URSI), Portland, OR, USA.

Third Harmonic Receiver Tracking for Far Field Wireless Power Transfer Feb 2023

Kundan Surse, Rutuj Gharate Gopika R., Chinmoy Saha.

The article got published in 2022 IEEE 19th India Council International Conference (INDICON), Kochi, India.

Dual-Band Shared Aperture Antenna (SAA) Array for Feedback-Enabled WPT Application Feb 2023

Kundan Surse, Gopika R., Chinmoy Saha.

The article got published in 2022 IEEE Microwaves, Antennas, and Propagation Conference (MAPCON), Banglore, India.

Workshops & Conferences

INSQT Workshop 4 : The International Network in Space Quantum Technologies March 2024

Physical Research Laboratory, Ahmedabad, India.

IITP : ISRO Induction Training Programme July 2023

Space Application Center(SAC) Ahmedabad & Satish Dhawan Space Center (SDSC-Shar) Shriharikota.

IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting.

Portland, OR, USA

INDICON 2022 : IEEE 19th India Council International Conference Nov 2022

Kochi, India.

MAPCON 2022 : EEE Microwaves, Antennas, and Propagation Conference Dec 2022

Bangalore, India.

Academic Course Projects

Scene Text Recognition.

As a project of Machine learning course, implemented the SCENE text recognition pipeline from scratch on Jupyter notebook, And trained the model on different data set on NVIDIA Ge-Force 940MX.

Electroencephalography Front End

As a third sem analog electronics project first simulated the 6th order Chebyshev low pass filters with notch filter on NI-Multisim, and then implemented on the breedboard.

Photo Stylization Using WCT in Deep Learning.

Tried to implement the papers on the Photo- WCT for photo stylization using deep learning with the help of pretrained VGG model.

Adaptive Echo Cancellation

Developed the code for the LMS filter for adaptive echo cancellation, as a Digital Signal Processing lab project and demonstrated the results with audio files.

Snake Game Using Verilog and Analog TV

Using Xilinx software developed the verilog code for the snake game with the understanding of Analog TV display.

Designed and Successfully Tested RC Plane

As a hobby Designed the RC plane with poly-carbonate sheet, with the Fly-sky FS-CT6B Manuel controller, and learned the skills to fly an UAV.

Skills and Experience

Software	Cadence virtuoso, Keysight ADS, CST Microwave Studio, KiCAD Matlab, LT-Spice, Optisystem, Auto-CAD.
Hardware/Equipment	Vector Network Analyzer (VNA), Power Meter, Spectrum Analyser, Signal Generator, Arbitrary waveform Generator(AWG), Digital Storage Oscilloscope(DSO).
Programming Languages	Matlab, Python, C/C++, TensorFlow.

Extracurricular

Sports	Swimming, Badminton.
Music	Sitar(Indian Classical musical instrument).