GOVERNMENT OF
KARNATAKA
Department of
Science & Technology

Quantum India
Bengaluru

31 JULY & 1 AUGUST • 2025 • HOTEL HILTON

EXHIBITORS DIRECTORY & POSTER DOCUMENT

ORGANISERS

KSTePS

IQTI

www.quantumindiabengaluru.com

Karnataka Science and Technology Promotion Society (KSTePS)

KSTePS - Karnataka Science and Technology Promotion Society is a registered autonomous organization established in 2013 under the Department of Information Technology, Biotechnology and Science & Technology (DST), Govt. of Karnataka. KSTePS aims at serving as a mechanism in supporting the preparation and implementation of policy initiatives of Department of Science and Technology and act as a nodal agency in channelizing the funding and in coordinating programs of the Department across the State.

KSTePS is Chaired by Secretary to Govt., Department of Electronics, Information Technology, Biotechnology and Science & Technology with members drawn from various line Departments. Director, Dept. of Science and Technology is the Member Secretary and Managing Director.

Objectives

- **To serve as a mechanism to support the Department of Science and Technology in the preparation and implementation of its policy initiatives.**
- **To act as a nodal agency or channelizing funding for programs and for coordination between various implementing agencies.**
- **To identify priority areas of science and technology, which are useful for long term development of the State, so as to develop core competency in such areas.**
- **To coordinate and liaise with organizations of the Government of India in working out collaborative and joint programs/ventures in the field of science and technology.**
- **To act as a facilitator and liaise with all concerned in establishment of science city, science centres and other types of scientific establishments across the State.**

One of the important programs of KSTePS is the organization of ***Quantum India Bengaluru*** Event as it is the next big technological surge impacting wide spectrum of Industry in the coming years. The aim of this event is to create a congenial ecosystem for the growth of this sunrise industry similar to the growth witnessed in Information Technology and Biotechnology sectors.

QIB will showcase the latest in quantum science and technologies and promote collaboration and synergy among the professionals (academics, industry, and entrepreneurs) working in India and abroad. With an ambitious goal to create a Quantum research & business ecosystem, our vision is to build **Bengaluru as the 'quantum city'** of the future**. It is important that QIB is being launched in 2025 - The International Year for Quantum.**

The first edition of *Quantum India Bengaluru* Event will be held during **July 31st - August 1st 2025** at Hotel Hilton, Manyata Embassy Business Park, Bengaluru. with the focused theme of "Building a Quantum Ecosystem: Qubits to Society"**.** The biennial event is organized in association with Indian Institute of Science (IISc) Quantum Technology Initiative (IQTI) with support from the National Quantum Mission.

Contact

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Since inception in 1989, we are serving the Photonics fraternity in India bringing best products and services in Indian market from all over the world.At Advanced Photonics we work very hard to bring products and services related to this field. We are the only company which has complete offering light source, optics and optical hardware and optical detection system. We are a team of very well qualified and highly motivated technical people. Apart from sales and service business, we are also evolving as a major system integrator in the niche photonics technology. Please be assured that if you can think of problem which will involve photonics solution in most likelihood we will be the one who will be able to supply you the products

AIMIL LTD.

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Aimil Ltd. is a leading ISO: 9001 (2015) certified company, with an All-India network of 15 offices, staffed and managed by over 900+ professionals with rich and varied experience in the instrumentation industry. The Company offers a range of Optical Sensors, Optical Fiber & Sensing, Laser etc.

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Applied Materials, Inc. (Nasdaq: AMAT) is the leader in materials engineering solutions that are at the foundation of virtually every new semiconductor and advanced display in the world. The technology we create is essential to advancing AI and accelerating the commercialization of next-generation chips. At Applied, we push the boundaries of science and engineering to deliver material innovation that changes the world.

AQMATICS

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Global AI & quantum solutions company offering PQC solutions and quantum algorithm solutions to enterprises in diverse domain areas like chemistry, finance, bio, space, logistics. AQMATiCS Academy trains corporates, unis, govts.

ASHAQS SYSTEMS PRIVATE LIMITED

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Profile :

Dirac Labs is a deep-tech startup focusing on quantum-based positioning, navigation, and sensing. Pioneering next-generation, GPS-alternative navigation by harnessing Earth's magnetic field signatures, they have gained institutional backing and grant funding in resilient navigation technologies.

ATOS INSTRUMENTS MARKETING SERVICES

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Scientific Instruments Sales and Marketing. ATOS Instruments Marketing Services, an instrumentation products and solutions provider, has over the years built a strong understanding of the instrumentation needs of the scientific and industrial community in India.

BOSONQ PSI

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BQP's quantum-inspired platform, BQPhy®, revolutionizes complex simulations in aerospace, space, and defense, achieving 10X performance over current GPUs accelerating innovation, cutting costs and development times with future-ready quantum solutions.

CENTRE FOR NANO SCIENCE & ENGINEERING

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CeNSE (Centre for Nano Science & Engineering) is an interdisciplinary research center focused on nano science, engineering, and research. It offers cutting-edge facilities and expertise in nanoelectronics, MEMS/NEMS, and materials science. And INCeNSE is the incubator @CeNSE to foster this tech.

D Y PATIL INTERNATIONAL UNIVERSITY, AKURDI, PUNE

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D Y Patil International University (DYPIU), Pune, is a UGC-recognized, future-ready institution focused on innovation, research, and industry-aligned education. The university offers cutting-edge programs across engineering, management, arts, design and media, fostering interdisciplinary learning and global exposure. With a strong emphasis on research, emerging technologies, and practical skills, DYPIU prepares students to lead in a tech-driven world. Quantum Computing is introduced in the B.Tech CSE curriculum, enabling students to gain foundational and advanced insights into next-gen computing technologies. Our students are researching in “Quantum Computing: Unveiling the Performance of the HHL Algorithm Using Quantum Correlations"

DIAMOND ELEMENTS PVT. LTD.

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Profile :

Diamond Element (DE) is keenly working on the production of indigenous quantum, optical, electronic, & semiconductor diamond materials. DE has expertise in the development and production of single NV to high-density NV diamond substrates for Quantum Computation & Quantum Sensor applications.

HANRON SPACE PVT. LTD.

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Hanron Space is a deep-tech startup incubated at IIT Gandhinagar, focused on developing indigenous RF and quantum sensing solutions. Our goal is to strengthen India's self-reliance in advanced electronics by building high-performance systems locally. Designed, Engineered and Made in India.

INDROBO TECHNOLOGIES LLP

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Profile :

INDRobo Technologies, based in Pune, India, partners with government bodies and research institutions to deliver high-quality scientific equipment, software, and components. With a strong focus on Quantum Computing, we provide a wide range of products essential for R&D.

KEYSIGHT TECHNOLOGIES

KEYSIGHT

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Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best Quantum Technologies. Keysight accelerates innovation with intelligent insights that reduce risk and speed time-to-market.

KWANTUMG RESEARCH LABS PRIVATE LIMITED

KwantumG Research Labs Pvt Ltd Curious Genius

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Profile :

A Quantum R&D Lab focusing on Quantum Machine Learning, Quantum Optimization and Quantum Inspired Solutions. We support in workforce enablement and faculty development with our Training and Consultancy.

NATIONAL QUANTUM MISSION

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New Age Instruments and Materials Pvt. Ltd. is involved in the trading and manufacturing of scientific and analytical instruments. The company was established in 2003, and since then, we have delivered various instruments and application solutions to different research organisations.

OXFORD INSTRUMENTS INDIA PVT. LTD.

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At Oxford Instruments NanoScience we design, supply and support market-leading research tools that enable quantum technologies, nanotechnology research, advanced materials and nanodevice development in the physical sciences.

QOSMIC

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QOSMIC is building the space based optical communication infrastructure to facilitate optical and quantum communication through free space optical links, enabling ultra-high data throughputs and secure communication channels.

QPIAI INDIA PRIVATE LIMITED

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Profile :

QpiAI is a Bangalore-based deep-tech startup pioneering the convergence of Artificial Intelligence and Quantum Computing to solve some of the world's most complex industrial and scientific challenges. Recognized under India's National Quantum Mission and with global centers in Finland and USA.

QUAN2D TECHNOLOGIES PRIVATE LIMITED

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Deep-tech startup advancing quantum sensing with superconducting nanowire single-photon detectors (SNSPDs), targeting ultra-sensitive, scalable solutions for quantum communication, imaging, and precision measurement applications.

QUANFLUENCE PRIVATE LIMITED

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Founded 2021, Quanfluence is a quantum computing startup based in Bangalore and Pune. We are building a CV photonic-based quantum computer and as of today, have a coherent Ising machine. Powered by quantum scientists and engineers, we deliver practical quantum solutions

QUANTEK SYSTEMS (A DIVISION OF SPECTEK INSTRUMENTS PVT. LTD.)

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Quantek Systems (a division of Spectek Instruments Pvt Ltd) provides reliable and robust solutions in the field of Quantum Technology and low temperature physics. We partner with some of the leading companies from Europe and USA to deliver consultative and application based scientific solutions.

QUANTROLOX

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Profile :

QuantrolOx is the provider of Quantum EDGE software that has set a new industry benchmark achieving fully automated quantum processing unit (QPU) characterization and tune-up, creating a 2-qubit gate in under 25 minutes. QuantrolOx is the only quantum software company thoroughly testing its software on a uniquely configured quantum computer 24/7, ensuring seamless "out-of-the-box" compatibility with 70% of the world's solid-state quantum computers. Quantum EDGE integrates easily with workflows in academia, research organizations, and industry, supporting open-architecture principles for compatibility with major quantum hardware providers.

QUANTUM AI GLOBAL

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Quantum AI Global builds advanced quantum hardware/software to solve today's challenges. We focus on quantum communication (incl. quantum repeaters), post-quantum cryptography, AI-integrated quantum technologies and quantum sensors for healthcare.

QUANTUM BIOSCIENCES

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Profile :

Quantum Biosciences is working on a predictive Quantum Sensing Platform using NV-centers in nanodiamonds to provide a real-time, non-invasive window into cellular health by detecting the earliest markers of treatment-induced stress.

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Quantum Design India provides sales and service support for products from Quantum Design Inc. and for partner products. Quantum Design Inc. located in San Diego, USA develops and manufacture automated temperature and magnetic field-testing platforms for material characterization.

QUANTUM MACHINES

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Quantum Machines delivers advanced quantum control solutions, accelerating quantum computing via its Hybrid Control approach. Integrating quantum and classical operations, it enhances performance and flexibility. QM supports any quantum processor, enabling scalable and groundbreaking innovation.

QUANTUM OPTICS AND INFORMATION PROCESSING LAB, IISC, BENGALURU

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Quantum Optics and Quantum Information Processing Laboratory at IISc is working in the area of quantum information and Photonic Quantum Computing. The display is a two-qubit photonic system which can generate entanglement secured quantum random number generation for cyber security application.

QUANTUM RESEARCH PARK (QURP)

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Quantum Research Park, a Hub for Quantum Computing and related technologies is a project administered by FSID, IISc with support from KITS, GoK. QuRP will encourage scientific inventions & innovations in the field of Quantum Computing and related technologies.

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QuantWare is a leading provider of quantum hardware and creator of the VIO QPU scaling technology, unlocking the fastest path towards systems with more than 1 million qubits. Powering quantum computers in 20+ countries, VIO is available in QPUs designed by QuantWare and via Foundry Services.

RIGETTI

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Rigetti is a pioneer in full-stack quantum computing. Rigetti has operated quantum computers over the cloud since 2017 through its Rigetti Quantum Cloud Services platform and designs and manufactures its chips in-house at Fab-1, the industry's first dedicated quantum device manufacturing facility.

SECURE MACHINES PVT. LTD.

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Secure Machines develops data security products designed to address the emerging Quantum Threat. Combining expertise in applied cryptography, security engineering, and systems engineering, the company focuses on building quantum-safe solutions for critical infrastructures.

SIMCO GLOBAL TECHNOLOGY & SYSTEMS LTD.

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Estd. in 1983, SIMCO Global is the most trusted technology partner providing advanced SCIENTIFIC & INDUSTRIAL solutions in the field of Quantum, Photonics, Metrology, Sensing, Material Science, Semiconductor, etc. Bringing cutting-edge technology from around the world to Indian scientific community.

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Strangeworks is an unconventional computing software company based in Austin, TX. Founded by whurley, Strangeworks is currently making quantum computing accessible by building and delivering tools for software developers and researchers, and systems management for IT Administrators and CIOs.

TAQBIT LABS PVT LTD

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TAQBIT Labs - an award winning deep-tech company, that offers quantum-based security products and solutions to organizations, government agencies, and defense establishments that help secure their digital assets and communication channels against 'quantum hacking' and 'harvesting attacks.' We enable companies and organizations in mitigating this risk based on 'Quantum Encryption' Technology. This cutting-edge technology aids in preparing organizations for the post-quantum digital era. We provide hardware and software products/solutions to enhance digital security based on quantum physics which is immune to any kind of computing and harvesting attacks. Key Products: QKD, QRNG, Post Quantum Cryptography.

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VT Vacuum Technologies was established in 2002 as a reliable supplier of Vacuum and cryogenic equipment and components imported from established overseas companies, within India.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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Visvesvaraya Technological University (VTU), is a public state university in Belagavi, Karnataka established by the Government of Karnataka. It is one of the largest Technological Universities in India with 26 years of Tradition of excellence in Engineering & Technical Education, Research and Innovations. It came into existence in the year 1998 to cater the needs of Indian industries for trained technical manpower with practical experience and sound theoretical knowledge. The university is named after Sir M. Visvesvaraya, an Indian civil engineer, statesman and the 19th Diwan of Mysore. It has more than 200+ affiliated Institutions. More than 4 Lakhs students are pursuing there degree in this university.

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POSTER DOCUMENT

Poster Index

Temperature-Dependent Spectral Diffusion And Coherent Dynamics In Quantum Emitters: A Simulation-Based Study

Abstract: This project investigates the temperature-dependent coherence properties of a resonantly driven two-level quantum emitter in a solid-state environment, inspired by recent experimental studies on defect centers in hexagonal boron nitride (hBN). We simulate the frequency fluctuations of the emitter using a hybrid model combining Ornstein-Uhlenbeck (OU) processes and Gaussian random spectral jumps, capturing both continuous and discrete spectral diffusion effects. The simulations analyze excited-state dynamics and second-order correlation functions g (2)(τ), revealing clear temperature-induced decoherence trends. We observe that the simulated linewidth (FWHM) scales with T 3 , in agreement with experimental findings, and that the coherence degrades as spectral diffusion increases. Our results show a near-linear dependence of FWHM on the diffusion strength σ for τSD > 0.001, highlighting the central role of diffusion in decoherence. Moreover, we find the FWHM to be more sensitive to jump rates than to jump standard deviations, underscoring the importance of the rate of environmental perturbations over their individual magnitudes. The second-order correlation plots demonstrate a gradual suppression of Rabi oscillations with temperature, matching the experimentally observed transition from underdamped to overdamped regimes around 30 K. These trends are consistent with recent studies emphasizing the impact of fast spectral diffusion and phonon coupling on coherent control in hBN emitters. Overall, this simulationbased framework provides a reliable tool to probe decoherence mechanisms and validate experimental observations in emerging quantum photonic systems.

POS-01

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Machine Learning With Quantum Data Using Experimental Quantum Kernels On Nmr

Abstract: Kernel methods map data of nonlinear functions onto linear functions in higherdimensional spaces, thus enabling efficient learning and predictions without explicit storage of individual feature vectors. Quantum kernel methods promise efficient machine learning by encoding feature maps onto exponentially large Hilbert spaces inherent in quantum systems. In this work, we implement quantum kernels on a 10- qubit star-topology register in a nuclear magnetic resonance (NMR) platform. We experimentally encode classical data in the evolution of multiple quantum coherence orders using data-dependent unitary transformations and then demonstrate onedimensional regression and two-dimensional classification tasks. By extending the register to a double-layered star configuration, we propose an extended quantum kernel to handle non-parametrized operator inputs. Specifically, we set up a kernel for the classification of entangling and non-entangling operations and validate this kernel first numerically by computing it on a double-layered star register and then experimentally by computing it on a three-qubit NMR register. Our results show that quantum kernels exhibit an ability to capture the inherent structure of quantum space and thereby to generalize well beyond the training domain. This confirms the superiority of quantum kernels over other classical methods in processing quantum data.

POS-02

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Qupepfold: A Python Package For Hybrid Quantum-Classical Protein Folding Simulations With Cvar-Optimized Vqe

Abstract: Peptide folding is a complex process crucial for understanding protein structure and function. Traditional methods for predicting peptide folding involve molecular dynamics simulations. Quantum algorithms like the CVaR-VQE offer a promising approach to optimize energy states. Structural alphabet analysis provides insights into the conformational space of peptides. This study aims to leverage quantum computing to enhance peptide folding predictions. QuPepFold is a python package developed which enables a classical quantum approach to run simulations over HPC and GPU based servers.

POS-03

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Interface Engineering For Minimizing Trapped Charge Density In B-Ga_2O_3 Schottky Barrier Diodes For High-Performance Power Devices

Abstract: Gallium oxide (Ga2O3), with its ultra-wide bandgap and high breakdown voltage, has emerged as a leading candidate for next-generation power devices. The performance and the Baliga figure-of-merit for power devices critically depend on breakdown voltage sustained by Schottky contact of metal with ultra-wide gap materials. However, high-quality Schottky contacts with Ga2O3 presents a significant challenge due to the presence of surface defects and formation of metal induced mid-gap defects states in Ga2O3. In this study, we investigate the electrical properties and defects at the interface between Ni metal and β-Ga_2O_3 thin films. Additionally, a 20 nm MgO thin films with various oxygen contents were deposited on βGa2O3 using radio-frequency magnetron sputtering and Ni/MgO/ β-Ga2O3 metal-insulatorsemiconductor Schottky diodes were fabricated. The frequency dependent C-V characteristic and surface-sensitive XPS depth profile is employed to study the interface of Ni/Ga2O3 and Ni/MgO/Ga2O3 Schottky barrier diodes. Our results show that the Ni/MgO/Ga_2O_3 Schottky barrier diode with 66% O_2 in the MgO thin film during synthesis attains a barrier height of 0.87 eV. Subsequent post-metallization annealing at 300ºC in an Ar ambient for 30 minutes enhances the barrier height up to 1.1 eV. Also, a reduced on-resistance of 11.65 mΩ·cm^2 and a lower on-voltage of 0.3V was obtained after annealing in Ar. The frequency dependent CV characteristic results show no dispersion in capacitance for the annealed sample which signify the passivation of interface defects density and oxide charges density (Nf) in the dielectric layer (MgO).

POS-04

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Key Reconciliation Protocol For Quantum Key Distribution

Abstract: In quantum cryptography, secret communications are delivered through a quantum channel. One of the most important breakthroughs in quantum cryptography has been the quantum key distribution (QKD). This process enables two distant parties to share secure communications based on physical laws. However, eavesdroppers can still interrupt the communication. To overcome this, we propose a different way to detect the presence of Eve through the polynomial interpolation technique. This technique also allows us for key verification. This approach prevents the receiver as well as the intruder from discovering the sender's fundamental basis. To fully utilize IBM quantum computers' quantum computing capabilities, this paper attempts to show % error against alpha (strength of eavesdropping) and the impact of noise on the success probability of the desired key bits. Furthermore, the success probability under depolarizing noise is explained for different qubit counts. In the enhanced QKD protocol, using polynomial interpolation for reconciliation shows a 50% probability of successful key generation. This is even when the noise is increased to the maximum capacity.

POS-05

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Hybrid Cnn-Bilstm Framework With Quantum Attention For Underwater Acoustic Signal Classification

Abstract: Underwater acoustic signal classification is essential for maritime surveillance, naval operations, and underwater target identification. However, the task is challenging due to environmental noise, variability in acoustic signals, and limited labeled data. Existing deep learning models are often complex and computationally intensive, limiting their practicality in real-world underwater scenarios. In this work, we propose a lightweight and efficient hybrid model that integrates Convolutional Neural Networks (CNN), Bidirectional Long Short-Term Memory (BiLSTM) networks, and a Quantum Attention mechanism for robust ship classification. Time-frequency features are extracted using Mel-spectrogram, Constant-Q Transform (CQT), and Gammatonegram, and combined to form a 3-channel image. This image is passed through a CNN for spatial feature extraction, followed by Max Pooling, BiLSTM layers for temporal modeling, and a final quantum attention module to enhance discriminative focus. Our model achieves a classification accuracy of 98%, outperforming the previous state-of-the-art method (97%), while requiring fewer trainable parameters. To the best of our knowledge, this is the first application of Quantum Machine Learning (QML) to underwater acoustic signal classification, demonstrating its potential for high-performance, resource-efficient acoustic sensing in complex underwater environments.

POS-06

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Generation Of Correlated Quantum Random Number Sequences With Bright Twin Beams

Abstract: We demonstrate a simple and effective method for generation of a pair of correlated quantum random number sequences. Here, we have used bright twin beams produced via four-wave mixing in a double-Λ configuration in rubidium-85 vapor. The inherent quantum noise in the intensity fluctuations of the beams serves as the source of randomness, while their strong quantum correlations enable the generation of identical random bitstreams. At an analysis frequency of 2 MHz, we have measured 95% correlation between the random intensity fluctuations of the twin beams. Our system yields more than 5 bits of entropy per sample, and through post-selection and hashing, we extract identical binary random sequences at a rate of 6 Mbps. These sequences successfully pass rigorous statistical benchmarks, including the NIST and TestU01 suites. This approach offers a practical and robust platform for secure quantum communication and cryptography applications.

POS-07

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Development Of A Trapped-Ion Based Quantum Computing Platform

Abstract: We aim to develop a 20-qubit quantum computing platform based on trapped calcium ions by the end of 2026. Trapped ions provide one of the best platforms for developing a quantum computer because of the long coherence times of the qubit states and the highest quantum gate fidelities compared to all the existing platforms so far. These properties significantly improve the qubit performance, making the ion trap platform ideal for implementing quantum algorithms and performing quantum simulations in chemistry, materials science, and biology. We have designed and fabricated the individual components using in-house facilities and assembled a fully functional ion trap set-up that is capable of trapping more than 10 ions. We have implemented the Doppler laser cooling scheme on the ions and achieved Coulomb crystals. Further, we have confirmed that the qubit laser induces transitions between the two qubit levels by observing quantum jumps signals. Finally, we have done measurements of the internal state of ions. Therefore, our system satisfies the essential criteria required for quantum computing, and this is a key milestone in our experiment. This sets the stage for performing basic gate operations like single-qubit rotations and multi-qubit entanglement, using laser pulses, as our next step. Further improvements in the current architecture, like the trap design and the imaging system, would enable trapping and imaging of the desired number of ions for implementing complex quantum circuits.

POS-08

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Deterministic Noise Reduction In Si/Sige Gated Quantum Dot Using Active Noise Cancellation

Abstract: Quantum devices based on gate-defined semiconductor nanostructures offer a tunable and scalable platform for both fundamental research and emerging quantum technologies. However, their sensitivity to the local electrostatic environment makes them highly susceptible to low-frequency noise, originating from powerline interference, instrument clocks, or ambient vibrations, which is difficult to filter using conventional techniques. In this work, we introduce a generalized active noise cancellation scheme tailored for quantum dot systems, aimed specifically at suppressing deterministic low-frequency noise components. Our approach involves injecting an anti-noise signal through the source terminal to destructively interfere with the dominant noise at the device level. Unlike passive filtering, which often fails at low frequencies due to system lag and prolonged stabilization times, our method enables real-time cancellation using automated phase and amplitude tuning. We demonstrate this technique on a gate-defined quantum dot formed in a doped Si/SiGe heterostructure, significantly reducing the impact of 50 Hz powerline interference and its harmonics. Experimental validation through measurements of Coulomb blockade oscillations (CBOs) and Coulomb diamond structures at 10 mK confirms substantial suppression of electrical noise, especially near the sensitive single-electron tunneling (SET) regime. Total noise power measurements within the 0–1.5 kHz bandwidth show a reduction from 0.02613 V^2 to 0.00221 V^2 when 180° (out-of-phase) anti-noise is applied. The observed noise suppression also implies a reduction in effective electron temperature. This method provides a robust and broadly applicable framework for active noise mitigation in mesoscopic quantum systems, where precision and signal integrity are paramount.

POS-09

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Modelling And Phase Control Of A Coherent Photonic Crossbar For Vector-Matrix Multiplications

Abstract: We present a Mach–Zehnder interferometer (MZI)-based crossbar architecture implemented on a coherent photonic integrated circuit (PIC) platform for high-speed, low-power matrix–vector multiplication (MVM), a key operation in artificial intelligence (AI) workloads. Our design uses a single-wavelength (1565 nm) coherent light source and a network of balanced MZIs with programmable phase shifters to perform multiply–accumulate (MAC) operations. Compared to conventional MZI meshes, which suffer from indirect programmability and scaling challenges due to the non-bijective mapping between matrix elements and phase shifters, our crossbar architecture offers a direct and intuitive programming scheme. Additionally, unlike WDM-based crossbars constrained by the number of available wavelengths, our single-wavelength approach simplifies system complexity while maintaining reconfigurability. We highlight the importance of phase control in coherent systems and demonstrate the working principle of our hardware using a fabricated crossbar. Our architecture replaces static directional couplers with balanced MZIs at each node. This design enables dynamic control over power coupling to the vertical arm, depending on the matrix element value. Consequently, unused optical power continues propagating along the horizontal path, improving overall power efficiency. By aligning power distribution with the sparsity structure of the matrix, our approach supports scalable implementation of high-dimensional MVMs with reduced insertion loss and better energy utilization. This architecture not only serves current AI applications but also establishes a scalable photonic platform—based on coherent light manipulation, linear interference, and precise phase control—that can be directly extended to quantum computing on photonic integrated circuits.

POS-10

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Cryogenic Frequency Comb Generation In Quantum Point Contact Coupled To Rf Tank Circuit

Abstract: Conventional RF components such as generators, mixers, and multipliers rely on nonlinear devices like diodes and transistors, which are typically unsuitable for cryogenic operation due to their power requirements and degraded performance. In contrast, quantum point contacts (QPCs) formed in high-mobility two-dimensional electron gases exhibit nonlinear conductance and quantized conductance steps at low temperatures, operating in the ballistic regime with minimal power dissipation. In this work, we demonstrate that the inherent nonlinearity of QPCs can be exploited for harmonic generation, resulting in a tunable RF frequency comb. We investigate the influence of biasing conditions on comb characteristics such as amplitude, frequency spacing, and the number of generated harmonics. Furthermore, by integrating the QPC with a resonant RF tank circuit, we achieve frequency up-conversion, effectively mixing low-frequency signals with a high-frequency carrier defined by the tank circuit's resonance. These results highlight the potential of QPC-based devices for low-power, cryogenically compatible RF signal generation and processing, offering a promising alternative to conventional room-temperature electronics for highly integrated in-situ quantum information processing.

POS-11

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Quantum Paraelectric Microwave Frequency Combs.

Abstract: A frequency comb is a spectral structure consisting of discrete, evenly spaced spectral lines, often described as an "optical ruler" due to its remarkable precision. They have become essential in fields such as astronomical spectrograph calibration, high-precision metrology, optical atomic clocks, frequency synthesis and spectroscopy. These combs are indispensable across various quantum technologies and essential due to the growing need for free-space quantum communication and circuit-based quantum devices—such as quantum electrical metrology, quantum sensing, and solid-state quantum information processors—which has made the development of microwave frequency combs of paramount importance. Despite their significance, microwave frequency combs remain relatively underexplored compared to their optical counterparts. Current methods mostly rely on complex, high-power optical systems that are incompatible with the low-power, cryogenic on-chip quantum technologies. Additionally, the limited tunability of comb lines also restricts their adaptability for advanced applications. In this experiment, we realise a tunable on-chip micro-comb using a coplanar waveguide resonator on SrTiO3(STO), leveraging its high Pockels coefficient in its quantum paraelectric phase. Our device exploits a superconducting microwave cavity on STO, and the frequency comb is generated as a result of the cavity phase modulation enabled by the linear electro-optic effect present as a result of field-induced effective $\chi(2)$, on STO. The on-chip, all-electrical approach with voltage-tunable comb-lines makes our approach a suitable choice for various applications in quantum technology.

POS-12

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Novel System Architecture For Microwave Excitation In Nvc Magnetometers For Full-Vector Magnetometry With Nt-Sensitivity

Abstract: Diamond Nitrogen Vacancy Center (NVC) based magnetometers that exploit quantum effects have the potential to outperform classical sensors in terms of sensitivity even when operated at room temperature. For applications in space, defence and geophysical exploration, the system complexity needs to be reduced in order to improve the form factor and power consumption, without compromising performance. We propose a novel system architecture for RF front-end in NVC magnetometers that utilizes a single 2.8 GHz band frequency source and a single FPGA controller for realization of full-vector magnetometry. Using independent phase-sensitive detection modules for each of the four NV axes implemented on the FPGA, we demonstrate a continuous wave portable NVC magnetometer with a bandwidth normalized sensitivity of 10 nT/√Hz and linear dynamic range of 200 μT.

POS-13

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Implementation Of Plug-And-Play Bb84 Based On Distributed Phase Reference Qkd With Clock Synchronization Over A 50 Km Fiber Link

Abstract: We present the experimental implementation of a Plug-and-Play BB84 protocol based on distributed phase reference Quantum Key Distribution (QKD), designed to enable secure communication over long fiber links. In our setup, the phase of optical pulses is modulated and reflected back to the sender, allowing for automatic compensation of polarization fluctuations and phase drift in the optical channel. We achieved a Quantum Bit Error Rate (QBER) of 9% over a 50 km optical fiber link. This QBER falls within the secure threshold for QKD and corresponds to a measured Secret Key Rate (SKR) of approximately 5 kbps. To evaluate the protocol's robustness, we systematically investigated the relationship between QBER and transmission distance by varying the fiber length and recording the resulting QBER values. Using these measurements, we derived the corresponding SKR at each length, demonstrating the protocol's feasibility for practical QKD applications over metropolitan-scale distances. A key aspect of our implementation is the integration of High-Accuracy Timing Clock Synchronization (HATI), which ensures precise alignment between the sender and receiver. The synchronization scheme achieved a timing jitter on the order of 200 picoseconds, which is crucial for long-distance QKD systems. Overall, our results validate the performance and scalability of Plug-and-Play BB84 with distributed phase reference encoding, combined with high-precision clock synchronization, as a practical solution for secure quantum communication over extended fiber links.

POS-14

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Round-The-Clock Entanglement-Based Qkd Over Free-Space Link With Passive Polarization Stabilization

Abstract: Quantum Key Distribution (QKD) offers an unconditionally secure communication based on the principles of quantum mechanics. However, practical deployment especially in free-space channels faces significant challenges arising from polarization instability, environmental fluctuations, and high background noise. In this work, we experimentally demonstrate round-the-clock QKD over a 50-meter free-space optical channel using an entanglement-based BBM92 protocol, focusing on robust operation during both day and night conditions. To mitigate polarization scrambling effects due to fibre birefringence and misalignment in reference frames between sender (Alice) and receiver (Bob), we implement a passive polarization correction scheme. This approach eliminates the need for active stabilization, thereby simplifying the setup and making it less resource intensive. Our system further incorporates precise spectral and spatial filtering techniques to reduce background noise critical for maintaining performance under daytime ambient light and dynamic atmospheric conditions. We report consistent quantum bit error rates (QBER) remaining below 11%, which is the information theoretic secure bound for QBER in BBM92 QKD protocol for secure key generation. Moreover, the system produces stable key rates across varying weather and lighting environments, establishing the robustness of our approach. Our work demonstrates the feasibility of continuous, secure, free-space QKD with minimal resource, paving the way towards real-world quantum communication networks particularly in mobile scenarios.

POS-15

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Noise-Driven Thermoelectric Transport On A Gated Quantum Dot

Abstract: Gated quantum dots (QDs) on semiconductor heterostructures are ideal candidate systems to study fundamental mesoscopic transport because of their quantized states and electrostatically tunable properties. In this work, we study the electrical transport through a QD system fabricated on GaAs/AlGaAs heterostructure, in a dilution refrigerator at a base temperature of 10mK. We observe thermally driven electron transport across the QD at zero source-drain bias. The discrete energy spectrum of the QD allows small differences in Fermi distributions between the source and drain reservoirs to be probed. The direction of the obtained current is determined by the chemical potential of the QD, while the magnitude is determined by the tunnel rate across the QD – both of which are tunable by gate voltages. Adding white noise to the hotter reservoir increases the current amplitude, confirming the thermoelectric origin of transport. Excited state signatures are seen in the zero-bias thermoelectric transport of smaller QDs. The temperature difference which can be sustained across the QD is seen to be determined by the effective tunnel rate across the QD. We also demonstrate double-QD (DQD) formation in the system and observe signatures of thermoelectric current at zero-bias at the triple points and along the charging lines, consistent with the energy level alignments in the DQD under thermal bias. Thermoelectric power conversion using quantum dots is a promising route to manage heat distribution within QD devices, allowing parts of the 2D-electron gas to be isolated from external circuits and to be locally cooled further.

POS-16

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Portable Nmr System For Enhanced Sensitivity And Spectral Resolution

Abstract: Low-field portable Nuclear Magnetic Resonance (NMR) has seen growing interest over the past decade for handheld and industrial applications, particularly in the food and petrochemical sectors, as well as for institutional research and field-based studies. Its compact size, lower weight, reduced power requirements, and cost advantages make it an attractive alternative to conventional bulky high-field systems. However, widespread use is hindered by performance challenges—mainly the instability of low-field permanent magnets, which causes signal sensitivity loss and poor spectral resolution. Our research tackles these challenges with a novel NMR probe design approach, integrated with transmitter–receiver hardware. The system supports a wide range of sample nuclei, enabling robust performance for industrial process monitoring, quality control, and complex NMR experiments in institutional research settings. To minimize spectral broadening caused by magnetic field fluctuations—particularly due to temperature variations in real-world environments—we have incorporated a real-time magnetic field fluctuation sensing feature. This field tracking enhances line shape resolution and supports achieving sensitivity levels close to the theoretical maximum. The proposed design significantly enhances the practicality and reliability of portable low-field NMR systems for industrial, institutional, and field applications alike. Looking ahead, this work lays the foundation for developing highly sensitive handheld NMR devices for future applications such as on-site healthcare diagnostics and continuous monitoring, expanding the impact and reach of NMR technology beyond traditional laboratories.

POS-17

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Intraparticle Entanglement In Noisy Quantum Channels: Degradation And Revival Through Amplitude Damping.

Abstract: Quantum correlations between two or more different degrees of freedom of the same particle are sometimes referred to as intraparticle entanglement. In this work, we study these intra-particle correlations between two different degrees of freedom under various decoherence channels, viz. amplitude damping, depolarizing and phase damping channels. We mainly focus on the amplitude damping channel for which we obtain an exact analytical expression for the concurrence of an arbitrary initial pure state. In this channel, we observe the unique feature of entanglement arising from a separable initial state. We also show that this channel allows for a revival of entanglement with increasing damping parameter including from a zero value of the concurrence. We also consider the amplitude damping channel for interparticle entanglement and show that it does not display any of the above-mentioned interesting features. Further, for comparable parameters, the decay of entanglement in the interparticle system is much greater than in the intraparticle system, which we also find to be true for the phase damping and depolarizing channels. Thus, intraparticle entanglement subjected to damping is much more robust than interparticle entanglement.

POS-18

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Robust Valley Splitting In A Si/Sige Strained Quantum Well Heterostructures

Abstract: Silicon-based heterostructures, particularly Si/SiGe, have emerged as strong candidates for spin-based qubit devices because of their longer coherence time and reduced hyperfine interaction compared with III-V GaAs/AlGaAs-based systems. In this study, we investigated the scattering mechanisms and valley splitting energy of a high-mobility, undoped Si/SiGe two-dimensional electron gas. The devices exhibited a peak mobility of $\mu=1.6\times10^{6}\ cm^{2}\ V^{-1}\ s^{-1}$ at $n=7.09\times10^{11}\ cm^{-2}$. At lower carrier densities, remote impurity scattering dominated, whereas at higher carrier densities, background impurity scattering near the quantum well became significant. The spin and valley splitting energies depend on the magnetic field and carrier density and are primarily influenced by the broadening of the density of states due to electron–impurity interactions. Temperature-dependent Shubnikov-de Haas (SdH) measurements revealed thermally activated valley splitting with a characteristic energy of $\Delta_v \sim 100\ \mu eV$ and an effective electron mass of $(0.189\pm0.01)\ m_o$. The electron temperature of $T_e \approx 300mK$ extracted from the current-biasing dependence highlights the role of carrier heating in determining the onset of valley splitting. These findings provide insights into density-driven scattering and its implications for valley coherence in silicon-based quantum devices.

POS-19

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Experimental Realization Of Universal Quantum Gates And Six-Qubit Entangled State Using Photonic Quantum Walk

Abstract: For quantum computation using photons, performing deterministic quantum gate operations is a challenge due to the probabilistic nature of the photon-photon interaction. Encoding qubits in multiple degrees of freedom of photons and controlling operations between them is one of the promising ways to navigate the probabilistic behaviour. Using single-photon discrete-time quantum walk in combination with polarization and path degrees-of-freedom, we experimentally demonstrate the realization of a universal set of quantum gates with high fidelity at room temperature. The deterministic realization of quantum gates through photonic quantum walk are characterized via quantum state tomography. For a three-qubit system using a single photon, the first qubit is encoded using polarization information, and the other two qubits are encoded using path information, closely resembling a Galton-board setup. To generate a six-qubit Greenberger-Horne-Zeilinger state, entangled photon pairs are used to entangle the two three-qubit modules on which gate operations are performed. We also provide insights into the mapping of photonic quantum walk operations to quantum circuits and propose methods to resourcefully scale. This demonstration marks significant progress towards using quantum walks for quantum computing and provides a framework for using fewer photons in combination with different degrees of freedom of photon to scale the number of qubits.

POS-20

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Hybrid Electromechanical Devices Using Heavy Fluxonium

Abstract: Hybrid superconducting–mechanical systems offer new pathways for quantum control and sensing by combining the coherence of superconducting qubits with the long lifetimes of mechanical resonators. In this work, we explore an electromechanical device in which a mechanical resonator is coupled to a heavy fluxonium qubit—a low-frequency (MHz), highly anharmonic superconducting circuit. The coupling between resonator and qubit is achieved via either the flux or charge degree of freedom. Theoretically, we model flux-based coupling and show that, by tuning the external flux, the interaction can be switched between transverse and longitudinal regimes. This tunability gives rise to mode hybridisation, electromagnetically induced transparency-like (EIT-like) features, and sideband cooling under red detuned qubit drives. Experimentally, we designed and fabricated heavy fluxonium qubits in both 3D cavity and 2D planar architectures. Spectroscopy measurements confirm a transition frequency as low as 2.5 MHz at the flux sweet spot, in agreement with our simulations. Looking ahead, we plan to suspend one arm of the heavy fluxonium's superinductor loop and integrate a mechanical element to realise the flux-based coupling. Moreover, for our 2D planar architecture, we aim to do a flip chip assembly and utilise the charge-based coupling. This work lays the groundwork for strongly coupled qubit–mechanical platforms to probe quantum dynamics in the MHz regime.

POS-21

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Accelerated First Detection In Discrete-Time Quantum Walks Using Sharp Restarts

Abstract: Restart is a common strategy observed in nature that accelerates first-passage processes, and has been extensively studied using classical random walks. In the quantum regime, restart in continuous-time quantum walks (CTQWs) has been shown to expedite the quantum hitting times [Phys. Rev. Lett. 130, 050802 (2023)]. Here, we study how restarting monitored discrete-time quantum walks (DTQWs) affects the quantum hitting times. We show that the restarted DTQWs outperform classical random walks in target searches, benefiting from quantum ballistic propagation, a feature shared with their continuous-time counterparts. Moreover, the explicit coin degree of freedom in DTQWs allows them to surpass even CTQWs in target detection without sacrificing any quantum advantage. Additionally, knowledge of the target's parity or position relative to the origin can be leveraged to tailor DTQWs for even faster searches. Our study paves the way for more efficient use of DTQWs in quantum-walk-based search algorithms, simulations, and modeling of quantum transport towards targeted sites in complex quantum networks.

POS-22

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An Fpga-Based Real Time Magnetometry Using Nv-Diamond

Abstract: Magnetometry has a wide range of applications, such as characterizing materials, scanning biological samples as a diagnostic tool, and geomagnetic surveys. Nitrogen-Vacancy (NV) centers are spin-1 color centers in diamonds exhibit exceptional sensitivity to the magnetic field at room temperature, and quick optical readout making them promising quantum sensing platform for performing magnetometry. The working principle of the NV-diamond magnetometer is based on measuring Zeeman splitting of the spin sub-levels. Conventionally, microwave is swept across a range, exciting spin sub-levels on-resonance to obtain the Zeeman splitted ODMR spectrum, which is impractical for real-time magnetometry. We demonstrate lock-in based detection where application of frequency-modulated microwave about initial resonance frequency excites the NV spins sub-levels, producing modulated photoluminescence which is demodulated by a lock-in amplifier. However, the lock-in detection method is real-time and highly sensitive, but the dynamic range is limited to one-tenth of the linewidth of the spectrum, which is impractical. We design an FPGA-based dual-channel PI-controller feedback loop that tracks the resonance frequencies adapting to the fluctuating external magnetic field and sends out analog signals to signal generators that shift the carrier frequencies of the FM microwaves in real-time. With the available FSK in the signal generator, we can choose to increase the dynamic with a real-time response. Dual resonance excitation makes the NV diamond magnetometer temperature robust alongside integrating feedback loop enables us to perform real-time magnetometry over a wide dynamic range preserving the sensitivity.

POS-23

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Quantum Games Under Repeated Noise

Abstract: Quantum game theory extends classical strategic interactions by exploiting quantum phenomena such as superposition and entanglement, offering novel equilibria and potential resolutions to classical dilemmas. However, the practical realization of quantum games is inherently subject to environmental decoherence and noise. In this work, we investigate the impact of repeated noise—modelled as sequential applications of quantum channels such as depolarizing, dephasing, and amplitude damping—on the dynamics and outcomes of quantum games. Using canonical examples like the quantum Prisoner's Dilemma, we analyze how repeated noise degrades quantum resources, alters payoff structures, and affects the stability of quantum Nash equilibria. Our findings show that repeated noise progressively suppresses quantum advantages, eventually reverting game behavior to classical limits. We further explore how non-Markovian noise and memory effects can lead to temporary revivals of quantum features, and we propose strategies to mitigate information loss through error-resilient encoding and adaptive operations. This study offers fundamental insights into the robustness of quantum strategic behavior in realistic, noisy settings, with implications for quantum information processing, decision theory, and multi-agent quantum systems.

POS-24

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Phase Classification And Parametric Forms For Ground State Solutions Of 2×2 Fermi Hubbard Model.

Abstract: Understanding strongly correlated electron systems remains a central challenge in condensed matter physics and quantum simulation. The Fermi-Hubbard model describes essential features of electron correlation, including metal-insulator transitions, magnetism, and charge ordering. Analytical solutions of Fermi-Hubbard models are typically limited to one-dimensional systems or high symmetric cases. Exact diagonalization of small lattices yields valuable insight and provide essential information to construct ansatzes for larger systems to be executed using algorithms like Variational Quantum Eigensolver (VQE). We report the classification of different quantum phases of matter along with the parametric forms of solutions for 2×2 Fermi-Hubbard model, solved through exact diagonalization. We compute the eigenstates up to 10th energy level for fixed hopping amplitude $t = -1$, with on-site interaction U and on-site potential offset V varied from −10 to +10 in steps of 0.1. For each energy level we classify the states according to the occupation subspace they reside within the Hilbert space. The classified states are represented as a phase diagram in the U-V space. This classification reveals distinct structural features of the wavefunctions, associated with different physical phases. To visualize and analyse eigenstates, we employ Q-sphere representations of wavefunction from each category. These visualizations provide geometric intuition about the entanglement, symmetry, and coherence. Although we perform analysis across all energy levels, we restrict our presentation only to ground states for clarity. These results guide the construction of physically motivated ansatzes for larger Fermi-Hubbard systems, which can significantly improve the efficiency of VQE-based quantum simulation of strongly correlated matter.

POS-25

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Interferometric Purcell Design For Small Qubit-Resonator Detunings

Abstract: Computation using quantum hardware requires fast and accurate readout of qubits. Coupling of qubit with the measurement apparatus induces additional channel of decay in the qubit, which is typically mitigated by introducing an extra mode, a Purcell filter resonator. A purcell filter can be configured not only to minimise the qubit decay to the measurement apparatus but also for faster readouts. In the prevailing CQED architecture, the qubit frequency is typically detuned by several GHz from the readout resonator frequency. Here, we employ a new Purcell filtration technique in which, by engineering a three-mode system, we could suppress the Purcell decay rate below 1 kHz at small detunings of only 200 MHz from the readout resonator. Given the small detuning, we further study the 'QNDness' of the readout to better understand measurement induced errors.

POS-26

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Engineering A Hybrid Nanophotonic Cavity Coupled To Color Defects In Diamond

Abstract: Wavelength-scale photonic cavities with high-Q factors and on-chip hybrid cavities offer a path toward scalable quantum technologies using color defects in diamonds. While various photonic crystal cavity designs have been proposed, their complex, multi-step fabrication often limits the experimental Q-factors and results in radiation loss. A promising method to reduce this loss in a 1-D photonic crystal cavity is by introducing a Gaussian defect near the cavity. In this work, we propose a hybrid waveguide-based Gaussian 1-D photonic crystal cavity. This high-Q design, with simulated Q-factors exceeding 10^5, could play a key role in integrating nanophotonic components for chip-scale photonic devices. Along with the optical characterisation of these devices, we have performed strain analysis and modelling of the nanostructures induced by ion implantation and nanofabrication. This comprehensive approach supports the development of efficient, scalable on-chip photonic platforms.

POS-27

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Dictionary-Based Reconstruction Of Spatio-Temporal 3d Magnetic Field Images From Quantum Diamond Microscope

Abstract: Three-dimensional magnetic imaging with high spatio-temporal resolution is critical for probing current paths in various systems, from biosensing to micro-electronics. Conventional 2D Fourier-based current source localization methods are ill-posed in multilayer or dynamic systems due to signal overlap and noise. In this work, we demonstrate an innovative nitrogen-vacancy (NV) center-based wide-field magnetic microscopy technique for dynamic three-dimensional imaging and localization of current sources. Using custom-fabricated multilayer micro-coil platform to emulate localized, time-varying currents similar to neuronal activity, we acquire magnetic field maps with micrometre-scale spatial and millisecond-scale temporal resolution using per-pixel lock-in-based detection. Source localization and image reconstruction are achieved using a Least Absolute Shrinkage and Selection Operator (LASSO)-based reconstruction framework that incorporates experimentally measured basis maps as spatial priors. Our method enables robust identification of active current sources across space and time, and significantly advance the accuracy of dynamic 3D current imaging and NV-based magnetometry for complex systems.

POS-28

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Efficient Hd-Mdi-Qkd Via Time-Bin Encoded High-Dimensional States

Abstract: We report the first experimental demonstration of Higher-Dimensional Measurement Device Independent Quantum Key Distribution (HD-MDI-QKD) using time-bin encoded qudits. MDI protocol eliminates potential detector-side channel attacks while also suffering from undesirable reduction in secret key rate (SKR) due to the need for coincidence measurements at the central node. Here, we utilize HD-MDI-QKD by mapping time-bin endoed states to multiple bits thereby increasing the information capacity per qudit transmitted. Our implementation using real fiber spools of length varying from 2 to 100 km demonstrates consistent positive SKR, with maximum improvement of ~2.63-times for an eight-dimensional encoding scheme when compared to the standard qubit implementation. Our measurements result in optimum value encoding dimension for which the SKR is maximized, and beyond which it decreases due to increased quantum bit error rates. We also compare the performance of HD-MDI-QKD and HD implementation for the widely used coherent-one-way (COW) protocol. This comparison shows a clear advantage of HD encoding for MDI-QKD due to level-d coincidence events increasing the useful detection events. This study provides important insights into the scalability and security of HD-QKD, paving the way for next-generation quantum cryptography networks with enhanced efficiency and minimal hardware modifications.

POS-29

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Quantum Speed Limit In Driven-Dissipative Systems

Abstract: Every quantum operation that takes a system from one state to another is known to have bounds on operation time, due to Heisenberg uncertainty principle. In open quantum systems (OQS), such bounds have been principally affected by system environment coupling. In the recent past, drives on OQS have shown to give rise to drive-induced dissipation (DID). In this work, we investigate how DID affects the quantum speed limits. To this end, we use a recently-reported quantum master equation that takes into account environment fluctuations and provide a closed form estimate of drive-induced dissipation. On such a system, we use Gradient Ascent Pulse Engineering (GRAPE) to find optimal route to move from an initial state to a desired final state. Our key result is that there exists an optimal evolution time that maximizes fidelity. This work enables robust quantum control in open systems, addressing a key challenge in scaling quantum technologies. By improving fidelity and efficiency, our method advances practical quantum computing under realistic dissipative conditions. Ref : Journal Ref : Sarfraj Fency, Riddhi Chatterjee, Rangeet Bhattacharyya; arXiv:2504.07931

POS-30

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Pediatric-Friendly Quantum Brain Imaging: Design, Acquisition, And Analysis Using Flexible Modular Meg Platforms With Cutting-Edge Technologies

Abstract: We present a pediatric-friendly, modular MEG system designed using flexible cap-based integration of 10 optically pumped magnetometers (OPMs) for non-invasive brain imaging. Tailored for small head sizes and increased comfort, the cap supports adjustable sensor placement while maintaining proximity to the scalp for improved signal quality. The use of quantum-enabled OPMs eliminates the need for cryogenic cooling, making the system lightweight, quiet, and portable—ideal for pediatric use. The system architecture includes a modular acquisition pipeline for capturing neuromagnetic signals, followed by real-time preprocessing, artifact rejection, and source localization. Initial phantom-based and simulated pediatric trials show effective spatial resolution, low noise levels, and tolerance to motion, validating the system's capability for dynamic neural tracking in children. This work demonstrates a scalable, motion-tolerant approach to pediatric brain imaging, offering a promising tool for developmental neuroscience and early diagnosis of neurological disorders.

POS-31

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Entangled Photon Pair Generation Using Vertically Stacked Mie Resonators

Abstract: Quantum entanglement serves as a fundamental principle and a powerful tool behind many modern quantum technologies. Entangled photon pairs are a vital resource for diverse quantum technologies, including imaging, communication, and computation. The most common method for producing entangled photon pairs is based on a process called spontaneous parametric down-conversion (SPDC), where a pump photon passes through a quadratically nonlinear medium and spontaneously splits into two lower-energy photons called signal and idler. However, SPDC in traditional nonlinear crystals and waveguides needs stringent momentum conservation, which restricts the flexibility of the states they generate. Optical metasurfaces have recently emerged as a promising new approach for overcoming this constraint. Metasurfaces made of III-V semiconductors with strong second-order nonlinearities and localized optical resonances making them useful for efficient on-chip quantum state generators. We report enhance spontaneous photon emission via SPDC process from vertically stacked three-disk Aluminium Gallium Arsenide (AlGaAs) nanoresonators supporting resonances at signal and idler wavelengths. We achieve a high pair generation rate (PGR) and Coincidences-to-Accidentals Ration (CAR).

POS-32

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Quantum-Enhanced Detection Of Cancerous Regions Via Variational Quantum Eigensolver Using Ibm Qiskit

Abstract: Quantum computing holds immense promise for advancing medical imaging through its exploitation of quantum mechanical principles such as superposition and entanglement. This study explores a novel implementation of the Variational Quantum Eigensolver (VQE) algorithm for the analysis of microscopic cancer cell images using IBM's Qiskit framework. Pixel intensities from medical images are encoded as quantum amplitudes within 2-qubit and 4-qubit circuits to estimate the ground state energy of selected regions. The quantum circuits incorporate Hadamard, CNOT, and parameterized rotation gates, with the COBYLA optimizer employed for classical minimization. Simulations reveal that regions containing malignant cells exhibit distinctly lower ground state energies, reflecting increased molecular complexity. Analysis using Bloch sphere visualization and quantum measurement histograms validates this behavior. The proposed hybrid quantum-classical approach demonstrates a viable and scalable methodology for enhancing cancer image resolution and improving early-stage diagnostic accuracy using current quantum hardware.

POS-33

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Interplay Of Charge And Energy Transfer In Layered Quantum Dot Assemblies

Abstract: Charge and energy transfer play crucial roles in tuning the optical properties of quantum dot heterostructures. This study investigates the interplay of Förster resonance energy transfer (FRET) and charge transfer in CuInS2/CdS|CuFeS2 and CuInS2/CdS|CdS|CuFeS2 layered nanocrystal assemblies. X-ray photoelectron spectroscopy (XPS) confirms charge transfer across the heterojunction, with shifts in binding energy indicating Fermi level equilibration, while photoluminescence measurements reveal strong exciton quenching in CuInS2/CdS|CuFeS2. The CuInS2/CdS film shows a lifetime of 335 ns, while introducing CuFeS2 reduces the lifetime to 26 ns, indicating strong quenching via charge transfer and FRET. The addition of a CdS spacer extends the lifetime to 209 ns, demonstrating partial suppression of these processes. While charge transfer depletes electrons in CuInS2/CdS, forming charged excitons with shorter lifetimes, the CdS spacer weakens direct electronic coupling and dipole–dipole interactions, increasing the emission lifetimes. These results show the way interfacial engineering in quantum dot solids controls charge and energy transfer and gives insights into optimizing quantum-dot-based devices.

POS-34

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Variational Quantum Eigensolver Algorithm For Quantum Computing-Based Analysis Of Classical Cancer Images

Abstract: Quantum Mechanics/ Physics principles are applied to develop a new computer which surpasses the existing classical computer, known as a Quantum Computer, which increases speed and storage capacity. Theoretically, the cancer cell image created by a traditional computer can be magnified to the grassroots level to identify and detect the presence of active cancer molecules using Quantum Computing. As a result, life-threatening diseases can be recognized and treated at an early stage, potentially saving many lives. The Hamiltonian of the basic Schrodinger wave equations was modeled to find cancer cells. The qubit is a quantum state for which we have developed a new quantum circuit with the theoretical potential to increase the number of active cancer molecules. The image consists of several interconnected spheres that represent qubits and are structured to reflect complicated interactions, entanglement, and energy levels. Quantum Computing's Variational Quantum Eigensolver (VQE) approach and its capacity to recognize quantum high energy superposition states of quantum states have enlarged the classical image of cancer cells to evaluate active cancer cells in a limited region. We have created Python scripts to generate quantum circuits and extracted cancer image pixel intensity to confine our formalisms to 4-qubit to reduce computational complexity and ease of simulation. VQE uses to determine the ground state energy of the cancer molecules actively engaged in spreading out to the body. We have faced practical implementation issues while going from lower to higher qubits. This study shows the possible gap between theoretical quantum techniques and real healthcare

POS-35

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Simulating Gaussian Boson Sampling Using A Graphical Method In Quantum Optics

Abstract: While theoretical studies have highlighted the potential superiority of quantum computers over classical counterparts in various tasks, practical demonstrations of such quantum supremacy remain elusive. One of the ways to tackle it is Boson Sampling, a task that can be efficiently performed on non-universal photonic quantum computers but is believed to be intractable for classical counterparts. We present a novel simulation approach for Boson Sampling and Gaussian Boson Sampling tasks by utilizing the graphical method in quantum optics for field operator transformations. This method allows for the comprehensive exploration of all potential output samples/states and their probabilities in a single iteration without the need for complex matrix calculations for each outcome. By directly simulating multiport interferometers with non-classical inputs, this approach offers a promising alternative to traditional matrix methods, paving the way for further research into its applicability and potential advantages. We demonstrated the simulation of the Densest k subgraph problem, showcasing one of the applications of Gaussian boson sampling through graphical methods. This approach offers the advantage of producing all potential outcomes in a single iteration, regardless of whether photon number-resolving detectors or threshold detectors are used. This simplifies the process of identifying the most probable configuration from vast datasets, in contrast to the traditional matrix method, which typically yields only a single outcome per iteration through intricate matrix computations.

POS-36

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Microwave Characterization Of A 3d Superconducting Qubit

Abstract: Superconducting qubits have emerged as a leading technology in the race to develop scalable quantum processors. In this work, we focus on the readout and characterization of a single superconducting qubit, which is coupled to a 3D microwave cavity resonator. By sending modulated microwave pulses we perform quantum non-demolition measurement of the state of the qubit through the cavity. We measure the time domain properties of the qubit, to optimize it for gate-based operations. The qubit can get affected by environmental noise mainly from inherent two-level systems and when subjected to control and measurement, resulting in the reduction of the qubit coherence and its operational fidelity. In the pure dephasing limit, one of the approaches to directly reconstruct the noise spectrum from standard time-domain measurements (Ramsey and Hahn-Echo pulse sequences) is by employing a recently developed technique called Fourier Transform Noise Spectroscopy (FTNS). This involves performing Fourier Transform on the numerical double derivative (in time) of the measured decay function of Ramsey and Hahn-echo sequences, without the involvement of any additional experimental overhead. We have performed experiments on a single transmon qubit whose T1 is ~ 30 us and T2 is ~ 5-9 us. By tuning the sampling interval (δt), and employing FTNS protocol, we could map the noise power spectrum to determine the frequency components in a simpler and effective manner. This comprehensive analysis is essential for enhancing the performance of superconducting quantum devices and advancing the field of quantum computing.

POS-37

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Geometrically Pertinent Data Encoding For Quantum Convolutional Neural Networks

Abstract: The research on quantum convolutional neural networks (QCNN has garnered significant interest owing to subsequent research showing deeper implications like effective generalization using few training data and absence of barren plateaus in the architecture. A literature survey showed that hybrid classical quantum architectures built using QCNN for supervised classification of images often relied on using amplitude encoding as the data encoding scheme. However, our work shows that when the neighboring two qubit interactions of the parameterized convolution and pooling layers of the QCNN are mapped on the amplitude encoded qubits of image data, the amplitude encoding flattens the image data and the receptive fields are observed to act asymmetrically which may cover geometrically inconsequential areas of the actual image. The focus of this work is in utilizing a data encoding scheme called Real Ket where its inherent block-wise image embedding mechanism directs these two qubit parameterized layers of QCNN to nearly act as symmetrically oriented kernels. Prompted by these observations, a binary classification using QCNN with Real Ket and then vanilla amplitude encoding is performed on the MNIST dataset in our work for comparison. While both of these encodings demonstrated comparable accuracy in their predictions, Real Ket may offer promising outcomes in handling image datasets of higher complexity level. Additionally, our findings underscore the need for further investigation into geometrically relevant data encoding schemes for image data in Quantum Machine Learning tasks.

POS-38

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Quantum Chemistry Of CRISPR-CAS9 Cleavage Efficiency: A Quantum-Bio Study

Abstract: This research explores the intersection of CRISPR, machine learning, and quantum chemistry. While CRISPR can target and cut specific DNA base pairs, its efficiency and specificity remain major challenges. This study examines quantum chemical factors—such as the HOMO-LUMO gap, hydrogen bonding, and stacking interactions—using quantum simulations and machine learning to assess their impact on CRISPR-Cas9 efficiency and develop a method for assigning cutting efficiency scores to spCas9 variants. The article "Quantum biological insights into CRISPR-Cas9 sgRNA efficiency from explainable-AI driven feature engineering" simulates a DNA molecule using the DFTB3/3ob quantum algorithm, which estimates electron density, HOMO-LUMO gaps, and molecular geometries. These outputs, along with temperature, position, and GC content, are fed into two machine learning models—Iterative Random Forest and Random Intersection Trees—which identify and rank the most influential factors, assigning "cutting scores" accordingly.

POS-39

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Microfabricated Cs Vapor Cell For Cpt Based Miniaturized Atomic Clock

Abstract: The emergence of miniaturized atomic clocks has revolutionized precision time and frequency measurements by providing compact, low-power alternatives to traditional bulky frequency standards. While the frequency stability of cesium (Cs) beam standards remains unmatched by miniaturized vapor cell atomic clocks, our work focuses on developing a Coherent Population Trapping (CPT)-based miniaturized atomic clock with enhanced stability using a cesium vapor cell measuring 10 × 10 × 1 mm. At the core of this technology are microfabricated vapor cells, consisting of deep reactive ion etching (DRIE)–etched silicon layers sandwiched between two borosilicate float glass plates. These cells have been characterized through absorption spectroscopy, exhibiting several GHz linewidths. CPT is achieved by preparing the atoms in a non-absorbing dark state, which manifests as a narrow transmission peak within the absorption dip. We have designed and developed an indigenous experimental setup to measure this CPT resonance. Initial results demonstrate a CPT linewidth of approximately 10 kHz. Locking the frequency to this CPT peak will enable the realization of a highly stable miniaturized atomic clock.

POS-40

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Indirect Control Of Noise In A Quantum Game Through Entangling Gates

Abstract: Entanglement, a non-local property, sets apart a quantum game from its classical counterpart. Moreover, the two-qubit entangling gate, alongside quantum strategies, has been shown to exhibit quantum advantage in resolving dilemmas in game theory, otherwise not possible through the classical version [1,2]. In view of the enhanced quantum advantage, and by exploring the non-local attributes of two-qubit entangling gates, a modification to the well-studied Eisert-Wilkens-Lewenstein (EWL) protocol [3] is proposed and studied. In this work [4], we show its robustness to noise by subjecting the protocol to an amplitude damping channel. We find that the effect of noise on the payoffs of the game can be tuned through the aid of a richer class of two-qubit entangling gates. While the factor of noise cannot be controlled directly, we see that a desired payoff (if not the maximum) can still be achieved for a given amount of noise. References: [1] Eisert, J., Wilkens, M., Lewenstein, M.: Quantum games and quantum strategies. Phys. Rev. Lett. 83, 3077–3080 (1999) [2]Dax Enshan Koh., Kaavya Kumar., Siong Thye Goh.: Quantum volunteer's dilemma. Phys. Rev. Research 013104 (2025) [3] Vijayakrishnan, V., Balakrishnan, S.: Role of two-qubit entangling operators in the modified Eisert-Wilkens-Lewenstein approach of quantization. Quantum Inf. Process. 18, 112 (2019) [4] Vijayakrishnan, V., Balakrishnan, S.: Influence of noise on a quantum game in the light of modified EWL scheme. Quantum Inf. Process. 24:203 (2025)

POS-41

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