



Workshop on  
**Frontiers in Quantum Information and Technologies (FQIT)**  
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Anusandhan  
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**Poster Presentations**

Name	Affiliation	Title	Abstract
Aryaman Sen	Shiv Nadar University	Key Exchange using Tree Parity Machines	Traditional key-exchange protocols, like Diffie-Hellman (DH) and Elliptic-Curve Diffie-Hellman (ECDH), while essential for today's secure communications globally, are heavily dependent on the algebraic foundations like modular exponentiation and Discrete Log-arithm Problem. This burdens IoT devices and systems, affecting their computation efficiency. Neural Cryptography offers a non-algebraic alternative with potential to be lighter than the existing algorithms. This paper will discuss Tree Parity Machines (TPM), focussing on their architecture, learning rules and their generalization properties for secure key exchange. While they resist attacks which normally breaks DH key exchange, TPMs are still susceptible to new learning-based adversaries. Consequently, this research aims to propose an efficient extension to the TPM architecture designed to enhance security against these specific attacks while maintaining synchronization in the coming semester.
G. Sharvan Prakash	SRM Institute of Science and Technology, Kattankulathur	Performance of quantum battery under a dissipative environment	Quantum batteries are devices capable of storing and delivering energy on demand by exploiting intrinsic quantum features of physical systems, such as entanglement and superposition. In recent years, these devices have attracted growing attention both theoretically and in laboratory-based implementations. In this work, we demonstrate the realization of a quantum battery using two distinct two-dimensional materials: doped graphene and MoS <sub>2</sub> . By employing a Gaussian pulse charging protocol under dissipative environmental conditions, we investigate key performance metrics, including ergotropy and state purity. Furthermore, we discuss the potential experimental feasibility and observable signatures of the proposed quantum battery.
Geerthana	SRM Institute of Science and Technology	Quantum Correlations in Hyperfine Structure	We investigate the quantum dynamics of a two-spin system governed by the hyperfine interaction using the Lindblad master equation framework. The model incorporates both coherent evolution driven by the hyperfine Hamiltonian and dissipative processes arising from environmental coupling. By solving the time evolution of the density matrix, we analyze how decoherence mechanisms influence quantum correlations in the system. Particular emphasis is placed on the behavior of entanglement, quantified through concurrence, under varying system parameters such as temperature and coupling strengths. We demonstrate how the interplay between coherent hyperfine interaction and dissipative channels leads to degradation or stabilization of quantum correlations. The study further explores steady-state properties and identifies regimes where non-classical correlations persist despite environmental effects. Our results reveal that dissipation can play a constructive as well as destructive role depending on the relative strength of system-environment interactions. This provides insight into controlling quantum coherence in spin-based quantum systems. The findings are relevant for quantum information processing and solid-state qubit implementations. Overall, this work highlights the significance of open-system approaches in understanding realistic quantum spin dynamics.
Hansika Tiwari	Harcourt Butler Technical University, Kanpur UP	Magnetic Skyrmion Size Evolution Using Micromagnetic Simulation	Magnetic skyrmions are nanoscale topological spin textures that form tiny, stable swirling patterns of magnetic moments, protected by the Dzyaloshinskii-Moriya interaction (DMI) [1,2]. Their unique properties—topological stability, small size, and efficient manipulation with low electric currents—make them highly promising for energy-efficient spintronic devices, and quantum information technologies [3,4]. However, creating stable skyrmions and its manipulation at room temperature ferromagnetic heterostructures remains challenging which requires precise tuning of material parameters [5, 6]. In this work, we investigated the nucleation, size, and stability of Néel-type skyrmions in thin magnetic films through systematic micromagnetic simulations using the Object Oriented Micromagnetic Framework (OOMMF). The key parameters such as DMI strength, perpendicular magnetic anisotropy, and saturation magnetization to explore their skyrmion size dependence. It is observed that DMI strength, anisotropy, and saturation magnetization significantly affect the skyrmion size and its stability. The detailed work will be presented during the workshop. References: [1] X. S. Wang, H.Y. Yuan, X. R. Wang, Communications Physics, 1:31, 2018 [2] R. M. Vakhitov, M. A. Filippov, Physica scripta, 100, 125932, 2025 [3] X. F. Pan, X. L. Hei, X.Y. Yao, J.Q. Chen, Y.M. Ren, X.L Dong, Y.F. Qiao, P.B. Li, Physical review research 6, 023067, 2024 [4] M. Komejl, V. Sršan, K. Žužek, S. Šturm, Physical review research 7, 033055, 2025 [5] M. Bhukta, B. B. Singh, S.Mallick, S. Rohart, S. Bedanta, Nanotechnology 33, 385702, 2022 [6] A. K. Behera, S. S. Mishra, S. Mallick, B. B. Singh, S. Bedanta, Journal of Physics D: Applied Physics, 51, 285001, 2018

Utkarsh Jain	Hindu College, University of Delhi	Efficient Simulation of Time Evolution of a Quantum System using a Quantum Computer	<p>High-resolution simulation of quantum dynamics is a fundamental workload in high-performance scientific computing, with applications spanning materials science, wave propagation, and quantum chemistry. Classical grid-based methods require storing and evolving <math>N</math> complex amplitudes, leading to memory usage <math>O(N)</math> and computational cost dominated by repeated Fourier transforms with time complexity <math>O(N \log N)</math>. As spatial resolution increases, these simulations become memory- and compute-bound even on large-scale HPC systems.</p> <p>We present a digital quantum simulation framework that leverages the exponentially compact state representation of quantum computers to address this challenge. A discretized wavefunction defined on <math>N</math> grid points is encoded into a register of only <math>\log(N)</math> qubits, achieving exponential reduction in spatial complexity. Time evolution is implemented via a quantum circuit analogue of the Split-Operator Fourier Transform (SOFT) method, using Trotterized kinetic and potential propagators and the Quantum Fourier Transform for efficient basis transformations.</p> <p>Because the Quantum Fourier Transform operates in <math>O((\log N)^2)</math> time, the overall algorithm exhibits asymptotically superior scaling compared to classical FFT-based methods, providing an exponential improvement in time complexity with respect to spatial discretization. The approach therefore offers a fundamentally different scaling regime for high-resolution simulations, where increasing accuracy classically incurs rapidly growing computational cost. The methodology is demonstrated for a one-dimensional quantum harmonic oscillator with Gaussian initial states. Validation on ideal quantum simulators confirms agreement with classical solutions.</p> <p>The results illustrate how quantum processors can efficiently represent and evolve finely discretized continuous systems that are computationally expensive for classical HPC architectures. This work highlights the potential of quantum computing as a complementary paradigm for high-performance computing.</p>
Zainab Gazali	University of Allahabad	Compositional Characterization of Diverse Renal Calculi Using Laser-Induced Breakdown Spectroscopy (LIBS)	<p>Laser-Induced Breakdown Spectroscopy (LIBS) was utilized for the systematic compositional characterization of diverse renal calculi collected from the Department of Surgical Gastroenterology, Narayan Swaroop, Prayagraj, Uttar Pradesh, India. The LIBS analysis enabled rapid, in situ identification of multiple elemental constituents, including calcium, magnesium, manganese, copper, iron, strontium, sodium, potassium, carbon, hydrogen, nitrogen, and oxygen. In addition to atomic emission lines, distinct molecular bands of calcium oxide (CaO) were observed, indicating the presence of complex molecular species within the stone matrix.</p> <p>A novel approach is proposed for evaluating the relative hardness of kidney stones based on the intensity ratio of ionic to atomic spectral lines derived from the LIBS spectra. This method provides an indirect yet reliable spectroscopic parameter for comparative hardness assessment. Furthermore, systematic variations in spectral line intensities revealed compositional heterogeneity among the analysed samples, offering insights into differences in elemental and molecular concentrations across various stone types. The findings demonstrate the efficacy of LIBS as a rapid, minimally destructive, and diagnostically valuable analytical technique for the compositional and structural assessment of renal calculi.</p>