Book of Abstracts

Q-Karyashala 2024

A 2-day workshop for aspiring individuals to deepen their understanding of Quantum technology

June 24th & 25th, 2024
8.30 AM to 6:00 PM

Quantum Research Park (QuRP)

A Hub for Quantum Computing and Related Technologies

K-tech

STARTUP KARNATAKA

KEYSIGHT

Keysight EDA Solutions

RF & MICROWAVE

- ADS - MMIC, RF Board, SIP, HSD
- EMPro -3D EM
- RFPro - EM-Circuit analysis for circuit designers
- Genesys - RF Board Circuit Synthesis
- HeatWave -IC electrothermal analysis
- GoldenGate -RFIC Mixed Signal

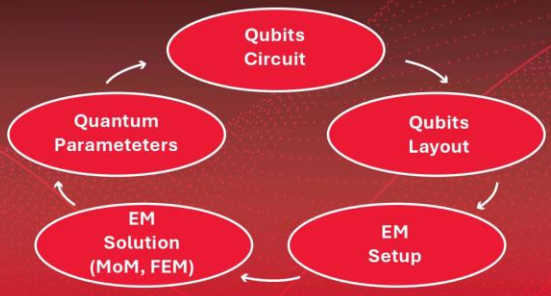
HIGH SPEED DIGITAL

- SIPro - Signal Integrity design for High Speed Digital
- PIPro Power Integrity design for DC power distribution network
- MemoryDesigner - Designs DDR4, DDR5 Memory modules

CLIOSOFT PRODUCTS

- cliosoft | SOS
- cliosoft | HUB
- cliosoft | VDD

SUPERCONDUCTING QUBITS



Title

Photonic integrated circuits as quantum computing platform

Speaker

Prof. Shankar Kumar Selvaraja

(Associate Professor, Centre for Nanoscience and Engineering, IISc)

Abstract :

Photonic Integrated Circuits are pivotal in advancing quantum computing. They offer precise control of photons, essential for manipulating quantum states; a key requirement for quantum operations. Photonic ICs scalability and compatibility with silicon technology facilitate integration into existing systems, promoting practical quantum computing applications. Their ability to operate at room temperature and integrate multiple quantum functions on a single chip makes them a promising platform for developing robust, scalable quantum computers. In this talk, I will discuss various demonstrations and research activities that gives us confidence in realising future photonic quantum computer.

Biography:

Prof. Shankar Kumar Selvaraja
(Associate Professor,CeNSE, IISc)

Prof. Shankar Kumar Selvaraja's Professor Shankar Kumar Selvaraja is an associate professor at the Centre for Nano Science and Engineering in the Indian Institute of Science Bangalore. He is also the Chair of the National Nano fabrication Centre (NNfC) at IISc. He was Prof. Ramakrishna Rao chair between 2021-2023. Before joining IISc in 2014, he was with imec Belgium. He received his PhD for his work on wafer-scale fabrication technology for Silicon photonic integrated circuits from Ghent university-imec Belgium. He is an alma mater of Bharathiar University, College of Engineering Guindy and University of Twenty, the Netherlands. He has spent over 18 years in silicon, and integrated photonics, developing state-of-the-art CMOS processes and device technology for high-speed optical interconnect and sensing applications. He has published over 250 research articles in international journals and conferences and has eight patents. He is a recipient of the DST-SERB Early Carrier Researcher Award and Visvesvaraya young faculty research fellowship award from the ministry of electronics and information technology. His current area of research includes silicon photonic IC enabled connectivity, computing, sensors, and quantum photonic integrated circuits.

Personal Webpage:
http://www.cense.iisc.ac.in/shankar-kumar-selvaraja

Title

Quantum materials fire like neurons

Speaker

Prof. Pavan Nukula

(Assistant Professor Centre for Nanoscience and Engineering, IISc)

Abstract :

I will show how a subset of "Quantum materials (materials whose band structure cannot be explained by simple tight binding model)", called Mott insulators, have interesting properties that emerge in them because of electron correlations. These lead to very nice phase transitions, and the systems can be engineered to oscillate between the two phases giving rise to neuron-like behaviour. In the bigger context of brain-inspired computing, these materials can be used like neurons. Biological neurons are electromechanical in nature, in that when a neural spike transmits, the signal is not just electronic, but also mechanical in nature (sound wave). When these quantum materials fire like neurons, they also transmit sound waves, making them complete inorganic analogues of biological neurons.

Biography:

Prof. Pavan Nukula's research interests are in correlated systems, ferroelectric and multiferroic thin films, topological defects and functions in context of quantum computation, in situ electro microscopy and spectroscopy, material networks for neuromorphic computing, phase change materials and thin film X-ray diffraction.

Prof. Pavan Nukula
(Assistant Professor, CeNSE, IISc)

Personal Webpage:
http://www.cense.iisc.ac.in/pavan-nukala

Title

Cryogenic Memory Technology for Quantum Computing Applications

Speaker

Prof. Bhagawati Prasad

(Associate Professor of Materials Engineering, IISc)

Abstract :

Cryogenic memory technology is crucial for applications in superconducting single-flux quantum electronics and quantum computing. However, the absence of cryogenic memory technologies that can operate at temperatures of 4 K or lower impedes the development of practical and scalable systems. In this talk, I will provide an overview of various emerging memory technologies that can be developed for cryogenic memory applications. I will discuss the main challenges associated with integrating these memories with single-flux quantum circuits and quantum computers. Additionally, I will compare the capabilities of various technologies in relation to the needs of superconducting electronics and quantum computing.

Biography:

Prof. Bhagawati Prasad's research interests are in Electronic and Magnetic Materials and Devices; Spintronic, Iontronics, Ferroelectrics, and Magnetoelectrics; Non-volatile memory; MRAM, FeRAM, RRAM, and PCM; DNA storage; AI Hardware Materials and Devices; Neuromorphic computing; and 3D sensors for Virtual and Augmented realities.

Prof. Bhagawati Prasad
(Associate Professor,
Materials Engineering, IISc)

Personal Webpage:
https://materials.iisc.ac.in/faculty/bhagwati

Title

Interactive session with Prof. Apoorva

Speaker

Prof. Apoorva D Patel

(Professor at the Centre for High Energy Physics &
Convener, IISc Quantum Technology Initiative)

Biography:

Apoorva D. Patel is a Professor at the Centre for High Energy Physics, IISc. He is notable for his work on quantum algorithms, and the application of information theory concepts to understand the structure of genetic languages. His major field of work has been the theory of quantum chromodynamics, where he has used lattice gauge theory techniques to investigate spectral properties, phase transitions, and matrix elements.

Prof. Apoorva D Patel
(Professor at the CHEP & Convener, IISc Quantum Technology Initiative)

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Title

Navigating the Design Challenges of Superconducting Quantum Systems

Speaker

Dr. Mohamed Hassan

(Segment lead for Quantum EDA at Keysight Technologies)

Abstract :

As quantum computing continues to progress, superconducting qubits have emerged as a promising platform due to their scalability and controllability. Concurrently, quantum amplifiers play a critical role in enhancing signal fidelity and enabling sensitive readout operations within superconducting quantum systems by efficiently amplifying quantum signals while suppressing noise. However, the complexity of these systems poses significant design hurdles, including the integration of numerous components, management of noise sources, and optimization of performance metrics. This talk explores how Quantum EDA techniques, tailored to the unique requirements of quantum circuits, can facilitate the design process by providing tools for simulation, verification, and optimization. By navigating these challenges effectively, Quantum EDA offers a pathway towards realizing robust and scalable superconducting quantum systems, accelerating progress in quantum computing and quantum information processing.

Dr. Mohamed Hassan
(Segment lead for Quantum EDA at Keysight Technologies)

Biography:

Mohamed Hassan is the segment lead for Quantum EDA at Keysight. He is a seasoned RF engineer with over two twenty years of experience at the vanguard of solving demanding electromagnetic problems, from optimizing high-performance superconducting cavities for particle accelerators to enhancing superconducting qubits for quantum computing and sensing. His experience spans multiple fronts from addressing the design challenges of real-life electromagnetic problems to leading successful experimental prototyping and testing endeavors.

He is well-versed in a variety of electromagnetic and Multiphysics EDA tools and has been at the forefront of ultra-low temperature testing of cavities and qubits. At Keysight, his role involves spearheading solutions for the rapidly evolving Quantum EDA market and its associated technologies. Dr. Hassan has authored and co-authored more than 100 technical papers and reports. Additionally, he holds two U.S. patents. Dr. Hassan is a senior IEEE member and a member of the American Physical Society.

Title

Generating random numbers using quantum mechanics

Speaker

Prof. Kausik Majumdar

(Associate Professor of Electrical Communication Engineering, IISc)

Abstract :

Data security is becoming increasingly important in today's life. In this talk, I shall discuss the importance of generating high quality random bit stream through hardware in the context of secure communication and other aspects of day-to-day life. I shall show how quantum mechanics can help in generating such a bit stream arising from natural randomness. One specific random number generating device that we recently demonstrated will be discussed.

Biography:

Prof. Kausik Majumdar's His research group uses a combination of theoretical and experimental techniques to investigate the electrical and optoelectronic properties of low dimensional materials and their nanostructures. They also explore the possibilities of applying these properties to develop novel devices, encompassing the entire spectrum of device design and simulation, device fabrication using state of the art semiconductor fabrication techniques, and device characterization using various electrical, optical and spectroscopic techniques.

Prof. Kausik Majumdar
(Associate Professor of
Electrical Communication Engineering, IISc)

Personal Webpage:
https://eecs.iisc.ac.in/people/kausik-majumdar/

Title

Shinning X-ray on quantum heterostructures

Speaker

Prof. Srimanta Middey

(Associate professor in the Physics department ,IISc)

Abstract :

Heterostructures of functional oxides exhibit various emergent properties, which are unattainable in individual constituent materials. However, understanding the origin of such behaviour in these nanoscale materials is extremely challenging. In this talk, I will focus on how X-ray-based techniques can be used for these purposes. Finally, I will discuss how these techniques are now being used to synthesize superior material platforms for quantum computation.

Biography :

Prof. Srimanta Middey
(Associate professor,
Physics department ,IISc)

Prof. Srimanta Middey is currently an associate professor in the Physics department of IISc. He completed his PhD at the Indian Association for the Cultivation of Science, Kolkata, India in 2012 and worked as a postdoc at the University of Arkansas, Fayetteville, USA from 2012-2016. He joined IISc in 2017 as an assistant professor and was promoted to associate professor in 2023.His group's aim is to discover exotic, emergent electronic and magnetic phenomena e.g. superconductivity, metal-insulator transition, high mobility electron gas, spin liquid phase, non-trivial spin texture etc., primarily in artificial quantum materials. His group grows thin films and heterostructures of complex oxides by pulsed laser deposition. To gain microscopic understanding of the electronic, magnetic and structural changes due to the heterostructuring, he uses synchrotron X-ray-based techniques such as X-ray diffraction, X-ray absorption spectroscopy, hard X-ray photoemission spectroscopy, and resonant X-ray scattering. He has published 75 papers in international journals and has received the SERB early carrier research award and the Infosys Young Investigator award.

Personal Webpage:
https://physics.iisc.ac.in/~srimanta/?page_id=1127

Title

Quantum with Quantum Dots

Speaker

Prof. Anshu Pandey

(Associate Professor at The Solid State and Structural Chemistry Unit, IISc)

Abstract :

Quantum Dots are important building blocks for photonic quantum technology. This presentation will give an overview of quantum dots, particularly the solution processed variety. We will cover recent progress made in the study of these materials as well as outstanding challenges facing their applications in photonic quantum technology.

Biography:

Prof. Anshu Pandey's research is aimed at understanding new physical properties that emerge in nanoscale matter. His group recently demonstrated ground state charge transfer between semiconductor nanocrystals, leading to the formation of "compounds" where individual quantum dots take the place of atoms. Yet other efforts in his lab are devoted to the development of semiconductors composed of earth abundant non-toxic elements, novel methods of synthesis and building materials with unusual properties

Prof. Anshu Pandey
(Associate Professor at The Solid State and Structural Chemistry Unit, IISc)

Personal Webpage:
https://sscu.iisc.ac.in/pandey/

Title

Workshop 1- Hands on training on an 'ADS Quantum Pro' by Keysight Technologies.

Workshop Instructors

Anil Kumar Pandey
Renuka Wekhande -Andankar

Workshop hosts/facilitators

Sharath N, Harsh Bhardwaj, Soumya Dey & Shobhit Tiwari

Objectives :

Hands on training on an 'ADS Quantum Pro' will cover

1. Step-by-step process to design basic superconducting circuits from scratch in the Advanced Design System (ADS).
2. How to design a schematic and layout circuit of a single superconductor-based qubit.
3. Full EM analysis and Energy Participation Analysis (EM Analysis) in QuantumPro.
4. Extracting quantum parameters in QuantumPro.

Anil Kumar Pandey
Principal Engineer, Keysight EDA

Biography

Anil Pandey is the Principal RnD Engineer at Keysight Technologies. He received his Master of Technology (Microwave Engineering) from the Indian Institute of Technology (IIT-BHU), Varanasi. He has more than 21 years of industry experience in RF Microwave design and development for various applications. Before joining Keysight Technologies, he worked as a Scientist in the Indian Space Research Organization (ISRO) where he was responsible for phased array antenna development for remote sensing satellites. His current research areas of interest include Quantum Circuit designs, Silicon Photonics, RF microwave designs, High-Speed digital designs and 5G/6G communication antennas. Anil has served as a reviewer for many international journals, such as IET, ACES, and Antenna Journal. He has more than 45 international/national research publications and 2 patents to his credit. Anil is author of technical book "Practical Microstrip and Printed Antenna Design" published by Artech House.

Renuka Wekhande -Andankar
Sr. Solutions Engineer—Keysight EDA

Renuka Wekhande –Andankar has total of 20+ years of experience in RF and Microwave domain, out of which 16 years of design, test and measurement experience in RF and Microwave Industry. She has successfully delivered Highly integrated 5G Complex Transceiver chips consisting of 14 different functions on a monolithic chip and designed and developed 200+ RFIC/MMIC products using GaAs (pHEMT) and Si CMOS technologies. She has managed engineering organization with 15+ engineers in small startup and delivered Training sessions in Universities and Government organization like BEL and DRDO.

- 1 patent granted: “CONTROLLABLE RF PHASE SHIFTER” for 5G Application.
- Published 2 papers in international journals: -
    - 1.Compact Highly Linear 2-6GHz Low Noise Amplifier for Digital RF.
    - 2. A prospective design Methodology of MMIC 2- 6 GHz Low Noise Amplifier
- Education: M.E(VLSI and Embedded System Design) Pune University, Pune, B.E (Electronics), VNIT Nagpur.

Sharath N B
Account Manager at Keysight Technologies

Sharath N B’s is a seasoned professional with over 14 years of experience in electronics and communication engineering. With a solid foundation as an application engineer specializing in EDA software, PCB design, and high-speed digital design, I transitioned into sales over the past Ten years, excelling in selling embedded design and EDA solutions.

Currently an Account Manager at Keysight Technologies, and have been with the company for 3 years, managing and promoting advanced technology solutions such as RF/MW design, high-speed digital design (HSD), Quantum solutions, power electronics, system-level design, and device modelling. My technical understanding and industry knowledge have been instrumental in driving sales and building strong client relationships.

Harsh Bhardwaj
Business Development Representative
Keysight EDA

Harsh Bhardwaj is the Business Development Representative for Keysight EDA . He has more than 7 years of industry experience in the field of Signal Integrity, Power Integrity, High speed board design and testing for various applications. Before joining Keysight Technologies, he worked as a Solutions Engineer with Cadence Design Systems where he was responsible for addressing the signal and Power integrity-based queries for the customers.

He received his bachelor's in technology (Electronics and Communications) from the VTU, Chennai. He can be reached at harsh.bhardwaj@keysight.com

Shobhit Tiwari
Expert Level R&D Engineer
Keysight Technologies

Shobhit Tiwari is Expert Level R&D Engineer at Keysight Technologies. Obtained MTech. degree in Microwave Electronics from the University of Delhi, South Campus in 2006. He has more than 18 years of industry experience in RF Microwave design and development for various applications. Before joining Keysight Technologies, he worked as a Senior Design Engineer (R & D), leveraged design & development of various types of Antenna's (Including Base Station Antennas), Passive components & High-Power Solid-State Amplifiers. Published four International technical Papers (includes one IEE International Journal & three International Conference Papers) & a Keysight Technical Conference Paper. Guided several MTech. project trainees as their project Guide & helped finishing their MTech Projects.

Soumya Dey
R & D Manager
Keysight EDA

Soumya Dey is a Senior R & D Manager for EDA R & D operations of Keysight Technologies since January 2010. He joined Agilent Technologies EEsof as an R & D Manager in June 2005.

Soumya is based in the Gurugram R & D center & collaborates with pan-India and worldwide teams In his current role, Soumya is responsible for efficient design & delivery of Electronic Design Automation products & plan, lead & manage the Thermal Software Development, Verification Software Product Development, Worldwide Foundry Program and Software Licensing for Keysight Technologies EDA.

He is one of the University Ambassador of Keysight Technologies EDA and drives the program's India chapter.

Soumya is a Quantum & Photonics technology enthusiast and collaborates with customers and educational institutions in adopting Keysight EDA QuantumPro and other measurement instruments for Quantum technology. He is also one of the founding member of the Keysight EDA EPDA sub segment.

Title

Workshop 2- Introduction session on IISc-Horiba Centre's equipment (Advancing Quantum Materials and Technology: HORIBA's Spectroscopy Solutions)

Speaker

Dr. Vikas Sharma
(Applications Scientist, Raman Spectroscopy & Process Control (PC),HORIBA India)

Workshop Instructors

H C Sudeeksha, Suman G R & Marudachalam Shanmugasundaram

Abstract :

Quantum materials are critical components in the advancement of quantum technologies such as quantum computing, sensing, and communication. Two-dimensional layered materials (2DLMs) are one such quantum materials with remarkable electronic, optical, and mechanical properties, generating both high scientific interest and exhibiting huge application potential. Characterizing crystallinity, defects, particle size, achieving suitable electronic properties such as high carrier mobility in these materials plays a crucial role in final device performance. This presentation gives a detailed discussion on HORIBA metrology solutions such as Raman Spectroscopy, fluorescence, and particle size analyzer and their applications to address the key issues in quantum materials. Raman spectroscopy has proven to be a fast, convenient, and nondestructive technique to characterize the fundamental properties of 2DLMs and other quantum materials. Raman characterization of mono layer and multilayer Graphene, thickness-dependent intralayer and interlayer modes and interesting features like mapping will be discussed. Further, the role of fluorescence A-TEEM technology for understanding fluorescence properties of quantum dots and particle size characterization by HORIBA Dynamic Light Scattering (DLS) method will be discussed.

Dr. Vikas Sharma
(Applications Scientist, Raman Spectroscopy & Process Control (PC),HORIBA India)

Title

- Workshop 3- Introduction session on Mach–Zehnder Interferometer
- Demonstration Session- At Prof. Vivek Tiwari's lab, SSCU.

Speaker
Sayan Ghosh

Workshop Instructors
Sayan Ghosh & Sanjoy Patra

Abstract :

Fourier Transform Spectroscopy (FTS) has revolutionized spectral analysis by offering significant advantages over traditional dispersive spectrometers. Unlike conventional spectrometers, FTS acquires entire spectra simultaneously through interferometric techniques, enabling rapid data collection and enhanced signal-to-noise ratios, which provide richer spectral details in various scientific disciplines, including astronomy, chemistry, and environmental monitoring.

In this tutorial workshop, we will give a brief hands-on experience of FTS using a home-built Mach-Zehnder interferometer

Sayan Ghosh
PhD student, MuSIG lab, SSCU, IISc, Joined Aug 2022

Sanjoy Patra
Integrated PhD student, MuSIG lab, SSCU, IISc, joined May 2019