Contribution ID: **96** Type: **Oral**

Special lecture: Quantum Computation

Saturday 6 September 2025 18:00 (30 minutes)

This interdisciplinary talk will chart the course of the quantum revolution, beginning with Richard Feynman's foundational vision of simulating nature. We will introduce the core principles of superposition, interference, and entanglement before taking a deep dive into the leading hardware platforms, including superconducting and trapped-ion qubits. The presentation will discuss some principles behind qubit control and the universal language of quantum gates.

A central focus will be quantum error correction. We will deconstruct how continuous physical imperfections are modeled as discrete probabilistic events, motivating the need for Quantum Error Correction. This builds to the concept of a protected logical qubit, using techniques to detect errors without destroying the quantum state. With this foundation, the presentation will survey the quantum applications such as the Grover search algorithm. The profound impact on cybersecurity will be addressed, detailing the "Harvest Now, Decrypt Later" threat and the dual global defense: the physics-based security of Quantum Key Distribution (QKD) and the software-based solution of Post-Quantum Cryptography (PQC).

Finally, the presentation will bring this global race home, providing a focused overview of India's ambitious National Quantum Mission (NQM) and the vast, interdisciplinary career opportunities it creates for the next generation of scientists and engineers.

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Session Classification: Discussion