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# India's Quantum connects, from 1924

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The story of quantum computing is intricately linked to India. It can be traced back to the legacy of Satyendra Nath Bose, the Indian theoretical physicist renowned for his work on quantum mechanics, and pioneer of quantum statistics and condensed matter physics. He wrote the last of the four publications that led to the foundation of quantum mechanics. His paper was published in 1924. S N Bose National Centre for Basic Sciences in Kolkata is celebrating 100 years of publication of Bose's paper. What a charming coincidence that a century later, the world's greatest tech companies are vying for a share of the quantum computing pie, and nations are evolving strategies for quantum technologies!

**Grover's algorithm:** Another major contribution came from the work of Lov Kumar Grover, an Indian-American computer scientist. He is credited as the creator of the Grover database search algorithm, a pivotal advancement in quantum computing. Grover's algorithm, introduced in 1996, gained widespread recognition as the second major algorithm proposed for quantum computing.

**What's quantum:** Quantum computing leverages principles from quantum mechanics to resolve intricate problems at accelerated rates, as compared to classical computers. Both hardware research and application development play crucial roles in quantum computing.

**India mission:** In 2023, India became the seventh country to have a National Quantum Mission – after the US, Austria, Finland, France, Canada and China – dedicated to the development of quantum technologies. The mission comprises four thematic hubs that come under quantum technologies: quantum computing, quantum communication, quantum sensors and metrology, and quantum materials and devices. Under the mission, over Rs 6,000 crore will be funnelled from 2023-24 to 2030-31, aiming to seed, nurture and scale up scientific and industrial R&D and create a vibrant and innovative ecosystem in quantum technology. India is 10 years behind and we need to catch up fast.

**Multiple objectives:** Key objectives of the mission include the development of intermediate-scale quantum computers boasting 50-1000 physical qubits across various platforms such as superconducting and photonic technology within an eight-year timeframe. The mission also seeks to establish satellite-based secure quantum

communications, spanning distances of up to 2,000 km between ground stations within India, as well as enabling longdistance secure quantum communications with other countries, both satellite and fibre-based. Furthermore, the mission seeks to implement inter-city quantum key distribution covering distances of over 2,000 km, alongside the establishment of multi-node quantum networks.

Lots of interest: It is one of the nine missions of national importance being driven by the Prime Minister's Science and Technology Innovation Advisory Council (PM-STIAC). On January 20 this year, a call for pre-proposals was made to set up the thematic hubs, which invited huge interest from academic institutions and R&D labs. The thematic hubs will get started in the next few months.

Boost to self-reliance: The mission, involving researchers and startups, will greatly benefit sectors like communication, health, finance, energy grids. It will be a huge boost to programmes like Digital India, Make in India, Self-reliant India and Sustainable Development Goals (SDG). In healthcare, quantum computing promises personalised medicine through rapid genomic analysis. In finance, it will bolster portfolio management and fraud detection.

Research initiatives starting: Quantum's transformative potential extends to machine learning, where algorithms process large datasets with unmatched efficiency. Enhanced security via quantum cryptography ensures foolproof encryption and secure communications, while scientific studies benefit from precise modelling and simulation. Leading Indian tech companies like TCS, Infosys, and Tech Mahindra are diving into quantum research.

Next big buzz: Quantum computing will not supplant classical systems but complement them, addressing specific challenges where quantum capabilities shine brightest. As India moves ahead, nurturing a fertile ecosystem of innovation and collaboration, it stands poised to lead the quantum charge. Tech enthusiasts may keep their eyes peeled as quantum technology takes centre-stage, the next big buzz following the AI revolution.

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