Research Unit
Press Information Bureau
Government of India

National Quantum Mission: India's Quantum Leap

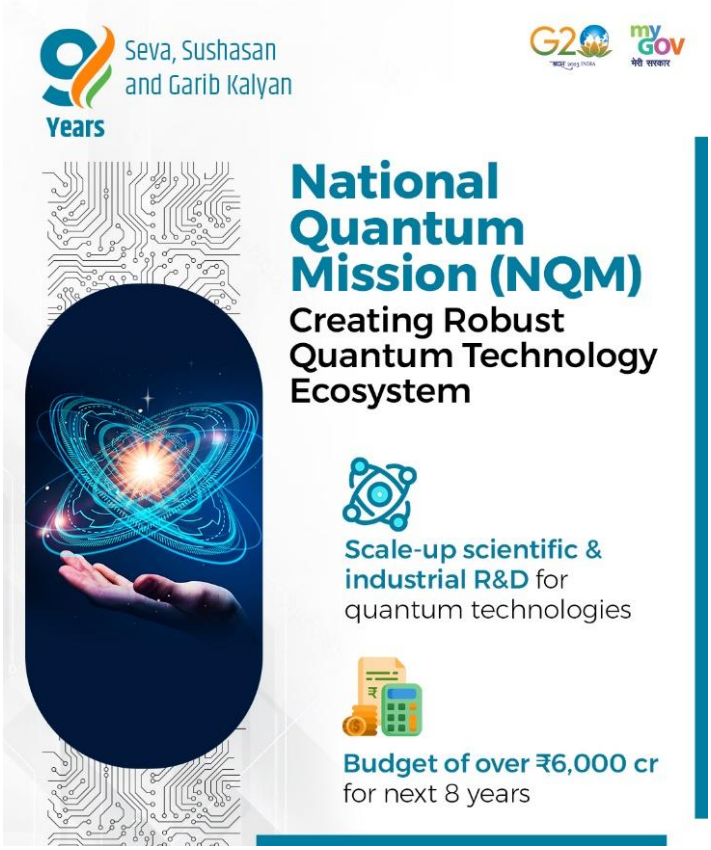
Unleashing the power of quantum technology and creating jobs of tomorrow

(Ministry of Science and Technology)

17th March, 2025

Introduction

With technology taking over the world, India is stepping into the future with the National Quantum Mission (NQM), a major initiative by the Government of India to propel the nation to the forefront of quantum technology research and development. Approved on 19th April 2023 by the Union Cabinet, the mission the mission is set to span from 2023–24 to 2030–31, with a budget allocation of ₹6,003.65 crore.



National Quantum mission, is not just a mission, but it is a bold step through which India aims to harness the power of quantum technology to drive innovation, strengthen security, and boost various industries, positioning itself as a global leader in this cutting-edge field.

What is Quantum Computing

Quantum computers use special units called qubits to store and process information. Unlike regular computers, where bits can only be 0 or 1, qubits can be both 0 and 1 at the same time. This ability to be in multiple states at once makes quantum computers different and potentially much more powerful than traditional ones.

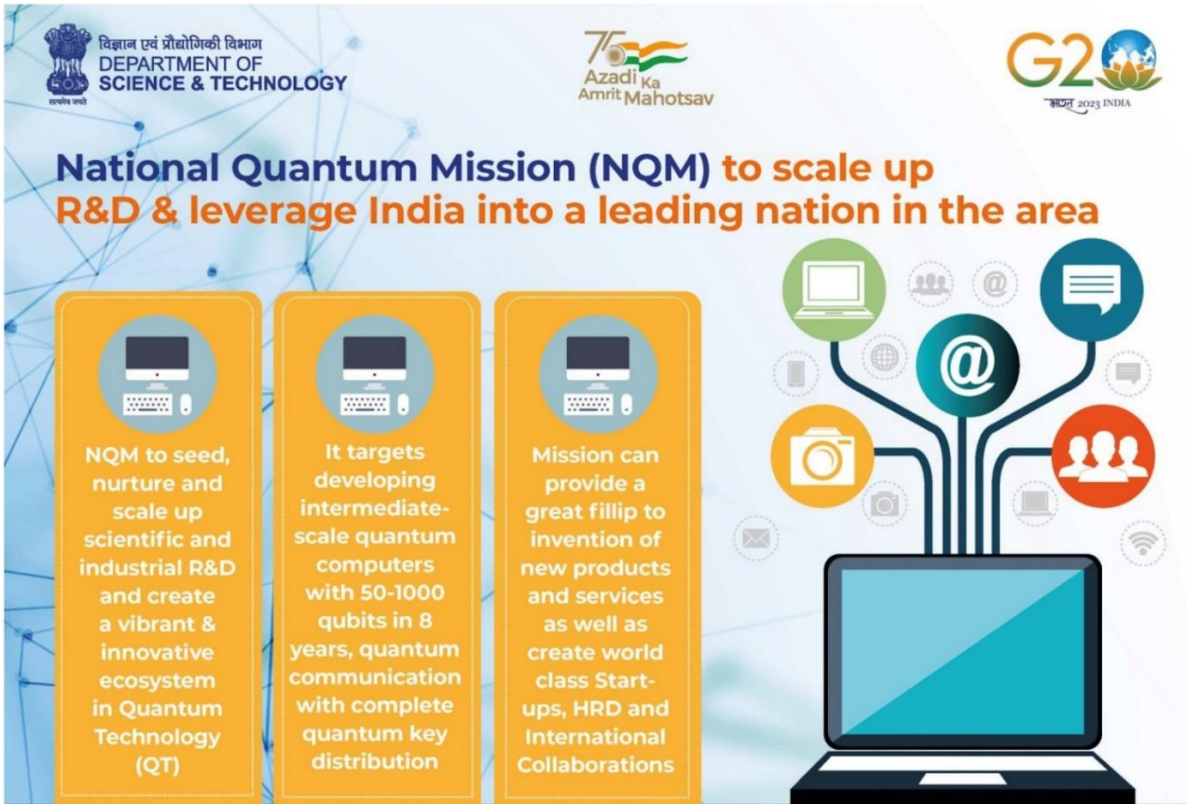
Many countries are actively working on quantum computing and other quantum technologies, and India has a great opportunity to make significant contributions. The national quantum mission offers India a chance to play a key role, especially with favourable conditions right now. The outcomes of this mission could impact healthcare, clean energy, climate change, job creation, and much more, affecting every citizen's life.

Objectives of the National Quantum Mission

With the broader aim to harness quantum technologies in India to bolster sectors like communication, cryptography, and computing, National Quantum Mission has outlined specific objectives to advance India's capabilities in the quantum realm:

- **Quantum Computing Evolution:** Develop intermediate-scale quantum computers with 20-50 physical qubits (3 years), 50-100 physical qubits (5 years), and 50-1000 physical qubits (8 years) across platforms like superconducting and photonic technologies to advance computational capabilities.
- **Satellite-Based Quantum Communication:** Establish satellite-enabled quantum-secured communication between two ground stations over 2000 km within India and extend this technology for long-distance secure quantum communication with other countries.
- **Inter-City Quantum Key Distribution (QKD):** Implement quantum-secured communication spanning 2000 km using trusted nodes and wavelength division multiplexing (WDM) on existing optical fiber infrastructure, enhancing secure data transmission.
- **Multi-Node Quantum Networks:** Develop a multi-node quantum network incorporating quantum memories, entanglement swapping, and synchronized quantum repeaters at each node, enabling scalable and robust quantum communication (2-3 nodes).
- **Advanced Quantum Sensing & Clocks:** Design highly sensitive quantum devices including magnetometers with 1 femto-Tesla/sqrt(Hz) sensitivity in atomic systems and better than 1 pico-Tesla/sqrt(Hz) in Nitrogen Vacancy centers, gravity sensors with better than 100 nano-meter/second^2 sensitivity, and atomic clocks with 10^{-19} fractional instability for precision timing, navigation, and secure communication.

- **Quantum Materials & Devices:** Develop and synthesize next-generation quantum materials such as superconductors, novel semiconductor structures, and topological materials for the fabrication of qubits, single-photon sources/detectors, entangled photon sources, and quantum sensing/metrological devices for applications in computing and communication.



The National Quantum Mission (NQM) is one of the nine initiatives under the Prime Minister's Science Technology Innovation Advisory Council (PMSTIAC), aimed at positioning India as a global leader in quantum technology. By fostering advancements in secure quantum communication, quantum computing, and precision sensing, the mission is poised to transform sectors such as telecommunications, defense, finance, and healthcare, delivering a profound societal impact.

Implementation Strategy: Thematic Hubs (T-Hubs)

The National Quantum Mission is a nationwide initiative driving cutting-edge advancements in quantum technology. As part of this mission, four Thematic Hubs (T-Hubs) have been set up, bringing together 14 Technical Groups across 17 states and 2 Union Territories. These hubs focus on technology innovation, skill development, entrepreneurship, industry partnerships, and global collaborations, ensuring a truly national impact. Women scientists from every corner of the country are actively encouraged to participate and benefit from the mission's exciting programs.

The four T-Hubs have been established across leading institutions in India:

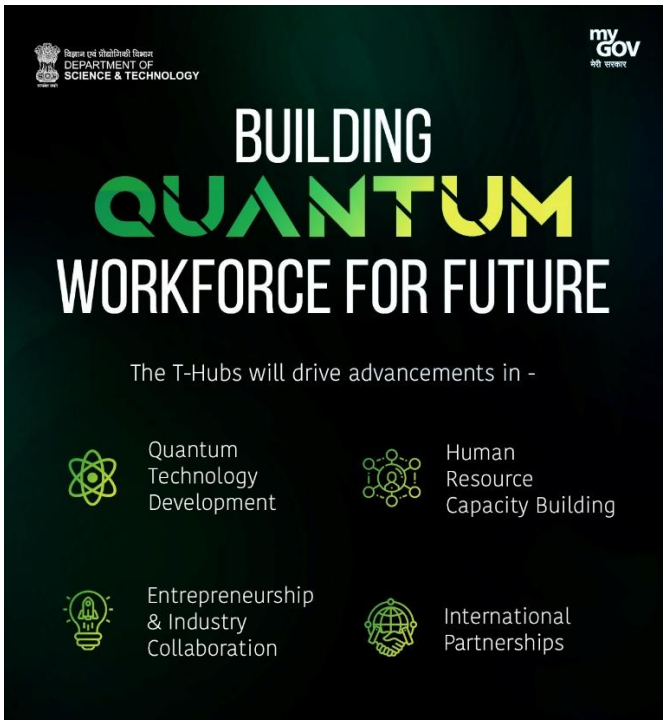
1. Indian Institute of Science (IISc) Bengaluru
2. Indian Institute of Technology (IIT), Madras along with the Centre for Development of Telematics, New Delhi
3. Indian Institute of Technology (IIT), Bombay
4. Indian Institute of Technology (IIT), Delhi.

These hubs were selected through a rigorous competitive process and each hub focuses on a specific quantum domain, driving advancements in Quantum Computing, Quantum Communication, Quantum Sensing & Metrology, and Quantum Materials & Devices.

Quantum Domains of Four Thematic Hubs

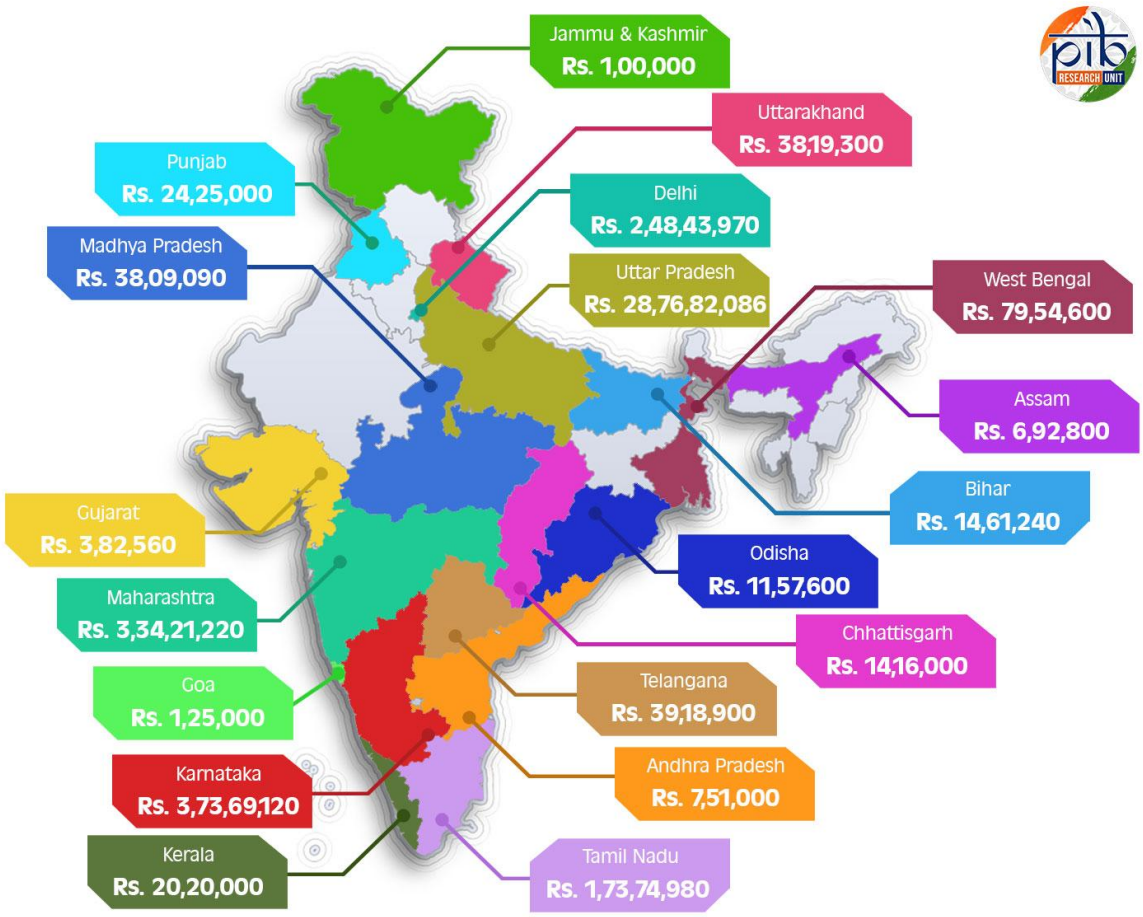
Hub-Spoke-Spike Model

Each T-Hub will follow the Hub-Spoke-Spike model, fostering a cluster-based network where research projects (Spokes) and individual research groups (Spikes) operate alongside central hubs. This structure enhances collaboration among research institutions, allowing them to share resources and expertise more effectively.



State-wise Funds Allocation

The four T-Hubs selected under NQM collectively involve 152 researchers from 43 institutions nationwide, fostering a collaborative ecosystem to drive research and innovation in quantum technologies. The activities carried out by these hubs include Technology Development, Human Resource Development, Entrepreneurship Development, Industry Collaborations, and International Collaborations.



State-wise Funds Released During 2024-2025

Initiatives under National Quantum Mission

Under NQM, dedicated efforts are underway to develop quantum-resilient encryption techniques and post-quantum cryptographic (PQC) frameworks, ensuring India's critical database systems remain secure in the quantum era. Key initiatives include:

- **Quantum-Safe Ecosystem Framework**: A concept paper has been developed to outline a strategic roadmap for securing and strengthening India's digital infrastructure against quantum threats.
- **DRDO Initiatives**: The Defence Research and Development Organization (DRDO) is leading projects focused on designing and testing quantum-resilient security schemes, along with quantum-safe symmetric and asymmetric key cryptographic algorithms.
- **Advancements by SETS**: The Society for Electronic Transactions and Security (SETS), under the Office of the Principal Scientific Adviser (PSA), is accelerating Post-Quantum Cryptography (PQC) research. It has implemented PQC algorithms for applications such as Fast IDentity Online (FIDO) authentication tokens and Internet of Things (IoT) security.

- **C-DoT Innovations**: The Centre for Development of Telematics (C-DoT), under the Department of Telecommunications (DoT), has developed cutting-edge solutions, including Quantum Key Distribution (QKD), Post-Quantum Cryptography (PQC), and Quantum Secure Video IP Phones.

These initiatives are crucial for safeguarding India's digital infrastructure against emerging quantum-era cybersecurity threats.

Global Competitiveness and Strategic Impact

The NQM has the potential to transform the country's technology development ecosystem, making it globally competitive. It will drive advancements across key sectors such as communication, healthcare, finance, and energy, with applications in drug discovery, space exploration, banking, and security. Moreover, the mission will play a crucial role in advancing national initiatives like Digital India, Make in India, Skill India, Stand-up India, Start-up India, Self-Reliant India, and the Sustainable Development Goals (SDGs).

Conclusion

The National Quantum Mission (NQM) is more than just a technological initiative—it is a strategic step towards securing India’s future in the quantum era. With significant investments, world-class research collaborations, and dedicated innovation hubs, the mission is set to propel India to the forefront of the global quantum revolution.

This initiative underscores India's commitment to scientific excellence, economic resilience, and national security in a world where quantum technologies are poised to reshape industries and societies.

References:

- https://dst.gov.in/national-quantum-mission-nqm
- https://pib.gov.in/PressReleasePage.aspx?PRID=2080120#:~:text=India's%20National%20Quantum%20Mission%20aims,their%20experience%20for%20mutual%20benefit.
- https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2083199
- https://pib.gov.in/PressReleasePage.aspx?PRID=2060435
- https://dst.gov.in/nqm-landmark-t-hubs-announced-lead-indias-quantum-revolution
- https://pib.gov.in/PressReleasePage.aspx?PRID=2060438
- https://www.pib.gov.in/PressReleasePage.aspx?PRID=2110771#:~:text=Under%20NQM%2C%20dedicated%20efforts%20are,database%20systems%20become%20quantum%2Dsafe
- https://www.facebook.com/MyGovIndia/posts/introducing-the-hub-spoke-spike-model-for-quantum-researchthis-collaborative-fra/940200794807986/
- https://dst.gov.in/national-quantum-mission-unprecedented-opportunity-india-leapfrog-quantum-computing-technologies

Santosh Kumar/ Sarla Meena/ Priya Nagar