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National Quantum Mission — India Reports Key Research Milestones

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SUBJECTS COVERED

SCIENCE & TECH

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National Quantum Mission — India Reports Key Research Milestones

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WHY IN NEWS

India's National Quantum Mission (NQM) reported key research milestones in early January 2026 — with IISc Bengaluru and TIFR Mumbai demonstrating quantum dot single-photon sources and superconducting qubit systems, advancing India toward its 2028 target of a 50-qubit prototype quantum computer.

NATIONAL QUANTUM MISSION — OVERVIEW

India's **National Quantum Mission (NQM)** was approved by the Union Cabinet on **April 19, 2023**, with a total outlay of **Rs 6,003 crore** for the period **2023–2031** (8 years). It is implemented under the **Department of Science and Technology (DST)**, Ministry of Science and Technology.

The NQM is one of nine National Missions under the **National Science Technology and Innovation Policy 2020** and is a response to the global quantum race in which the USA, China, the EU, and Canada have invested billions in quantum technologies.

JANUARY 2026 MILESTONES

IISc Bengaluru and **TIFR (Tata Institute of Fundamental Research), Mumbai** jointly reported:

Milestone	Significance
Quantum dot single-photon sources demonstrated	Foundational for quantum key distribution (QKD) and quantum cryptography
Superconducting qubit systems at near-milli-Kelvin temperatures	Core building block for quantum processors
Photonic entanglement experiments validated	Enables quantum communication over optical fibre

These milestones mark progress on India's trajectory toward the 2028 intermediate target of a **50-qubit quantum computer prototype**.

NQM TECHNOLOGY TARGETS

Timeline	Target
2026–2028	Quantum sensing, metrology applications; 50-qubit prototype
2028	Satellite-based quantum key distribution (QKD)
2028–2031	50–1,000 qubit quantum computing system
2031	Long-distance quantum secure communication (2,000 km)

TECHNOLOGY HUBS (T-HUBS)

NQM establishes **four Technology Hubs** across premier research institutions, each focused on a pillar of quantum technology:

- **Quantum Computing** — IISc Bengaluru (lead)
- **Quantum Communication** — IIT Madras / C-DoT
- **Quantum Sensing and Metrology** — IIT Bombay / NPL Delhi
- **Quantum Materials and Devices** — TIFR Mumbai

WHAT IS QUANTUM COMPUTING?

Classical computers use bits (0 or 1). **Quantum computers** use **qubits**, which exploit:

- **Superposition:** A qubit can be 0 AND 1 simultaneously until measured — enabling exponentially more computation states
- **Entanglement:** Two qubits can be instantaneously correlated regardless of distance — enabling quantum communication
- **Quantum interference:** Paths that lead to wrong answers are cancelled out, amplifying correct answers

Key applications: Drug discovery, cryptography, climate modelling, financial optimisation, and breaking current encryption standards (RSA/AES).

GLOBAL QUANTUM RACE — INDIA'S POSITION

Country	Investment	Status
USA	USD 1.2 billion (National Quantum Initiative Act, 2018)	IBM 1,000+ qubit systems; Google Willow processor (2024)
China	USD 15 billion+	Multiple satellite QKD systems; 1,000+ km quantum network
EU	EUR 1 billion (Quantum Flagship, 2018)	Pan-European quantum network underway
India	Rs 6,003 crore (~USD 720 million)	50-qubit target by 2028; NQM 2023

India's NQM places it among the top-tier quantum investing nations. The **strategic context**: Post-quantum cryptography is critical because a sufficiently powerful quantum computer could break RSA-2048 encryption, compromising SWIFT financial transfers, military communications, and government databases.

QUANTUM IN NATIONAL SECURITY

Quantum Key Distribution (QKD): Uses quantum physics (single photons) to generate encryption keys that cannot be intercepted without detection — makes eavesdropping physically impossible

India's defence applications: MoD and DRDO are exploring quantum-secured communication for border surveillance and naval coordination

ISRO angle: Satellite-based QKD (by 2028) will enable quantum-secured communication between ground stations across India's territory

UPSC RELEVANCE

National Quantum Mission (Cabinet: April 19, 2023; Rs 6,003 crore; DST; 2023–2031); qubit vs bit; superposition; entanglement; QKD; TIFR Mumbai; IISc Bengaluru.

MAINS GS-3:

Science & Technology — quantum computing strategic race; dual-use technology (civilian + defence); India's science investment adequacy; technology sovereignty.

📌 FACTS CORNER — KNOWLEDGEPEDIA

NATIONAL QUANTUM MISSION:

Approved: **April 19, 2023** by Union Cabinet

Outlay: **Rs 6,003 crore** | Duration: **2023–2031** (8 years)

Implementing ministry: **Department of Science and Technology (DST)**

Technology Hubs: **4 T-Hubs** at premier institutions

50-qubit prototype target: **2028** | 1,000-qubit system: **2031**

Satellite QKD target: **2028**

QUBIT FACTS:

Classical bit: 0 or 1 | Qubit: superposition of 0 and 1

Superposition: state before measurement

Entanglement: non-local quantum correlation (Einstein called it “spooky action at a distance”)

Decoherence: loss of quantum state due to environmental interference — main engineering challenge

KEY INSTITUTIONS (JANUARY 2026 MILESTONES):

IISc Bengaluru: Quantum Computing T-Hub lead; demonstrated superconducting qubits

TIFR Mumbai: Quantum Materials lead; demonstrated quantum dot single-photon sources

GLOBAL COMPARISONS:

IBM Eagle: 127 qubits (2021) | IBM Osprey: 433 qubits (2022) | IBM Condor: 1,121 qubits (2023)

Google Willow processor (Dec 2024): 105 qubits; solved in 5 minutes what would take 10 septillion years on classical computer

China Micius satellite: World’s first quantum satellite (2016); 1,200 km QKD demonstrated

OTHER RELEVANT FACTS:

India’s first quantum computing access: Cloud-based via IBM Q Network (2021)

Post-Quantum Cryptography (PQC): NIST (USA) standardised first PQC algorithms August 2024

NQM connects to: Digital India, Atmanirbhar Bharat in deep tech, National Supercomputing Mission

CDOT (Centre for Development of Telematics): India’s quantum communication implementation partner

Sources: DST, PIB, The Hindu

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