

PARLIAMENT QUESTION: WOMEN'S PARTICIPATION IN QUANTUM RESEARCH AND ENTREPRENEURSHIP INCLUDING FELLOWSHIPS

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The Government of India is implementing the National Quantum Mission (NQM) to promote research, development, and innovation in quantum technologies with an outlay of ₹6003.65 crore for a period of eight years. Under the Mission, four Thematic Hubs (T-Hubs), namely Quantum Computing (led by IISc Bengaluru), Quantum Communications (led by IIT Madras), Quantum Sensing (led by IIT Bombay) and Quantum Materials (led by IIT Delhi) have been established in F.Y. 2024-25. These T-Hubs comprises of 14 Technical Groups having 17 Project Teams bringing together a total of 152 researchers from 43 Institutions across 17 states and 2 UTs, including Maharashtra. The hubs are now fully functional and are engaged in a range of activities including Technology Development, Human Resource Development, Entrepreneurship Development & Industry Collaboration and International Collaborations.

Institutions from Maharashtra participating as lead or partner (member) institutions in these T-Hubs include Indian Institute of Technology (IIT) Bombay, Indian Institute of Science Education and Research (IISER) Pune, and Tata Institute of Fundamental Research (TIFR) Mumbai. IIT Bombay is the Host Institute for the Quantum Sensing & Metrology Hub, while the other institutions participate as Lead Institution and Member Institution in various Technical Groups under different technology verticals.

Details of the institutions, approved projects and funding is given in table below:

Institution	Approved Projects	Total Sanctioned (₹ Cr till Mar 2031)	Released (₹ Cr)	Utilized (₹ Cr)
IISER Pune	a. Neutral Atom Qubits b. 2D Spintronic Materials	30.61	18.14	4.71

IIT Bombay	a. Qmet Tech Foundation (T-Hub for Quantum Sensing & Metrology) b. Spin Qubits c. 2D Spintronic Materials; d. NV-centre based Sensors; e. Superconducting Qubits; f. Quantum Dots; g. 2D Photonic Qubits; h. Quantum Enhanced Sensors	558.76	114.89	22.31
TIFR Mumbai	a. Superconducting Qubits; b. NV-centre based Sensors; c. Quantum Enhanced Sensors	71.03	36.15	3.63

The mission is for a period of eight years. However, the implementation broadly has three timelines, i.e. 3 years, 5 years and 8 years. Following are the key deliverables of the mission:

- i. Develop intermediate scale quantum computers with 20-50 physical qubits, 50-100 physical qubits and 50-1000 physical qubits in 3 years, 5 years and 8 years, respectively.
- ii. Develop satellite based secure quantum communications between two ground stations over a range of 2000 kilometres within India as well as long distance secure quantum communications with other countries.
- iii. Develop inter-city quantum key distribution over 2000 km with trusted nodes using wavelength division multiplexing on existing optical fibre.
- iv. Develop multi-node quantum network with quantum memories, entanglement swapping and synchronised quantum repeaters at each node (2-3 nodes).
- v. Develop magnetometers with 1 femto-Tesla/sqrt (Hz) sensitivity in atomic systems and better than 1 pico-Tesla/sqrt (Hz) sensitivity in nitrogen vacancy-centers; gravity measurements having sensitivity better than 100 nano-meter/second² using atoms and atomic clocks with 10⁻¹⁹ fractional instability for precision timing, communications and navigation.
- vi. Design and synthesis of quantum materials such as superconductors, novel Semiconductor structures and topological materials for fabrication of quantum devices for quantum computing and communication.

Under the NQM, institutions in Maharashtra, including IIT Bombay, IISER Pune and TIFR Mumbai, have contributed to research, capacity building, startups and technology development. Under the call for Undergraduate Teaching Laboratories in Quantum Technologies, VNIT Nagpur has been selected among 23 institutions across India to provide hands-on training in quantum technologies. Further, IISER Pune, TIFR Mumbai and IIT Bombay have been selected under the Technical Groups on Quantum Algorithms. Quantum Sensing & Metrology Hub at IIT Bombay, has developed three prototypes namely Portable Magnetometer, Quantum Diamond Microscope and Nano-positioner. Research groups in Maharashtra have produced around 10 publications and trained about 500 participants in the area of Quantum Technologies. Entrepreneurship and industry collaboration form an important mandate under the Mission. Accordingly, the T-Hubs have launched a rolling call to support startups in quantum technologies. One startup from Maharashtra, namely QuPrayog Pvt. Ltd., has been supported.

The National Quantum Mission is a pan-India initiative implemented through a collaborative network of T-Hubs, academic institutions, R&D laboratories, startups and industry partners. The activities under the Mission including research projects, fellowships, training programmes, startup support and capacity-

building initiatives are open to researchers, students and entrepreneurs across the country, including women. Further, under the Quantum Sensing & Metrology Hub at IIT Bombay, fellowships have been awarded to eight women researchers, including three from Maharashtra, and various training and upskilling programmes have trained about 220 women participants in quantum science and technology.

Under NQM, technology development and skill development are carried out through T-Hubs involving academia, R&D institutions, startups and industry partners. These hubs facilitate industry engagement and interactions that support technology translation and transfer to industry, including MSMEs and startups. Additionally, the Technology Innovation Hub (TIH) established in the area of Quantum Technologies at IISER Pune, has enabled technology transfer through the indigenous iQuantrol Arbitrary Waveform Generator (AWG) developed in collaboration with Sci-Com Software India Pvt. Ltd.

This information was given by the Minister of State (Independent charge) for the Ministry of Science and Technology & Earth Sciences Dr. Jitendra Singh in a written reply in the Lok Sabha today.

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