Analysing the Progress of Quantum Technology in India

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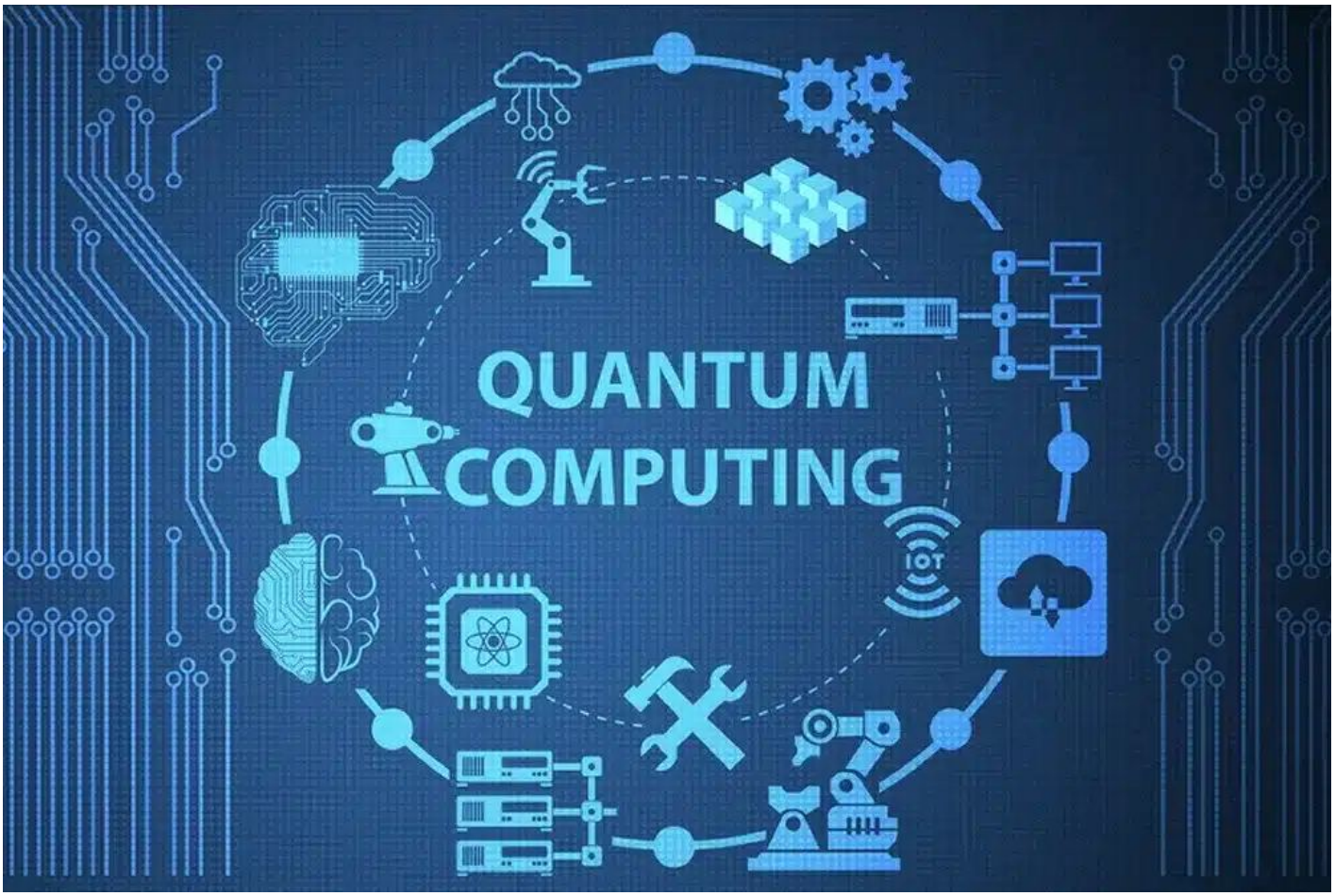

What's in today's article?

- Why in News?
- What are Foreigners' Tribunals?
- What is Quantum Technology?
- What is the Indian Government's National Quantum Mission (NQM)?
- Analysing the Progress of Quantum Technology in India

Why in News?

- In 2023, India launched the National Quantum Mission and became one of the few countries in the world to have a dedicated programme to harness the power of quantum technologies.
- But India is far behind China and the US despite having a fairly strong research base in quantum science.

What is Quantum Technology?

- It is a class of technology (developed in the early 20th century) that **works by using the principles of quantum mechanics** – the physics of subatomic particles, including quantum entanglement and quantum superposition.
- Hence, it is based on **phenomena exhibited by microscopic particles** (like photons, electrons, atoms, etc) which are quite distinct from the way normal macroscopic objects behave.
- As behaviour of these microscopic particles **can't be described by Classical Physics** (based on Newtonian Mechanics), consequently Quantum Mechanics came into picture.
- **The principles behind quantum technology:**
- **Applications:** In more reliable navigation and timing systems, more secure communications, more accurate healthcare imaging through **quantum sensing** (perform a measurement of a physical quantity), more powerful computing (**quantum computer**), etc.
- **Progress in India:** India is currently at the forefront of tapping the quantum revolution through massive investments in the field. **The** Union Budget **2020-21** proposed to spend
    - ₹8,000 crore on the newly launched National Mission on Quantum Technologies and Applications (**NMQTA**) and
    - ₹ 3660 Crore for National Mission on Interdisciplinary Cyber Physical Systems (**NM-ICPS**).

What is the Indian Government's National Quantum Mission (NQM)?

- NQM will be led by the Department of Science and Technology (DST) for **strengthening India's R&D in the quantum arena**, andfocuses on **four key domains:** computing, communications, sensors, and materials.
- It will target **developing intermediate scale** quantum computers with 50-1000 physical qubits in eight years in various platforms like superconducting and photonic technology.
- **Other objectives of the mission:**
    - **Satellite based secure quantum communications** over a range of 2000 km within India and with other countries.
    - **Develop magnetometers** with high sensitivity in atomic systems and **Atomic Clocks** for precision timing, communications and navigation.
    - It will also support design and synthesis of quantum materials such as **superconductors, novel semiconductor structures and topological materials** for fabrication of quantum devices.
- **Four 'Thematic Hubs' (T-Hubs)** will be set up in top academic and national R&D institutes in the domains of quantum computing, communication, sensing and metrology.
    - The hubs will focus on **generation of new knowledge** through basic and applied research as well as promote R&D.
- The Mission will have wide-scale applications ranging from **healthcare and diagnostics, defence, energy and data security.**

Analysing the Progress of Quantum Technology in India:

- **India lagging behind other nations:**

- A new report has found that countries like **China and the US have a huge head start** in quantum technologies over India.
- Not only have these nations **invested significantly more funds to research**, they have a larger number of professionals in this field, have been publishing more scientific papers, and have registered many more patents.

- **India still remains in competition:**
  - Indian scientists are at the **forefront of research into quantum communications and quantum sensing.**
  - Even in areas such as computing and materials, **the gap is not such that it cannot be bridged.**
  - Outside the European Union, India had the largest number of graduate students in disciplines (biochemistry, electronics, statistics, ICT, etc) aligned to quantum technologies.
  - There were more than 82,000 such students enrolled, which is more than in China or the US.
- **Way ahead for India:**
  - In a decade or two, a quantum-enabled transition can lay the groundwork for a new economy by surpassing the limitations of existing technology. This is why India wants to rapidly build its capabilities in these areas.
  - **Partnering in technology development** would ensure early success, leading to swift economic progress and access to cutting-edge technologies for India.
  - **The NQM needs to identify and promote young talent**, helping to raise a separate cadre of quantum scientists.

● **Conclusion:** There is much ground to cover, and the NQM is only the first step. But the good thing is that India is not exactly starting from zero.

Q.1. What is the difference between a computer and a quantum computer?

A quantum computer uses a quantum property called superposition or qubits to store data. Unlike a classical computer whose bits of data can exist as either a zero or a 1, a qubit can be a zero, 1, or both simultaneously.

Q.2. What is QuIC lab?

The Quantum Information and Computing (QuIC) lab at the Raman Research Institute, Bangalore is one of the first labs in India to manufacture and establish the usage of heralded and entangled photon sources towards various applications in quantum technologies.

Source: National Quantum Mission: Why India has a lot of catching up to do | ORF

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