

CURRENT AFFAIRS



S & T HEALTH ENVIRONMENT



30th to 32nd WEEK

MODULE - 1

INDIA IN QUANTUM COMPUTING QUANTUM CRYPTOGRAPHY

MODEL QUESTIONS

- What is Quantum Cryptography? Why was it in the news recently?
- What is Quantum cryptography? Examine its significance.
- Is India in the race to leap frog in Quantum Computing. Critically Comment

WHAT IS QUANTUM COMPUTING?



- Quantum computing was first proposed in the 1970s,
 - It relies on quantum physics by taking advantage of certain quantum physics properties of atoms or nuclei
 - Quantum theory represents the smallest scales and shapes of matter, describing the behaviour of subatomic particles like electrons, protons, neutrons and photons.
-
- Quantum computers work on as quantum bits, or qubits, to be the computer's processor and memory.
 - Qubits can perform certain calculations exponentially faster than conventional computers.

QUANTUM COMPUTING

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graph TD; A[QUANTUM COMPUTING] --> B[SUPERPOSITION]; A --> C[ENTANGLEMENT];
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SUPERPOSITION

- Every quantum state can be represented as a sum of two or more other distinct states.
- In Quantum superposition the state can be in configuration of both 0 and 1
- A qubit may be in a superposition of both states

ENTANGLEMENT

- Entanglement is a special connection between pairs or groups of quantum systems
- It occurs when pairs or groups of particles are generated, interact, or share spatial proximity in ways such that the quantum state of each particle cannot be described independently of the state of the other

QUANTUM Vs BINARY COMPUTING...

WHAT IS THE DIFFERENCE?

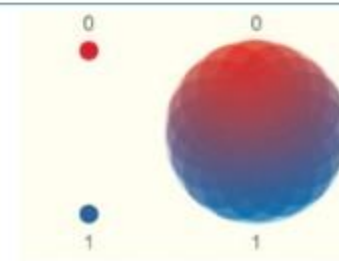
BINARY COMPUTERS

- Common digital computing requires that the data be encoded into binary digits 0 and 1
- They work relatively slower
- Binary computers use transistors as their most basic processing system and some logic gates

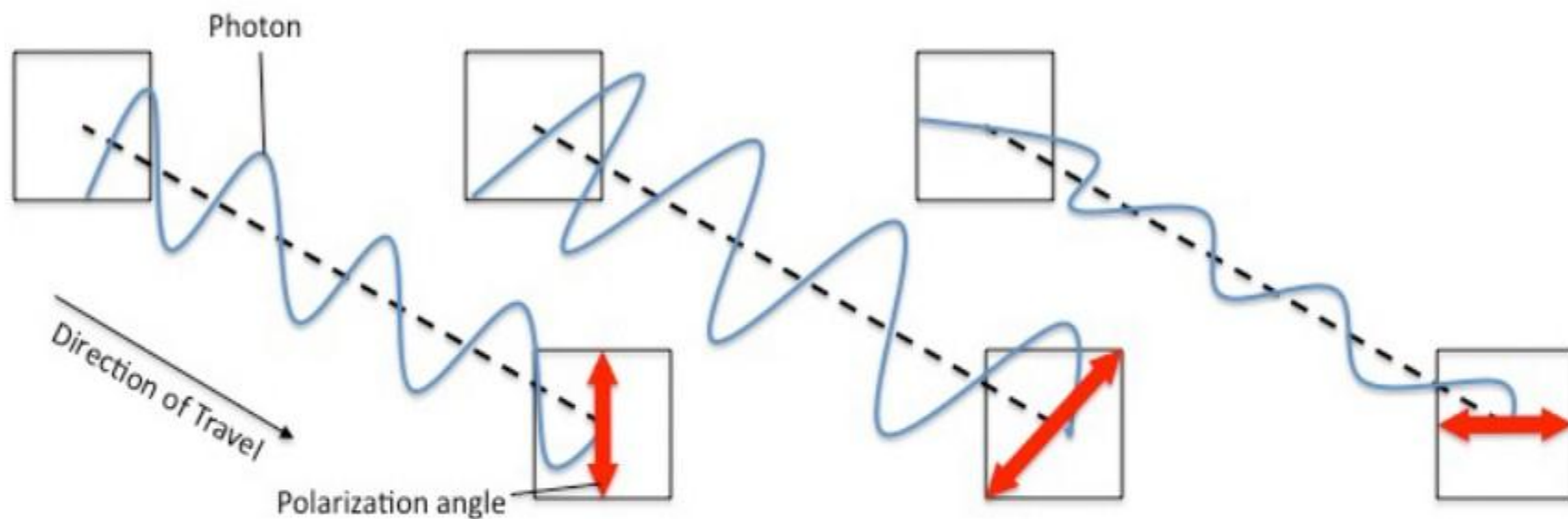
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0									
0	0	1	0	1	0	1	1									
x	x	x	x	x	x	x	x									
128	64	32	16	8	4	2	1									
↓	↓	↓	↓	↓	↓	↓	↓									
0	+	0	+	32	+	0	+	8	+	0	+	2	+	1	=	43

QUANTUM COMPUTERS

- Quantum computation uses quantum bits, which can be in superpositions of states.
- They work extremely fast because of the way such circuits are designed,
- They can do intensive number-crunching tasks much more efficiently than the fastest comparable computers by overcoming the problem of size of transistor.

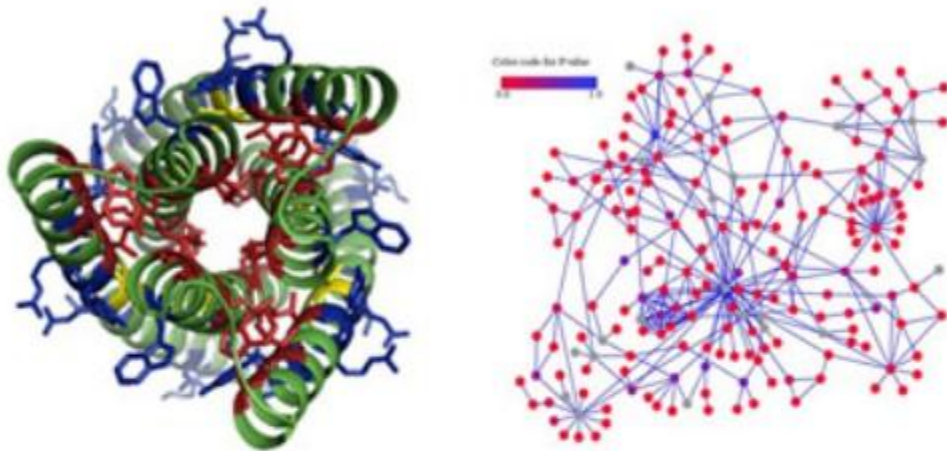


QUANTUM CRYPTOGRAPHY



- Quantum cryptography uses quantum physics and not mathematics.
- In this, key is generated using polarized photons.
- Since, it uses polarized photons, i.e. spin of photons as key, there's little chance it can be cracked using mathematics.
- Quantum cryptography makes it impossible to interfere with messages being sent (using light waves) without hindering the basic properties of the message.

APPLICATIONS OF QUANTUM CRYPTOGRAPHY



- This is the process of encoding and decoding information or messages so that it is sent securely over communication network.
 - Quantum cryptography is the science of exploiting quantum mechanical properties to perform cryptographic tasks.
-
- It is impossible to copy data encoded in a quantum state and the very act of reading data encoded in a quantum state changes the state. This could be used to detect any breach in security in quantum key distribution
 - It will help in faster calculations in fields such as weather forecasting, proteomics, drug discovery etc.

APPLICATIONS OF QUANTUM CRYPTOGRAPHY

BANKING PASSWORDS MADE SECURE



ENCRYPTED COMMUNICATION



REAL TIME LANGUAGE TRANSLATION



WEATHER FORECASTING



IMAGE & SPEECH RECOGNITION



DRUG DISCOVERY

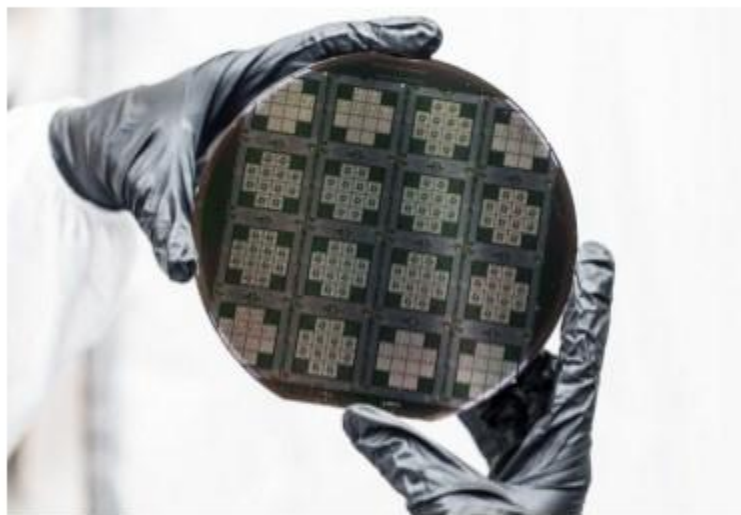


QUANTUM CRYPTOGRAPHY IN INDIA



- 1** Quantum computing is paving the way for the development of fifth generation of computers and scores over existing computing methods by performing more efficient algorithms than traditional computing.
- 2** The US, Australian and European Commission have already invested huge amounts towards development of quantum circuit
- 3** India in an attempt to tap into the next big advances in computing technology, the Department of Science and Technology (DST) has upcoming plans to fund projects to develop quantum computers.

QUANTUM CRYPTOGRAPHY IN INDIA



4 The Physics departments at the Indian Institute of Science, Bangalore and the Harish Chandra Research Institute, Allahabad, have also forayed into the theoretical aspects of quantum computing

5 Deep Talent — India has eminent scientists: India is home to the best scientists working on quantum computing.

INSTITUTES THAT HAVE TAKEN UP QUANTUM COMPUTING IN INDIA



Indian Institute of
Astrophysics
Bengaluru



Inter-University Centre for
Astronomy and Astrophysics
Pune



Aryabhata Research Institute
of Observational Sciences
Nainital



Tata Institute of
Fundamental Research,
Mumbai



Indian Institute of Science,
Bengaluru



Raman Research Institute
Bengaluru



Physical Research Laboratory
Ahmedabad

QUANTUM COMPUTING IN INDIA ... CHALLENGES



- 1** Because of its totally new function hardware issues remains the main issue in quantum technology
- 2** India lacks experimental facilities to carry out the work. In terms of R&D India lags behind other countries in quantum computing
- 3** The existing systems use principles of quantum computing to solve very limited problems.
- 4** Security remains an issue as quantum computing can open a Pandora's box for security concerns



WHAT NEEDS TO BE IMPROVED IN QUANTUM COMPUTING SYSTEMS?



- Last year, the Indian government set up the initiative – **Quantum Information Science and Technology (QuST)** with an aim to revolutionize the future computation and communication systems which will ultimately have huge impact on India.
 - It remains vital for the government to upgrade their computer systems with increasing encryption
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- Algorithms need to be made 'quantum safe'
 - To generate a wide interest among students, the country should set up high value fellowships to encourage doctoral and postdoctoral researchers to work in the area of quantum computing

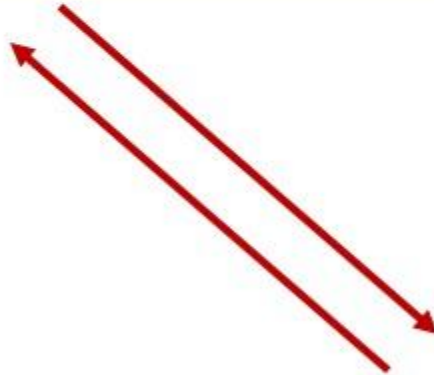
COHESION IN THE FIELDS WILL YIELD BETTER RESULTS



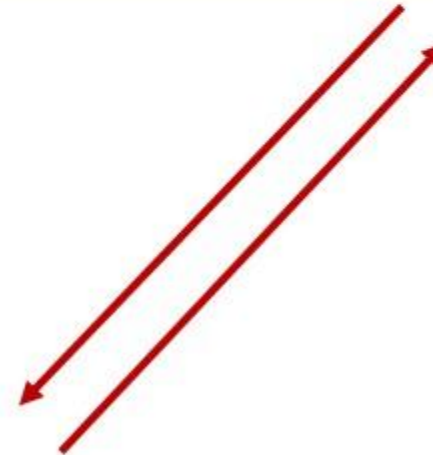
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