



# Manipulating Phonons for Quantum Computing

## Why in News?

In a recent study, researchers from IBM have developed an **Acoustic Beam-Splitter** to manipulate **Phonons** to be used for [Quantum Computing](#), potentially solving complex problems beyond the reach of conventional Computers.

- Beam-splitters, commonly used in **optics research**, **split a beam of light into two parts**. The working of a beam-splitter draws on quantum physics.

## What are Phonons?

- Phonons are packets of vibrational energy and can be **considered as the quantum equivalent of sound**.
- Similar to **photons, which are packets of light energy**, phonons can potentially serve as units of information in quantum computing (qubits).
  - Researchers are investigating ways **to manipulate and control phonons for quantum computing purposes**.
  - The challenge lies in identifying methods to manipulate phonons analogous to the manipulation of electrons or photons.

## What is Acoustic Beam-Splitter?

- It is a small device shaped like a **comb with metal bars**. It was placed in a short channel made of lithium niobate.
- At each end of the channel, there was a **superconducting qubit that could emit** and detect individual Phonons.
- The whole setup was kept at very low temperatures. The phonons represented the collective **vibration of billions of atoms and behaved similarly** to how photons interact with an optical beam-splitter.
- When a phonon was emitted from one side, it was **reflected half the time and transmitted to the other side** the other half.
- If photons were emitted from both sides at the same time, they **all ended up on one side**.
- The data confirmed that **such two-phonon interference occurred, which** shows phonons act **just as quantum as photons**.

## What is Quantum Computing?

- **About:**
  - Quantum computing is a **rapidly emerging technology that harnesses** the laws of quantum mechanics to solve problems too complex for classical computers.
    - Quantum mechanics is a **subfield of physics that describes the behavior of particles** — atoms, electrons, photons, and almost everything in the molecular and sub molecular realm.
  - It is an exciting new technology that will **shape our world tomorrow by providing us with an edge** and a myriad of possibilities.
  - It is a fundamentally different way of processing information compared to today's classical

computing systems.

▪ **Features:**

- While today's classical computers store information as binary 0 and 1 states, quantum computers draw on the fundamental laws of nature to **carry out calculations using quantum bits (Qubits)**.
- Unlike a bit that has to be a 0 or a 1, a qubit can be in a **combination of states, which allows for exponentially larger calculations** and gives them the potential to solve complex problems which even the most powerful classical supercomputers are not capable of.

Bit

0

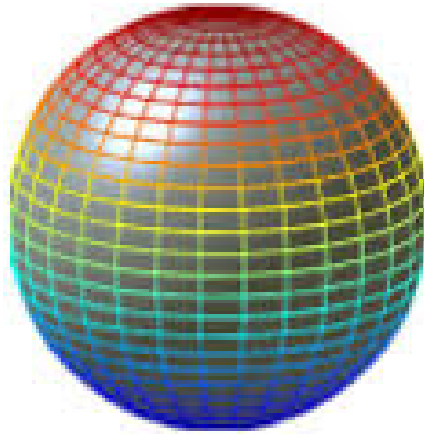


1



Qubit

0



1

▪ **Significance:**

- Quantum computers can tap into the quantum mechanical phenomenon to manipulate information and are **expected to shed light on processes of molecular and chemical interactions**, address difficult optimization problems, and boost the power of artificial intelligence.
- These could open the door to new scientific discoveries, **life-saving drugs, and improvements in supply chains**, logistics and the modelling of financial data.

## UPSC Civil Services Examination Previous Year Question (PYQ)

### Prelims

**Q. Which one of the following is the context in which the term "qubit" is mentioned?**

- (a) Cloud Services
- (b) Quantum Computing
- (c) Visible Light Communication Technologies
- (d) Wireless Communication Technologies

**Ans: (b)**

[Source: TH](#)

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