A HERMETICALLY SEALED DEVICE & METHOD TO REALIZE PHONON ANTIBUNCHING

IITM Technology Available for Licensing

Problem Statement

- Phononics is a branch of science which is the study and application of mechanical/elastic wave phenomena.. Due to its **longer timescales and deeper penetration in various media**, elastic waves are desirable for sensing and device applications.
- The lack of a true source of single phonons prevents the creation of such quantum devices. Antibunching must be enabled to find a true source of single phonons.
- **Antibunching in phonons is similar to "Photon blockade" for photons and Coulomb blockade for electrons**. Achieving antibunching by conventional means requires scaling down the device to nano scale.
- Since sound waves are greatly affected by surrounding heat, stringent requirement of temperature of a few mK (milli Kelvin) is required which cannot be achieved by standard equipment.
- There is, therefore, a need for a device and a method to efficiently achieve the antibunching.

Technology Category/ Market

Category - Phononics, Micro/Nanoelectromechanical system (MEMS/NEMS)
Applications - Quantum Ultrasonic sensing, Quantum Computing

Market - The global quantum computing market is poised to grow at a **CAGR of 36.89%** from 2022 - 2030 and it is expected to reach around USD 125 billion by 2030.

Technology

DEVICE & METHOD: (refer Fig. 1&2)
It comprises of:

- A hermetically sealed enclosure contains **a pair of resonators, one linear and one non-linear, that are Coulomb-coupled to accomplish phonon anti-bunching**.
- A predetermined pre-tension value is applied to the pair of resonators, which are separated by a predefined separation value and driven by an alternating current source coupled to the linear resonator.
- Thereafter, the parameters such as **quantity of charge, predefined pre-tension value, separation value, and driving frequency** are needed to achieve phonon anti-bunching at near-kelvin temperatures or near-micron device dimensions.
- Thereafter, these parameters are tuned based on a model (Liouville-von Neumann master equation) and the suitable temperature for Phonon antibunching is observed to be 0.04To.

Intellectual Property

- **IITM IDF Ref. 2091**
- **IN 202041038660**

DEVICE

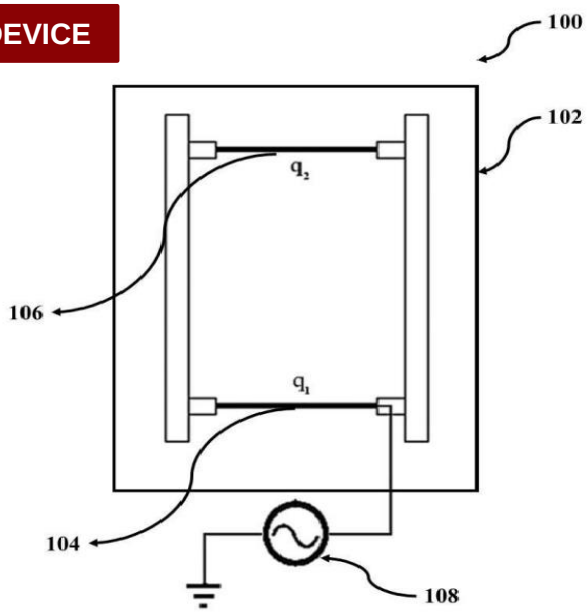

Fig 1. illustrates a device to realize phonon antibunching.

Reference numerals	Description
100	Device to realize phonon antibunching
102	Hermetically sealed casing
104	Linear Resonator
106	Non-linear Resonator
108	Alternating Current (AC) source
400	Method to realize phonon antibunching

TRL (Technology Readiness Level)

TRL - 3, Proof of concept stage

Research Lab

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Key Features / Value Proposition

1. The technique disclosed in the present disclosure is capable of achieving antibunching at near-kelvin temperatures or near micron dimensions.
2. This technology is novel due to the **gigahertz range in vacuum setting,** as a source of antibunched single phonons.
3. The pair of resonators are made of a material comprising at least one of diamond and graphene.
4. The hermetically sealed casing has an ultra-high vacuum of the order of 10-5 - 10-10 Pascal.
5. The present disclosure employing unconventional phonon blockade phenomenon implemented by a device to **achieve phonon antibunching for larger and hotter systems**.

- **Device**

Hermetically sealed casing of linear & non linear resonators which are coulomb-coupled;

- **Method**

The pair of resonators are driven by an alternating current source and pre-tensioned value besides other parameters .

- **Invention**

Phonon Antibunching is achieved at near-kelvin temperatures or near-micron device dimensions

METHOD

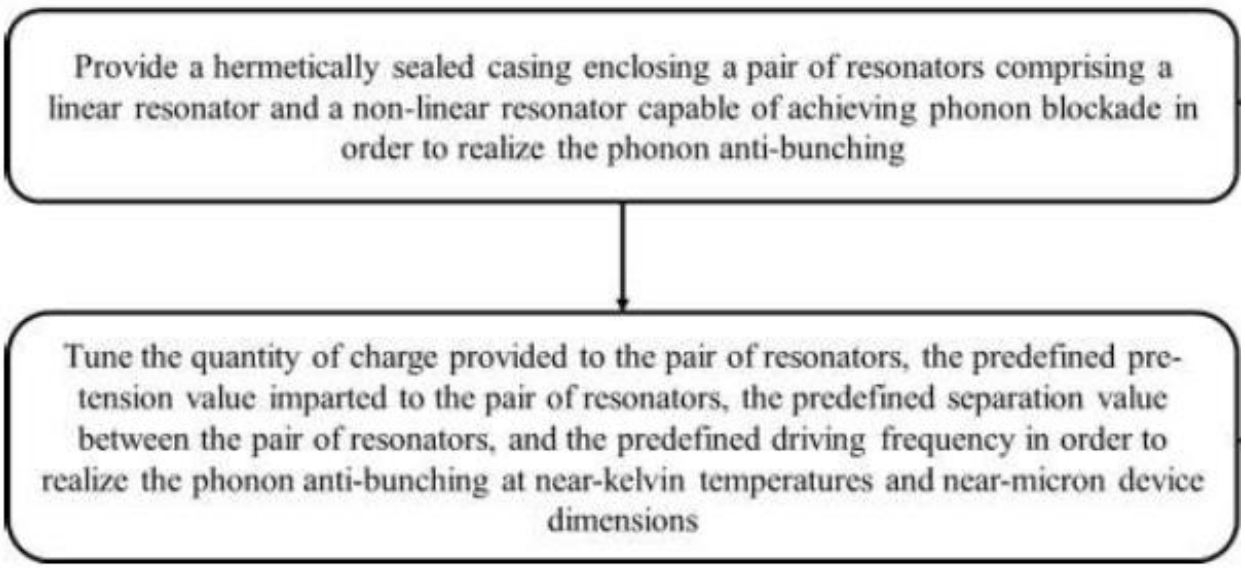

Fig 2. illustrates a method to realize phonon antibunching.

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