Two species of electrons in helium discovered

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In news

The scientists at Bangalore's Indian Institute of Science (IISc) have discovered the existence of two species of few electron bubbles (FEBs) in superfluid helium for the first time.

Key updates

- Scientists have experimentally observed FEBs for the first time and understood how they are created.
- The study was published in 'Science Advances'.
- This is the first time scientists have shown the existence of two species of few electron bubbles (FEBs) in superfluid helium.
- The scientists applied a voltage pulse to a tungsten tip on the surface of liquid helium.
- They generated a pressure wave on the charged surface, using an ultrasonic transducer.
- This allowed them to create 8EBs (electron bubbles) and 6EBs, two species of FEBs containing 8 and 6 electrons.
- The study stated that, like how current flows without resistance in superconducting materials at very low temperatures, superfluid helium also conducts heat efficiently at very low temperatures.
- Defects in the system, called vortices, however, can lower its thermal conductivity. As FEBs are present at the core of such vortices, they can help in studying how vortices interact with each other.

Single Electronic Bubble(SEB)

- As per the study, an electron injected into a superfluid

form of helium creates a single electron bubble – a cavity free of helium atoms and containing only the electron.
- The shape of the bubble depends on the energy state of the electron.

An electron bubble is the empty space created around a free electron in a cryogenic gas or liquid, such as neon or helium. They are typically very small, about 2 nm in diameter at atmospheric pressure.

Few Electron Bubbles (FEBs)

- FEBs are nano-metre-sized cavities in liquid helium containing a few free electrons.
- The number, state and interactions between them dictate the physical and chemical properties of materials.
- FEBs form an interesting system that has electron-electron interaction and electron-surface interaction.
- FEBs can also help scientists decipher turbulent flows in super-fluids and viscous fluids, or the flow of heat in superfluid helium.

Significance

- FEBs can serve as a useful model to study how the energy states of electrons and interactions between them in a material influence its properties.
- Understanding how FEBs are formed can provide insights into the assembly of soft materials, which can be used to develop next-generation quantum materials.

What is helium?

It is a chemical element of the noble gas group found especially in natural gases.

Its symbol is He and the atomic number is 2.

This gas is lighter than air.

It is a colorless, odorless, tasteless, non-toxic, inert, monatomic gas, the first in the noble gas group in the periodic table.

Its boiling point is the lowest among all the elements.

Helium is the second lightest and second most abundant element in the observable universe (hydrogen is the lightest and most abundant).

It is used chiefly for inflating airships and balloons, as a coolant for superconductors, and as a component of inert atmospheres (as in welding).

What are electrons?

- Electrons are the subatomic particles that orbit the nucleus of an atom.
- Since atoms are made up of three particles such as Protons, Neutrons and Electrons,the Electrons are called the subatomic particles .
- They are generally negative in charge and are much smaller than the nucleus of the atom.
- Electrons are known to fall into orbits or energy levels.
- Electrons are also important for the bonding of individual atoms together.
- Electrons belong to the first generation of the lepton particle family and are generally thought to be elementary particles because they have no known components or substructure.