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‘Excitonium’: A New Form Of Matter Discovered

The discovery of this new form of matter known as "excitonium" could unlock the mysteries of quantum mechanics.

SCIENCE

GREGHKA27 / THINKSTOCK

Ellainie Calangian

Scientists discovered and confirmed a new form of matter called “excitonium.” This new matter was first theorized almost 50 years ago.

The descriptions of the discovery were published in the journal *Science* on December 8. The research was led by researchers from the University of Illinois at Urbana-Champaign and colleagues from the University of California, Berkeley and University of Amsterdam. The scientists examined the non-doped crystals of the oft-analyzed transition metal dichalcogenide titanium diselenide (1T-TiSe2). And they were able to reproduce their results five times on various cleaved crystals, according to *Phys.org*.

Excitonium is made up of excitons, which are particles that are formed in an odd quantum mechanical pairing, which is an escaped electron and the hole it left behind. It is a condensate that displays macroscopic quantum phenomena such as superconductor, superfluid, or insulating electronic crystal.

Bert Halperin, a Harvard theoretical physicist, coined the word “excitonium” in the 1960s. Since then, theorists have been debating whether excitonium would be an insulator, a perfect conductor, or a superfluid. There have been

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many experimentalists proving evidence of the existence of excitonium since the 1970s. However, their findings were not of definitive proof.

In the new research, the scientists have confirmed the existence of excitonium. They found that when the electron gets excited and jumps, it leaves behind a hole. Then, the hole behaves as though it was a particle with a positive charge and attracts the escaped electron. Afterwards, when the escaped electron that has a negative charge pairs up with the hole, together they become a composite particle known as a boson, which is an exciton.

To further examine this form of matter, the scientists created a momentum-resolved electron energy-loss spectroscopy (M-EELS), which is a technique that is sensitive to excitations. The team was able to measure excitations of the particles for the first time. They also observed the "smoking gun proof," which is a soft plasmon phase that becomes visible when the material approaches its critical temperature, according to *Daily Mail*.

Professor of physics Peter Abbamonte said that the result of this study is of cosmic significance. This discovery could lead to unlocking the mysteries of quantum mechanics. In addition, it could also shed light on the metal-insulator transition in band solids, according to researchers.

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