Scientists discover new form of matter, Excitonium

Excitonium , Representational Image

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Scientists have proven the existence of new form of matter called excitonium - which was first theorised almost 50 years ago. Researchers from University of California Berkeley and University of Illinois at Urbana-Champaign in the US studied non-doped crystals of the transition metal dichalcogenide titanium diselenide (1T-TiSe2).

Excitonium is a condensate - it exhibits macroscopic quantum phenomena, like a superconductor. It is made up of excitons, particles that are formed in a very strange quantum mechanical pairing, namely that of an escaped electron and the hole it left behind.

It defies reason, but it turns out that when an electron, seated at the edge of a crowded-with-electrons valence band in a semiconductor, gets excited and jumps over the energy gap to the otherwise empty conduction band, it leaves behind a "hole" in the valence band. That hole behaves as though it were a particle with positive charge, and it attracts the escaped electron.

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When the escaped electron with its negative charge, pairs up with the hole,

the two remarkably form a composite particle, a boson - an exciton. In point of fact, the hole's particle-like attributes are due to the collective behaviour of the surrounding crowd of electrons. However, that understanding makes the pairing no less strange and wonderful, researchers said.

Until now, scientists have not had the experimental tools to positively distinguish whether what looked like excitonium was not in fact a Peierls phase. Peierls phases and exciton condensation share the same symmetry and similar observables. Abbamonte and his team were able to overcome that challenge by using a novel technique they developed called momentum-resolved electron energy-loss spectroscopy (M-EELS).

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With their new technique, the group was able to measure collective excitations of the low-energy bosonic particles, the paired electrons and holes, regardless of their momentum. "Ever since the term 'excitonium' was coined in the 1960s by Harvard theoretical physicist Bert Halperin, physicists have sought to demonstrate its existence," said Peter Abbamonte, professor at University of Illinois.

"Theorists have debated whether it would be an insulator, a perfect conductor, or a superfluid with some convincing arguments on all sides," Abbamonte said. "Since the 1970s, many experimentalists have published evidence of the existence of excitonium, but their findings were not definitive proof and could equally have been explained by a conventional structural phase transition," he said.

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The findings, published in the journal Science, holds great promise for unlocking further quantum mechanical mysteries, researchers said. It could also shed light on the metal-insulator transition in band solids, in which exciton condensation is believed to play a part. Beyond that, possible technological applications of excitonium are purely speculative.

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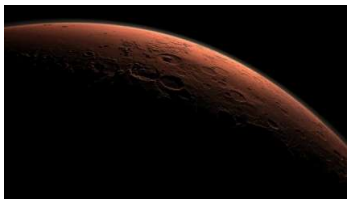

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Scientists identify genes linked to homosexuality

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Friday 8 December 2017 22:12 IST

Scientists have discovered genetic variants linked to homosexuality by analysing the entire DNA codes of gay and heterosexual men.They discovered that DNA was different for gay and straight men around two genes: SLITRK5 and SLITRK6.

The study, published in the journal Scientific Reports, is the first to look at the complete genome of over 1,000 homosexual men and compare it to genetic data from 1,231 heterosexual males.SLITRK6 is an important gene for brain development and is particularly active in the brain region which includes the hypothalamus.

The hypothalamus is crucial for producing hormones linked to control sex drive. Previous studies have shown that parts of it are up to 34 per cent larger in gay men.Researchers from North Shore University Health System (NSUHS) in the US also discovered differences in the TSHR gene, which is linked to the thyroid, 'The Telegraph' reported.

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"Because sexuality is an essential part of human life for individuals and society it is important to understand the development and expression of human sexual orientation," said Alan Sanders, from NSUHS."The goal of this study was to search for genetic underpinnings of male sexual orientation, and thus ultimately increase our knowledge of biological

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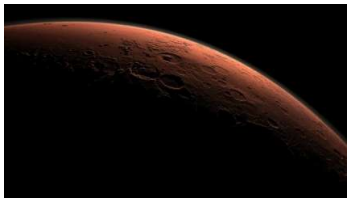

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mechanisms underlying sexual orientation," Sanders said.

However, experts suggest that the number of participants in the study is too small to draw population-wide conclusions, and the findings are not statistically significant."Even if a gene variant does show some correlation with sexual orientation, this does not mean that the gene is in any way responsible for being gay it just means it has some association with a trait that is more likely to found in the relatively few people involved as subjects in the study," said Robin Lovell-Badge from The Francis Crick Institute in the UK, who was not involved in the study.

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