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## Excitonium: A new form of matter found by the scientists

BY AMANDA HEROUX IN SCIENCE — DÉC 10, 2017



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The matter was first theorized nearly 50 years ago, but until now, it was not confirmed and lacked definitive proof.

The research was led by **Peter Abbamonte** from University of Illinois at Urbana-Champaign, working with the graduate students **Anshul Kogar** and **Mindy Rak**, and receiving input from colleagues at Illinois, University

### **Carmelo Anthony finishes with 21 as Thunder win in OT**

The Thunder won for the fourth time in their last five games and are now ninth in the Western Conference with a 12-13 record. Memphis led by as many as 20 in the first half, with the Thunder's comeback their second largest in franchise history.  
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### **Hibernian revive from two goals down against Celtic to snatch a draw**

Substitute Oli Shaw put the teams level three minutes later after spinning Jozo Simunovic and firing beyond Craig Gordon. After a goalless first period with few chances it looked as if Hibs and Celtic were going to play out a 0-0 draw.  
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### **Baby Born With Mermaid Syndrome Dies Four Hours Later**

Babies born with the syndrome usually die within a day or two due to complications in organ developments and functions. In a recent incident, a baby born with four legs was considered divine and people started flocking to see the child.  
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### **Geminid meteor shower to occur next week**

As meteor showers appear best in dark skies, picking a viewing spot with open sky and minimal light pollution would be ideal. Geminids can be seen

of California, Berkeley, and University of Amsterdam.

Researchers at the University of IL have announced [an exciting finding](#) - the discovery of a new form of matter: excitonium.

According to a description in Phys.org, excitonium is made of [excitons](#) - bonded particles made out electrons, attracted to what is termed an 'electron hole.' An electron hole is a theoretical abstraction for the empty space left behind by an excited electron that has jumped to a higher band of conduction.

The University of California Berkeley and University of IL at Urbana Champaign researchers in the United States have studied about the non-doped **crystals** of dichalcogenide titanium diselenide (1T-TiSe<sub>2</sub>)- transition metal. The hole behaves like a positively-charged particle itself.

Until now, scientists had not had the experimental tools needed to distinguish with certainty whether they were detecting excitonium or another similar phase of matter.



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"This result is of cosmic significance", affirms Abbamonte.

Previously, researchers confused excitonium with *Peierls phase* transition. Abbamonte and his crew were able to overcome that difficulty by using a novel method they produced called momentum-resolved electron energy-loss spectroscopy.

"Ever since the term "excitonium" was invented in the 1960s by Harvard theoretical physicist Bert Halperin, physicists have sought to demonstrate its existence", stated **Peter Abbamonte**, a professor at the University of IL. He says that the theorists have debated whether it would be an insulator or ideal conductor or a superfluid and according to them they were able to reproduce five times the results on the different **crystals**.

With their new technique, the group was able for the first time to measure collective excitations of the low-energy

bosonic particles, the paired electrons and holes, regardless of their momentum. The phase is "smoking gun" proof of **exciton** condensation in a three-dimensional solid and the first-ever definitive evidence for the discovery of excitonium. "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.

"The excitement generated by this discovery remained with us throughout the entire project", she continues.

This fundamental research holds great promise for unlocking further quantum mechanical mysteries: after all, the study of macroscopic quantum phenomena is what has shaped our understanding of quantum mechanics. It could also shed light on the metal-insulator transition in band solids. Beyond that, possible technological applications of excitonium are purely speculative.

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