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Scientists discover entirely new material that cannot be explained by classical physics

New development could have interesting technological applications

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Development of new quantum materials could have applications in quantum computing Getty Images/iStockphoto

An international team of physicists has “stumbled upon” an entirely new material, which they have called “Weyl-Kondo semimetal”.

The “semimetal” belongs to a category of substances known as “quantum materials”.

Quantum materials have various quirky properties, some of which could contribute to future technological innovations like quantum computing – regarded by many as the **next revolution in computer technology**.

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to understand how they work and how more useful ones can be produced.

“The word quantum in quantum materials means they have properties that cannot be described by classical **physics** – we have to invoke quantum physics,” said Dr Amalia Coldea, a quantum materials researcher at the University of Oxford who was not involved in this new study.

“Often we refer to materials where there are very strong interactions between their components – you don’t know what properties they will have, and you can’t predict in advance.”

As scientists don’t necessarily have the theories to predict the behaviour of quantum materials, often they create them experimentally first and measure them to observe their properties.

The new findings, **published in the journal Proceedings of the National Academy of Sciences**, emerged this way, with a team at the Vienna University of Technology carrying out experimental work to develop new materials, and a team at Rice University carrying out theoretical work.

“We had the material and the theory developing in parallel,” said Prof Silke Buehler-Paschen, who led the Vienna team.

Prof Buehler-Paschen and her team experimented with structures made from the metals cerium, bismuth and palladium in very specific combinations.

This work then fed into theoretical work being done by Dr Hsin-Hua Lai and his team at Rice University, who realised the potential to create an entirely new material.

“We really just stumbled upon a model in which, suddenly, we found that the mass had gone from like 1,000 times the mass of an electron to zero,” said Dr Lai.



'Angel particle' that is both matter and anti-matter discovered

This is a characteristic of "Weyl fermions", elusive particles first proposed over 80 years ago.

The scientists realised that these particles were originating due to a phenomenon known as the "Kondo effect", leading them to name their new material Weyl-Kondo semimetal.

While this research is still of interest primarily to other quantum researchers, Prof Buehler-Paschen is clear about where it could ultimately lead.

"Currently we design these materials to find new effects," she said. "We search for them because these effects could be very useful, with technological applications like [quantum computing](#)."

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