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New insight aligns quantum mechanics and special relativity

Research by Professor Emeritus Young Suh Kim, at the University of Maryland, USA, has finally confirmed the compatibility of quantum mechanics and Einstein's theory of special relativity. His work offers a deeper understanding of nature and the universe that has eluded scientists for decades. Kim's insights relate to gaps in pivotal research papers published by celebrated physicist Paul Dirac, who put forward the idea that quantum mechanics and special relativity can be combined into one theory.

For most of the 20th century the world of physics has had two approaches to understanding the universe: Einstein's theories of relativity, and quantum mechanics. In the early 20th century, Albert Einstein developed his special theory of relativity – which applies to atomic and nuclear physics; and the general theory of relativity – which applies to what happens in the universe. Around the same time, Niels Bohr's studies of the electron's orbit around a proton in the hydrogen atom led to our present theories of quantum mechanics.

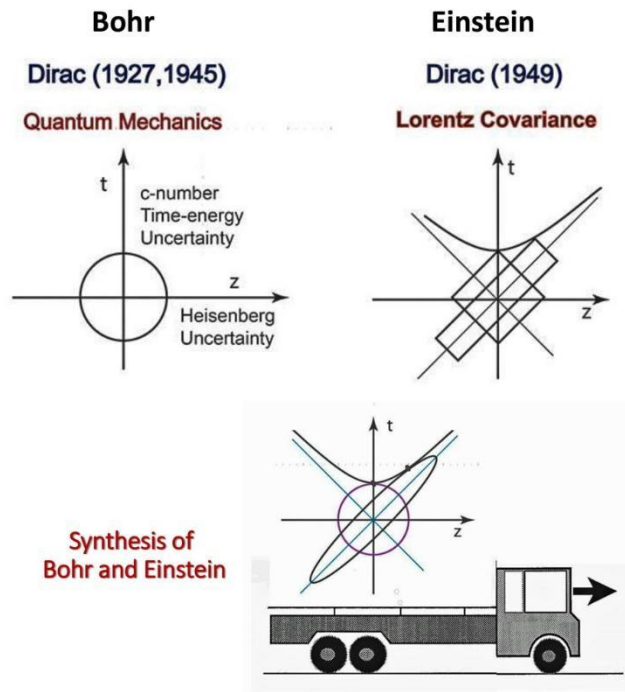
These two great achievements of modern physics are fundamentally incompatible with each other, and scientists have grappled with how to combine them for decades. Although Bohr's quantum mechanics and Einstein's relativity appeared to work well by themselves, the mathematical languages needed to describe them seemed initially to be completely incompatible with each other.

Celebrated physicist Paul Dirac was the first to see that these two theories are not at odds with each other. Dirac presented his ideas in four crucially important papers, spanning five decades of his long career. Because of his unique way of seeing the world, physicists to this day find these papers incredibly enjoyable to read. But, despite their brilliance, there were gaps in Dirac's arguments that meant his papers were never fully integrated into one cohesive proposal. In 1962, Dirac visited the University of Maryland, giving Professor Kim an excellent opportunity to learn directly from Dirac himself.

Now, Kim has integrated Dirac's papers to show that quantum mechanics and special relativity can be combined into one unified theory.

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Kim compares the brilliance of Dirac's papers to poetry, 'From 1927 to 1963, Dirac published four major papers in his lifelong effort to combine quantum mechanics and special relativity. His papers are like poems with clean and clear mathematics.' said Kim. 'However, he never used figures to illustrate his ideas. I was fortunate enough to translate his three papers into two figures, and it is then very easy to integrate those two figures into one'.



Kim's work takes us a step forward in our knowledge of how the physics which plays out on the very smallest of scales can be compatible with that which occurs on the very largest cosmological scales. This unification of relativity and quantum mechanics offers scientists a deeper understanding of nature and the universe.

NOTES FOR EDITORS

Further information

The *Research Features* article contains a full description of Professor Kim's work, including links to his research papers: [https://researchfeatures.com/reassessing-view-second-law-thermodynamics/Construction of quantum mechanics in Einstein's world by filling in the gaps in Dirac's four papers on this subject](https://researchfeatures.com/reassessing-view-second-law-thermodynamics/Construction%20of%20quantum%20mechanics%20in%20Einstein's%20world%20by%20filling%20in%20the%20gaps%20in%20Dirac's%20four%20papers%20on%20this%20subject)

About the researcher

Professor Young Suh Kim has a PhD in Physics from Princeton University, and is professor emeritus at the University of Maryland. He has integrated Dirac's pivotal papers to construct quantum mechanics valid in the Lorentz-covariant world based on Einstein's special relativity which produces $E = mc^2$.

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