Researchers describe the wavefunction of Schroedinger's cat

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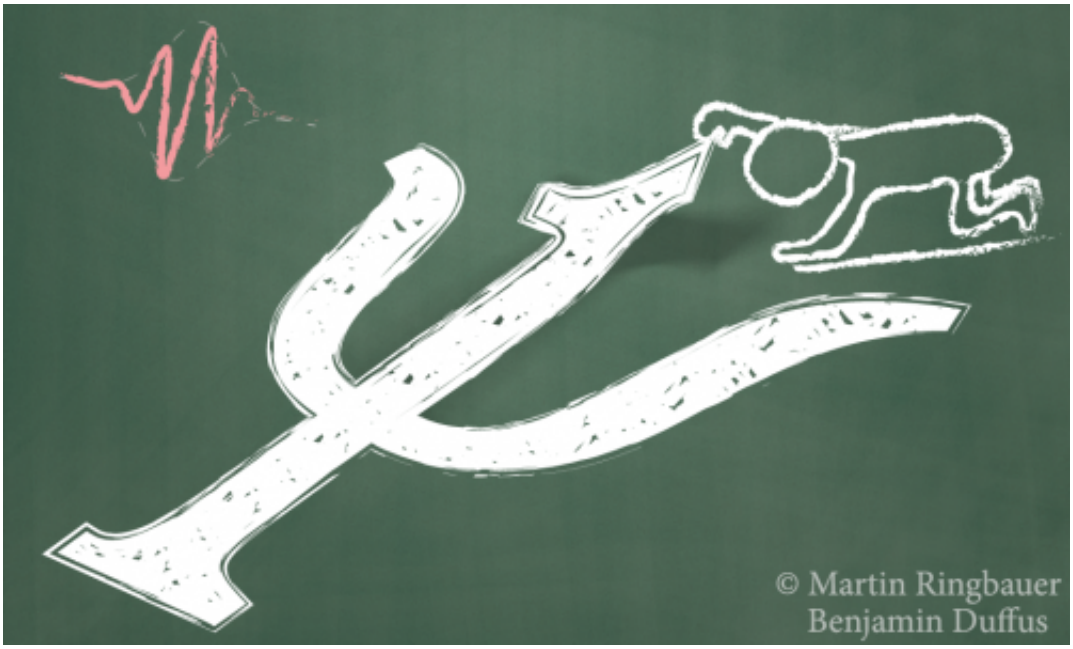

Looking underneath the wavefunction — represented by the Greek letter “psi” — in the search for quantum reality. Credit: Benjamin Duffus and Martin Ringbauer

Schrödinger's cat highlights a long-standing dilemma in quantum mechanics: is the cat really alive and dead, or is the weirdness just in our head?

Researchers at The University of Queensland have now made major progress in answering this question.

Using four-dimensional states of photons, and subjecting them to very precise measurements, they ruled out the popular view that describing the cat as dead and alive is just due to a lack of knowledge about its real state.

As with all objects in quantum physics, the cat is described by the quantum wavefunction.

Dr Alessandro Fedrizzi, from the UQ School of Mathematics and Physics, explains that although the quantum wavefunction is our central tool for describing physical systems in quantum mechanics, it is still unclear what it actually is.

"Does it only represent our limited knowledge about the real state of a system, or is it in direct correspondence with this reality?

"And is there any objective reality at all?"

This debate has remained purely theoretical for decades, until three teams of quantum theorists—including co-authors Dr Cyril Branciard and Dr Eric Cavalcanti—recently proposed experimental tests to answer this question.

"The new approach tests whether the competing interpretations of the wavefunction can explain why we cannot tell quantum states apart with certainty, which is a central feature of quantum mechanics," says lead author Mr Martin Ringbauer.

"Our results suggest that, if there is objective reality, the wavefunction corresponds to this reality."

In other words, Schrödinger's cat really is in a state of being both alive and dead.

As measurements improve further, physicists will be left with two possible interpretations of the wavefunction: either the wavefunction is completely real, or nothing is.

More information: "Measurements on the reality of the wavefunction." *Nature Physics* (2015) DOI: 10.1038/nphys3233

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