Experimental method measures robustness of quantum coherence

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Researchers at the UAB have come up with a method to measure the strength of the superposition coherence in any given quantum state. The method, published in the journal *Proceedings of the Royal Society A*, is based on the measurement of experimental parameters related to the visibility of the interference fringe patterns produced when the two states are superimposed.

One of the main principles of quantum physics is the superposition of states. Systems are simultaneously in different states, i.e. "alive and dead" at the same time, in the case of the Schrödinger's cat thought experiment. When measured, the superstate collapses to one of the possibilities. As long as the superposition lasts, the system is said to be in a coherent state. In real systems, a set of diverse elemental particles or atoms existing in a state of superposition—for example, in different positions simultaneously, with different levels of energy, or with two opposite spins (rotating trajectories)—are said to have weak coherence. The superposition is broken easily by the vibrations associated with temperature and environmental interactions.

Researchers from the UAB Department of Physics and the Indian Institute of Science, Education and Research Kolkata propose a new way of measuring the robustness of the quantum coherence of a superimposed state. The method is based on the measurement of the visibility of interference fringes characterized by alternate dark and intense stripes produced when two coherent states coincide.

According to UAB researcher Andreas Winter, "The existence of quantum superpositions is at the heart of the non-classical nature of quantum physics. It manifests itself by producing interference patterns in interferometric experiments. We show that each visibility parameter of the interference pattern, such as the difference between maximums and minimums in intensity, gives rise to a measure of coherence. The study thus connects the recently burgeoning, but hitherto abstract resource theory of coherence to concrete and physically relevant observations."

The scientists, experts in information quantum theory, study the intrinsic properties of quantum mechanics such as entanglement, uncertainty, superposition, indeterminism and interference, to be used as resources in quantum information processing, the foundation of future quantum computers.

More information: Tanmoy Biswas et al. Interferometric visibility and coherence, *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Science* (2017). DOI: 10.1098/rspa.2017.0170

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