

Observation affects motion

An every-day experience and postulate of classical physics is that dynamical processes - for example motion - can be observed without any back action on the dynamical process itself. In quantum mechanics this paradigm is violated: A quantum object is unavoidably influenced by its observation. In extreme cases, a dynamical process can be completely inhibited by observation. In analogy to a classical antic paradox this is called quantum Zeno effect.

Recently, physicists from Humboldt-Universität zu Berlin achieved a major breakthrough: In an article in the learned journal *Physical Review A* that was also discussed in *Nature News*, researchers around Janik Wolters from the nano optics group of Professor Oliver Benson report for the first successful demonstration of the quantum Zeno effect on one single electron in a solid state system.

"Previous experiments from the Nobel laureate D.J. Wineland used many trapped atoms, or more precisely ions in ultra-high vacuum apparatuses. Our experiment succeeded with exactly one quantum system in a solid matrix at room-temperature - without exorbitant experimental effort", comments Janik Wolters. The physicists from HU used color center in diamond as quantum system, in their case a nitrogen atom that is immobilized in a diamond.

Using microwave radiation the researchers rotated the spin of this color center, while it's orientation was measured via precise laser excitation. This dynamical process is comparable to the rotation of a miniaturized magnet. Remarkably, the

rotation of the spin could be strongly inhibited by one single measurement of its orientation. "The measurement destroys the quantum mechanical coherence and thus inhibits the dynamics. By measuring or not measuring, we decide if the spin rotation stops or continues", explains Wolters. A novel aspect of this experiment is that it can be repeated over and over again on one and the same quantum system due to the realization in a solid at room temperature. Thus, the scientists can exclude that the observed effect originates in averaging over many similar quantum systems.

The researcher's results are highly relevant. "From the experiments, we expect deeper understanding of the underlying quantum dynamics and further insight into the complex interplay between quantum systems and their environment", says Prof. Benson.

Observation of the Quantum Zeno Effect on a Single Solid State Spin

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