Physicist suggests Einstein could have beaten Bohr in famous thought experiment

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(PhysOrg.com) -- Way back in the 1930's, Albert Einstein and Niels Bohr were sparring over ideas related to whether the new field of quantum mechanics was correct. In one thought experiment that Einstein said showed that quantum mechanics was inconsistent, he said the Heisenberg principal could be shown to be inconsistent by imagining a box of photons that could be measured both time-wise and energy-wise at the same time. Bohr knocked down Einstein's arguments and in the process elevated his stature among their peers. Now, however, Hrvoje Nikoli at the Rudjer Boskovic Institute in Croatia says that Einstein could have won that argument had he used the argument he gave Bohr just five years later in trying to explain how entanglement made quantum mechanics inconsistent. Nikoli has published his reasoning on the preprint server *arXiv*.

In the first thought experiment presented by Einstein, he proposed that if the lid were opened on a box full of photons allowing just one to escape, it could be measured time-wise by simply measuring how long the box was open. He then said it could be simultaneously measured energy-wise by measuring the change in the total amount of energy in the box. This he said disproved the Heisenberg principle which meant quantum mechanics was inconsistent. After some thought, Bohr replied that if Einstein's own theory of relativity were brought into the experiment, the apparent inconsistency could be explained away by noting that the measurement took place in a gravitational field, thus, the measurement of the time that the lid was open on the box would depend on it's position. Einstein was unable to counter Bohr's argument and lost that

round.

Five years later, the two were at it again. This time Einstein said that there was no way quantum mechanics could include both entanglement and the belief that nothing could travel faster than the speed of light. If causing a change to one particle instantly caused a change in the other, how could it do so without violating such a basic principle? He called the whole thing “spooky action at a distance.” Bohr was unable to come up with a reasonable argument in response. And neither has anyone else for that matter, though John Bell made it more palatable in 1964 by declaring entanglement a wholly new kind of phenomenon, which he dubbed "nonlocal."

This is where Nikoli comes in. He says that had Einstein put forth his arguments regarding entanglement five years earlier during their debate about the Heisenberg principle, he could have won by suggesting that the photon escaping from the box was entangled with the box itself, thus quashing any possible response from Bohr. But alas, that was not to be, Einstein didn’t think of that and thus, Bohr went on to win that first round, one of just a few such occurrences in Einstein’s illustrious career.

More information: EPR before EPR: a 1930 Einstein-Bohr thought experiment revisited, arXiv:1203.1139v1 [quant-ph] arxiv.org/abs/1203.1139

In 1930 Einstein argued against consistency of the time-energy uncertainty relation by discussing a thought experiment involving a measurement of mass of the box which emitted a photon. Bohr seemingly triumphed over Einstein by arguing that the Einstein's own general theory of relativity saves the consistency of quantum mechanics. We revisit this thought experiment from a modern point of view and find that neither Einstein nor Bohr was right. Instead, this thought experiment should be thought of as an early example of a system

demonstrating nonlocal "EPR" quantum correlations, five years before the famous Einstein-Podolsky-Rosen paper.

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