Violation of Bell inequalities

Alex Popert, Youri Popoff, Lea Krämer

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Bell inequalities are constraints that any theory based on local hidden variables (local realism) has to satisfy, but that are violated by quantum mechanics. As they can in principle be verified experimentally, they are a powerful tool to ultimately refute any theory of local realism, giving a strong argument that the world is inherently quantum.
There are many physical systems that can be used for such an experiment, such as photons, atom-based systems or superconducting circuits. However, in any such implementation special care has to be taken to close a number of loopholes. After a general introduction into Bell inequalities and experimental loopholes, we present a concrete example of a Bell inequality violation experiment using entangled photons (Weihs, Jennewein, Simon, Weinfurter, Zeilinger (PRL, 1998)). The focus of this experiment was to close the locality loophole, and we will show how this is achieved through a combination of fast measurements and large spatial separation.