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Bell's inequality and two conscientious experiments

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ABSTRACT:

Local realism is the worldview in which physical properties of objects exist independently of measurement and where physical influences cannot travel faster than the speed of light. Bell's theorem states that this worldview is incompatible with the predictions of quantum mechanics, as is expressed in Bell's inequalities. Previous experiments convincingly supported the quantum predictions. Yet, every experiment requires assumptions that provide loopholes for a local realist explanation.

In this work we report on two Bell experiments. One closes the so-called fair-sampling loophole in a photonic setup by ensuring high collection efficiency from the photon pair source through the system to the detection. The other experiment closes the several most significant of these loopholes simultaneously: Using a well-optimized source of entangled photons, rapid setting generation, and highly efficient superconducting detectors, we observe a violation of a Bell inequality with high statistical significance.