An Experimental Refutation Against the Retrocausality Interpretation of the DCQE

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?We demonstrate that the delayed choice quantum eraser (DCQE) exhibits no retrocausality. While the lack of necessity for retrocausality in interpreting the DCQE has been previously proposed, its inconsistency with experimental results has not been well discussed. To address this controversy, we designed a polarization-based optical experiment to resolve the issue. The event in which the signal photon enters the interferometer is spacelike-separated from the event in which the measurement basis of the idler photon is chosen, ruling out any possibility of causal interaction between the two events. Since original quantum eraser (QE) experiments and the 'spacelike-separated QE' produce identical results, it can be inferred that the QE is not a consequence of causal interaction between the signal and idler photons. Therefore, we conclude that retrocausality is an inappropriate explanation for the DCQE and that a complete understanding of entanglement—a phenomenon at the core of the quantum eraser—is crucial for properly understanding the DCQE.

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