Entanglement Between Photons that have Never Coexisted
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The role of the timing and order of quantum measurements is not just a fundamental question of quantum mechanics, but also a puzzling one. Any part of a quantum system that has finished evolving, can be measured immediately or saved for later, without affecting the final results, regardless of the continued evolution of the rest of the system. In addition, the non-locality of quantum mechanics, as manifested by entanglement, does not apply only to particles with spatial separation, but also with temporal separation. Here we demonstrate these principles by generating and fully characterizing an entangled pair of photons that never coexisted. Using entanglement swapping between two temporally separated photon pairs we entangle one photon from the first pair with another photon from the second pair. The first photon was detected even before the other was created. The observed quantum correlations manifest the non-locality of quantum mechanics in spacetime.