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Quantum decay at short, intermediate, and long times: Observation in integrated photonics

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The decay of an unstable system is usually described by an exponential law. However, quantum mechanics generally predicts deviations from the exponential at both short and long times. The latter case, in which a power-law decay is predicted, is particularly elusive, as its onset commonly occurs when the survival probability is heavily depleted. We describe a hopping model on a semi-infinite array, in which a power-law quantum decay can be observed. We report the experimental observation non-exponential decay dynamics, including power-law regimes, in arrays of parallel single-mode optical waveguides, fabricated by femtosecond laser direct inscription. We finally comment on the features of state propagation in the array, highlighting the behavior of wavefronts.

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