Avalanche amplification of a single exciton in a semiconductor nanowire

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Interfacing single photons and electrons is a crucial element in sharing quantum information between remote solid-state qubits. Semiconductor nanowires offer the unique possibility of combining optical quantum dots with avalanche photodiodes, thus enabling the conversion of an incoming single photon into a macroscopic current for efficient electrical detection. Currently, millions of excitation events are required to perform electrical readout of an exciton qubit state. Here, we demonstrate multiplication of carriers from only a single exciton generated in a quantum dot after tunnelling into a nanowire avalanche photodiode. Owing to the large amplification of both electrons and holes (>104), we reduce by four orders of magnitude the number of excitation events required to electrically detect a single exciton generated in a quantum dot. This work represents a significant step towards achieving single-shot electrical readout and offers a new functionality for on-chip quantum information circuits.

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