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A bright and fast source of coherent single photons

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Author(s) Tomm, Natasha; Javadi, Alisa; Antoniadis, Nadia Olympia; Najer, Daniel; Loebl, Matthias Christian; Korsch, Alexander Rolf; Schott, Ruediger; Valentin, Sascha Rene; Wieck, Andreas Dirk; Ludwig, Arne; Warburton, Richard John
Author(s) at UniBasel Warburton, Richard ;
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A single-photon source is an enabling technology in device-independent quantum communication1, quantum simulation2,3, and linear optics-based4 and measurement-based quantum computing5. These applications employ many photons and place stringent requirements on the efficiency of single-photon creation. The scaling on efficiency is typically an exponential function of the number of photons. Schemes taking full advantage of quantum superpositions also depend sensitively on the coherence of the photons, that is, their indistinguishability6. Here, we report a single-photon source with a high end-to-end efficiency. We employ gated quantum dots in an open, tunable microcavity7. The gating provides control of the charge and electrical tuning of the emission frequency; the high-quality material ensures low noise; and the tunability of the microcavity compensates for the lack of control in quantum dot position and emission frequency. Transmission through the top mirror is the dominant escape route for photons from the microcavity, and this output is well matched to a single-mode fibre. With this design, we can create a single photon at the output of the final optical fibre on-demand with a probability of up to 57% and with an average two-photon interference visibility of 97.5%. Coherence persists in trains of thousands of photons with single-photon creation at a repetition rate of 1.
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