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Single-photon emission driven by a surface acoustic wave in a lateral undoped GaAs/AlGaAs n-i-p junction, resolved in time, position and energy

We induce both electrons and holes in an undoped GaAs quantum well using surface gates to form a lateral n-i-p junction, which is confined into a quasi-1D channel by etching and side gates. A surface acoustic wave (SAW) collects electrons in the n-region and transports them into the p-region where they recombine with holes. The narrow channel and the SAW potential can combine to limit the number of electrons pumped per cycle to 1, so the recombination with holes should produce a stream of single photons. We observe SAW-driven light emission. Time-resolved electroluminescence in the regime where less than one electron is transported per cycle on average shows a recombination time of 100 ps.

The second-order correlation, g2(0), measured using a Hanbury Brown and Twiss interferometer with single-photon detectors, shows the signature of antibunching and satisfies the criterion for being a single-photon source, $g2(0)<0.5$. SAW-driven pumping holes into a region of electrons shows a much shorter recombination time. The dynamics is investigated in detail by resolving simultaneously the emission time, position in the channel, and energy, at T=1.5K.