

A Single Photon Source based on Two-Photon Emission from a Quantum-Dot Biexciton

Dirk Heinze¹, Tom Praschan¹, Artur Zrenner¹, Andrea Walther², and Stefan Schumacher¹

¹ Department of Physics and Center for Optoelectronics and Photonics Paderborn (CeOPP),
Paderborn University, Warburger Strasse 100, 33098 Paderborn, Germany

² Institute of Mathematics, Paderborn University, Warburger Strasse 100, 33098 Paderborn, Germany

Abstract

Single photon sources are a key component in quantum information applications. In this contribution we focus on a two-photon process to produce single photons, whose properties, for instance the state of polarization, the time of emission and the spectral shape, can be controlled optically. Further, we explore the potential to emit single photons on demand. Here, complex and optimized pulse shapes may be the key to increase the single photon emission probability.

Semiconductor quantum dots are known to be good sources for quantum light. Two-photon processes from a biexciton have shown the potential to emit both polarization-entangled photon pairs [1, 4] and single photons [2]. In this contribution we analyze the single photon emission based on a two-photon emission process theoretically. Starting with an occupied biexciton state, a laser pulse drives the system into a virtual state inside the band gap of the semiconductor (see figure 1a)). Once the system relaxes to the ground state a single photon is emitted (see figure 1b)). Due to the partly stimulated nature of this two-photon transition the properties of the single photon can be tailored optically. This allows us to control the polarization state [2], the time of emission [2] and the spectral properties [3] of the single photon. A high-Q cavity enhances the single photon emission. Tuning the optical fields close to the exciton and biexciton states increases the possibility of undesirable quantum interferences [5]. In this regime, we analyze the effect of complex and numerically optimized pulse shapes on the emission process to enhance and optimize the resulting single photon process (see figure 1c)) towards on-demand emission.

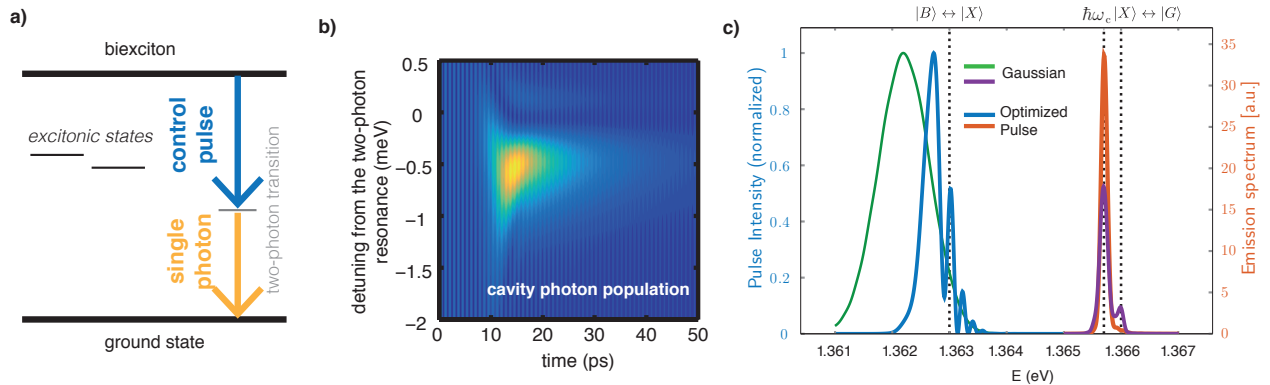


Figure 1: **Single photon emission:** In a) the single photon emission scheme based on a two-photon process is shown. The calculated single photon population in a cavity mode is depicted in b). The single photon emission c) of a cavity mode is increased using an optimized control pulse.

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