Two-color excitation for quantum systems

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Coherently exciting quantum systems is of crucial important for their utilization in quantum technology. The standard excitation mechanism is the resonant excitation, which leads to Rabi oscillations in a few-level system. However, for photon generation, it might be advantageous, when the frequency of the exciting light differs from the emitted light. Hence, off-resonant excitation methods are necessary. In semiconductor quantum dots, one possibility is the phonon-assisted excitation, but it has the drawback that it is not coherent. A coherent option is the excitation with two-laser off-resonant pulses. For this, we developed the Swing-UP of quantum EmitteR (SUPER) method [1], which uses two red-detuned pulses to excite the system. While a single pulse alone does not lead to excitation, the coherent interplay between the pulses and the few-level system results in a full control of the quantum system.
In this talk, I will introduce the SUPER scheme and discuss how it can be understood within a dressed state picture [2]. In experiment, the SUPER excitation has been demonstrated to induce emitter inversion for semiconductor quantum dots [3] and SnV centers in diamond [4]. However, the theory is universally applicable to any quantum system with an optical transition, such as Rydberg excitons.

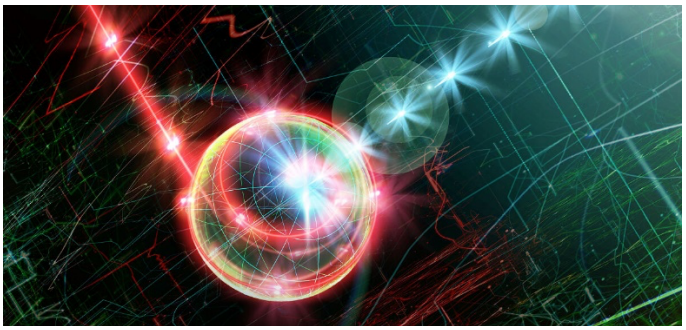

Fig. 1. Artistic view Bloch vector under the excitation via the SUPER scheme resulting in single photon emission.

References

[1] Bracht et al., PRX Quantum 2, 040354 (2021)

[2] T. K. Bracht et al., Phys. Rev. B 107 , 035425 (2023)

[3] Karli et al., Nano Lett. 16, 6567 (2022)

[4] C. G. Torun et al. arXiv:2312.05246 (2023)