Quantum dots in microcavities: from single spins to engineered states of light

Steindl, P.

Curriculum Vitae

Petr Steindl was born on 20th January of 1994 in Brno, Czechia. In 2013, after completing his pre-university education at Gymnázium Brno, třída Kapitána Jaroše, he started his studies in Physics at Masaryk University (Brno, Czechia). During his bachelor's studies, he worked under the supervision of Dr. Klenovský specialized in the optical spectroscopy of III-V semiconductor quantum dots with spatially indirect optical transitions.

After his bachelor's graduation in 2016, he joined the two-year Master's program at Masaryk University with a specialization in condensed matter physics and continued his research under Dr. Klenovský with two research topics. In his first year, he was developing metalized tips for tip-enhanced Raman spectroscopy of semiconductor quantum dots and used this method to study the strain distribution around, and defect implantation in, germanium-based quantum dots. Simultaneously and mostly in his second year, he worked on his master's thesis, where he investigated both experimentally and theoretically the optical properties of III-V quantum dots, including exotic antimony-rich material combinations proposed for flash memories. During this year, he collaborated with, visited, and performed experiments at several international institutions (JKU Linz, TU Berlin, IMM-CSIC Madrid). For his work, Petr was awarded with several awards, including the Award of the Czech Minister of Education, Youth, and Sports for outstanding students.

After graduating with a MSc degree in 2018, Petr started the Ph.D. program at Masaryk University on a theoretical research topic with semiconductor quantum dots. He spent six months at Tyndal Institute (Cork, Ireland), where he studied the emission properties of interstitial defects in germanium quantum dots using density-function theory, under the supervision of Dr. Murphy-Armando. During this period, Petr missed experimental work and decided to switch to a Ph.D. in experimental physics.

In April 2019, Petr joined the group of Wolfgang Löffler at Leiden University as a Ph.D. candidate and started mostly experimental work using devices with InGaAs quantum dots embedded in optical cavities. Using resonant optical fields to operate the devices, he improved cross-polarization filtering methods, enabling him to perform cavity-enhanced spin-state spectroscopy and optimize single-photon emission. Having the access to high-quality single photons, he explored their combining and synthesis of multi-photon states in simple linear optics setups.

List of publications

1. P. Klenovský, D. Hemzal, **P. Steindl**, M. Zíková, V. Křápek, and J. Humlíček. *Polarization anisotropy of the emission from type-II quantum dots.* Phys. Rev. B **92**, 241302(R) (2015)

2. P. Klenovský, **P. Steindl**, D. Geffroy, *Excitonic structure and pumping power dependent emission blue-shift of type-II quantum dots*, Scientific Reports **7**, 45568 (2017)

3. P. Klenovský, **P. Steindl**, J. Aberl, E. Zallo, R. Trotta, A. Rastelli, and T. Fromherz, *Effect of second-order piezoelectricity on the excitonic structure of stress-tuned In(Ga)As/GaAs quantum dots*, Phys. Rev. B **97**, 245314 (2018)

4. **P. Steindl**, E. M. Sala, B. Alén, D. Fuertes Marrón, D. Bimberg, and P. Klenovský, *Optical response of (InGa)(AsSb)/GaAs quantum dots embedded in a GaP matri*x, Phys. Rev. B **100**, 195407 (2019)

5. R. S. R. Gajjela, A. L. Hendriks, J. O. Douglas, E. M. Sala, **P. Steindl**, P. Klenovský, P. A. J. Bagot, M. P. Moody, D. Bimberg, P. M. Koenraad, *Structural and compositional analysis of (InGa)(AsSb)/GaAs/GaP Stranski–Krastanov quantum dots*, Light: Science & Applications **10**, 125 (2021)

6. F. Murphy-Armando, M. Brehm, **P. Steindl**, M. T. Lusk, T. Fromherz, K. Schwarz, P. Blaha, *Light emission from direct band gap germanium containing split-interstitial defects*, Phys. Rev. B **103**, 085310 (2021)

7. **P. Steindl**, E.M. Sala, B. Alén, D. Bimberg, P. Klenovský, *On the importance of antimony for temporal evolution of emission from self-assembled (InGa)(AsSb)/GaAs quantum dots on GaP(001)*, New J. Phys. **23**, 103029 (2021)

8. **P. Steindl**, H. Snijders, G. Westra, E. Hissink, K. Iakovlev, S. Polla, J. A. Frey, J. Norman, A. C. Gossard, J. E. Bowers, D. Bouwmeester, and W. Löffler, *Artificial Coherent States of Light by Multiphoton Interference in a Single-Photon Stream*, Phys. Rev. Lett. **126**, 143601 (2021)

9. **P. Steindl**, P. Klenovský, *Dimension-Dependent Phenomenological Model of Excitonic Electric Dipole in InGaAs Quantum Dots*, Nanomaterials **12**, 719 (2022)

10. **P. Steindl**, J.A. Frey, J. Norman, J.E. Bowers, D. Bouwmeester, W. Löffler, *Cross-polarization extinction enhancement and spin-orbit coupling of light for quantum-dot cavity-QED spectroscopy*, submitted, arXiv:2302.05359

11. **P. Steindl**, T. van der Ent, H. van der Meer, J.A. Frey, J. Norman, J.E. Bowers, D. Bouwmeester, W. Löffler, *Resonant two-laser spin-state spectroscopy of a negatively charged quantum dot-microcavity system with a cold permanent magnet*, submitted, arXiv:2303.02763

12. **P. Steindl**, V. Tubío, W. Löffler, *Single-photon addition and photon correlations*, in preparation
13. D. Hemzal, J. Dvořák, F. Münz, J. Čechal, **P. Steindl**, J. Humlíček, *In situ optical characterisation of surface plasmon resonance*, in preparation

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