WWU MÜNSTER

Aktuelle Fragen der Nanophysik

Montag, 08.05.2023 um 15:15 Uhr
R87, Wilhelm-Klemm-Str. 10

Monolayer-based single photon sources and exciton-polaritons in open microcavities


© Dr. Martin Esmann

Dr. Martin Esmann
Department for Physics
Carl von Ossietzky Universität Oldenburg

Transition metal dichalcogenide (TMDC) monolayers emerged as potential candidates to emit non-classical states of light with promising applications as efficient single photon sources. At the same time, the giant light-matter coupling and large binding energies of excitons in TMDC monolayers make them ideal materials for studying microcavity exciton-polaritons. A formidable challenge in both contexts is the implementation of cavity devices with optimized spatio-spectral light-matter coupling between a confined optical mode and few-micron scale active TMDC materials.
In this talk, I will discuss our implementation of single photon sources based on monolayer WSe_2 coupled to a tunable open microcavity. The vibrational stability of our cavity allows us to operate it in a liquid helium-free cryostat without further need for stabilization routines. While the performance of monolayer-based single photon sources has so far been lacking behind state-of-the-art devices based on volume crystals, our source presents a high single photon purity ($g^{(2)}(0) = 4.7 \pm 0.7$ %) and a record-high first lens brightness of linearly polarized photons of 65 ± 4 %. The cavity also allows us to observe genuine quantum interference phenomena in a Hong-Ou-Mandel experiment.
I will furthermore discuss spectrally tunable, room temperature exciton-polaritons using a WS_2 monolayer in a high quality open cavity. We imprint an optical lattice in the photonic structure, which emulates the canonical Su-Schrieffer-Heeger (SSH) Hamiltonian with non-trivial topology. Using the unique tilt-tunability of the open cavity, we *in-situ* transform the SSH-lattice into a Stark-ladder and fundamentally change the topological class of the structure. This “on-the-fly” cavity reconfiguration significantly expands the versatility of TMDC exciton-polaritons.

[1] J. Drawer, V. N. Mitryakhin, H. Shan, S. Stephan, M. Gittinger, L. Lackner, B. Han, G. Leibeling, F. Eilenberger, R. Banerjee, S. Tongay, K. Watanabe, T. Taniguchi, C. Lienau, M. Silies, C. Anton-Solanas, M. Esmann, C. Schneider, arXiv:2302.06340v1 (2023).