Seminar announcement

Tuesday, June 25, 2024
1:30 pm
WSI, Seminar room S 101
Exclusively in person

"Valley-hybridized gate-tunable 1D exciton confinement in $MoSe_2$"

Controlling excitons at the nanoscale in semiconductor materials represents a formidable challenge in quantum photonics and optoelectronics fields. Achieving this control holds excellent potential for unlocking strong exciton-exciton interaction regimes, enabling exciton-based logic operations, exploring exotic quantum phases of matter, facilitating deterministic positioning and tuning of quantum emitters, and designing advanced optoelectronic devices. Monolayers of transition metal dichalcogenides (TMDs) offer inherent two-dimensional confinement and possess significant binding energies, making them promising candidates for achieving electric-field-based confinement of excitons without dissociation. While previous exciton engineering strategies have predominantly focused on local strain gradients [1], the recent emergence of electrically confined states in TMDs has paved the way for novel approaches [2-3]. Exploiting the valley degree of freedom associated with these confined states further broadens the prospects for exciton engineering. In this talk, I will show electric control of light polarization emitted from one-dimensional (1D) quantum confined states in MoSe2. By employing non-uniform in-plane electric fields, we demonstrate the in-situ tuning of the trapping potential and reveal how gate-tunable valley-hybridization gives rise to linearly polarized emission from these localized states. Remarkably, the polarization of the localized states can be entirely engineered through either the spatial geometry of the 1D confinement potential or the application of an out-of-plane magnetic field [4].

References:

[1] Dirnberger, F. et al. Quasi-1D exciton channels in strain-engineered 2D materials. Science Advances 7, (2021).
[2] Thureja, D. et al. Electrically tunable quantum confinement of neutral excitons. Nature 606, 298–304 (2022).
[3] Hu, J. et al. Quantum control of exciton wavefunctions in 2D semiconductors. (2023) doi:10.48550/arxiv.2308.06361.
[4] Heithoff, M. et al. Valley-hybridized gate-tunable 1D exciton confinement in MoSe2. (2023) https://doi.org/10.48550/arXiv.2311.05299

Dr. Antoine Reserbat-Plantey
Université Cote d`Azur
CRHEA
Nice, France