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DYNAmics and STructural analYsis of 2D materials DYNASTY

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DYNASTY

IESL SEMINAR

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FORTH Seminar Room 1

Control of the Exciton and Spin/Valley Properties in Atomically Thin Transition Metal Dichalcogenides

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Abstract

In this talk I will first recall briefly the general properties of 2D excitons in Transition Metal Dichalcogenides (TMD) monolayers: giant binding energy, oscillator strength, exchange interactions, spin/valley locking ...[1].

Encapsulation of TMD monolayers in hexagonal boron nitride (hBN) yields narrow optical transitions approaching the homogeneous exciton linewidth[2,3]. We have demonstrated that the exciton radiative rate in these van der Waals heterostructures can be tailored by a simple change of the hBN encapsulation layer thickness as a consequence of the Purcell effect [4].

We also measured the exciton fine structure by magneto-photoluminescence spectroscopy in magnetic fields up to 30 T [5,6]. I will show that the bright-dark exciton splitting can be tuned by a few meV, as a result of a significant Lamb shift of the optically active exciton which arises from emission and absorption of virtual photons triggered by the vacuum fluctuations of the electromagnetic field[7] .

Finally I will present recent experimental results on spin/valley pumping of resident electrons in WSe_2 and WS_2 monolayers[8]. Using a spatially-resolved optical pump-probe experiment, we measure the lateral transport of spin/valley polarized electrons over very long distances (tens of micrometers)[9]. These results highlight the key role played by the spin-valley locking effect in TMD monolayers on the pumping efficiency and the polarized electron transport.

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[5] C. Robert *et al*, Phys. Rev. Lett . **126**, 067403 (2021)
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[7] L. Ren et al, submitted (2023)
[8] C. Robert *et al*, Nature Com. **12**, 5455 (2021)
[9] C. Robert *et al*, Phys. Rev. Lett. **129**, 027402 (2022)

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