Flipping exciton angular momentum with chiral phonons in $MoSe_2/WSe_2$ heterobilayers.

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The spin of quasi-particles is expected to be conserved during an optical transition, leading to the terminology of dark and bright excitons in monolayer transition metal dichalcogenides (TMDs) [1,2]. However, when taking spin conservation for granted in an optical transition, one fails to describe correctly the interlayer transition in 60° aligned $MoSe_2/WSe_2$ heterobilayers [3]. Indeed, due to the three-fold rotational symmetry of the system, one has to consider the total angular momentum of quasiparticles in order to describe the exciton recombination paths. This has direct implication on the exciton-phonon coupling mechanism in TMD heterostructures. Magneto spectroscopy experiments show that, because of the high value of the Landé factor [4], the Zeeman energy E_z of the interlayer exciton (IX) can be tuned in resonance with chiral phonons carrying definite angular momentum, opening a very efficient relaxation canal between the two valleys precisely because of the total angular momentum conservation. Our results shed new light on how chirality and angular momentum conservation have a profound impact on the physical properties of TMDs.

References

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Figures

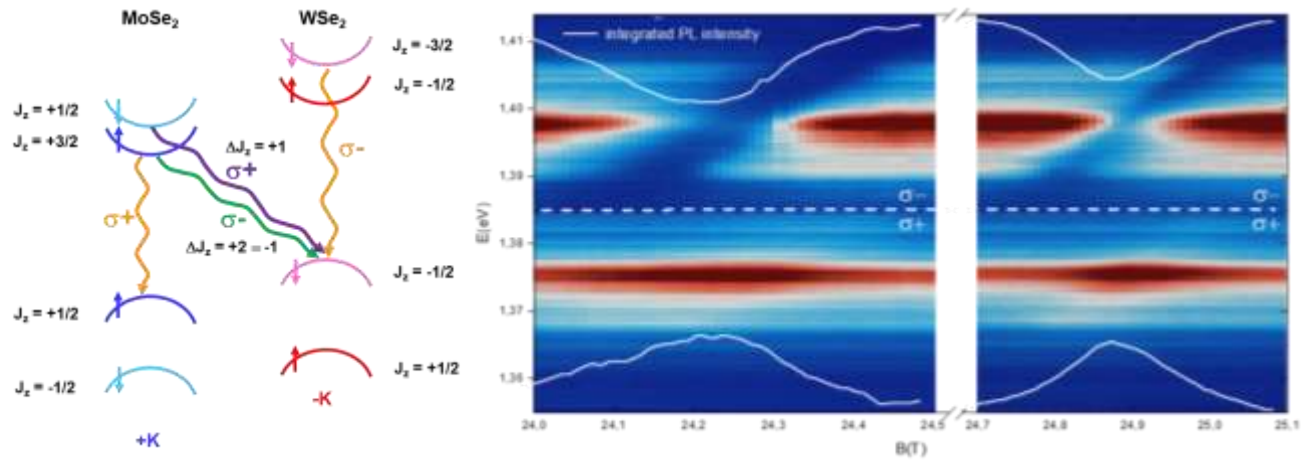

Figure 1: On right: schematics of the electronic bands at the +K point of a 60° aligned $MoSe_2/WSe_2$ Heterostructure. On left : false color map of the circularly polarized PL emission from IX measured with a resolution of 10 mT in the vicinity of the two identified exciton-chiral phonon resonances. White curves represent integrated intensity over the entire IX peak.