Exciton Manipulation in 2D TMDC Heterostructures

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The discovery of graphene marked the start of research in 2D electronic materials which was expanded in new directions with MoS_2 and other layered semiconducting materials. They have a wide range of promising potential applications, including those in digital electronics, optoelectronics and flexible devices. New opportunities are enabled by the band structure of transition metal dichalcogenides (TMDCs) with valence band edges at different locations in the momentum space which could be harnessed to build devices with operation relying on the valley degree of freedom for valleytronics and next-generation photonics. Long-lived interlayer excitons in van der Waals heterostructures based on TMDCs have recently emerged as a promising platform for valleytronics, allowing control over exciton diffusion length, energy and polarisation. I will show here how by using MoS_2/WSe_2 van der Waals heterostructures, we can realise transistor action, switching, confinement and control over diffusion length at room temperature in a reconfigurable potential landscape. Long-range moiré potentials in $MoSe_2/WSe_2$ heterostructures, on the other hand, offer the way to control both the polarisation and the wavelength of emitted light, allowing us to realize a tuneable polarisation switch.