Valley-polarized Hyperbolic-Exciton-Polaritons in Multilayer 2D Semiconductors at Visible Frequencies

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We predict the existence of hyperbolic-exciton-polaritons (HEPs) in multilayer transition-metal-dichalcogenides (TMDs) at visible frequencies. We show that resonant exitonic-based hyperbolicity can be induced in TMDs, leading to the consequent existence of HEPs. In addition, we show that owing to the valley properties of TMDs, the HEPs are coupled to the valley degree-of-freedom, leading to a hyperbolic spin-valley hall effect. We derive the HEPs dispersion relation and analyze their confinement and loss properties, finding large momentum modes with losses that increase slower than the confinement. Such highly confined and valley-polarized HEPs provide new opportunities and means of controlling strong light-matter interaction at the atomic scale.