Spintronics with van der Waals heterostructures

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Van der Waals heterostructures allow an efficient control of the electronic states which comprise valley and spin degrees of freedom. These degrees of freedom can conspire to result in novel topological states, facilitated by spin-orbit coupling and exchange splitting. Recent technological advances have allowed to systematically investigate twisted heterostructures, in which two or more layers are twisted with respect to each other. It turns out that twisting can severely affect the spin-orbit and exchange coupling, providing a new tool to control topological states [1]. I will present our recent results of first-principles calculations and model simulations of twisted heterostructures and show how to modulate topological states into pure spin-current states in graphene flakes by magnetic field.

[1] J. F. Sierra, J. Fabian, R. K. Kawakami, S. Roche, and S. O. Valenzuela Nature Nanotechnology 16, 856 (2021)