Proximity Effects in Layered Heterostructures

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Abstract. Graphene placed in a van der Waals heterostructure stack can borrow some specific properties of the nearby constituents. Involving novel 2d semiconductors in design of the stacks allow to utilize emergent proximity effects as enhanced spin-orbit or exchange coupling offering new perspectives for graphene spintronics [1]. Control of spin and orbital properties of graphene on 2d transition metal dichalcogenides can be effectively performed. Such heterostructures in addition offer a new materials basis for optospintronics applications [2] or they can host protected pseudohelical states [3,4]. Bilayer graphene on transition metal dichalcogenides is even more appealing as the spin properties of the proximitized bilayer graphene can be turned on and off by gate voltage, creating a platform for spin-orbit valves and spin transistors [5]. Proximity effects induced in chiral semiconducting carbon nanotubes in vicinity to superconducting layered semiconductors provide a prospect of engineering a device realizing topological superconductivity with Majorana fermions.

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