Département de Physique
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LPENS
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Proximitized Materials

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Proximity effects can transform a given material through its adjacent regions to become superconducting, magnetic, or topologically nontrivial[1]. In bulk materials, the sample size often greatly exceeds the characteristic lengths of proximity effects allowing their neglect. However, in 2D materials such as graphene, transition-metal dichalcogenides (TMDs) and 2D electron gas (2DEG), the situation is drastically different. Even short-range magnetic proximity effects exceed their thickness and strongly modify spin transport and optical properties[2,3]. Experimental confirmation[4] of our prediction for bias-controlled spin polarization reversal in Co/h- BN/graphene[2] suggests that magnetic proximity effects may overcome the need for an applied magnetic field and a magnetization reversal to implement spin logic[5]. In TMDs, where robust excitons dominate their optical response, magnetic proximity effects cannot be described by the single-particle description. We predict a conversion between optically inactive and active excitons by rotating the magnetization of the substrate[3]. Combined magnetic and superconducting proximity effects could enable elusive Majorana bounds states (MBS) for fault-tolerant quantum computing. Exchanging (braiding) MBS yields a noncommutative phase, a sign of non-Abelian statistics and nonlocal degrees of freedom protected from local perturbations. MBS could be manipulated and braided in proximity-induced superconductivity in a 2DEG with magnetic textures from the fringing fields of magnetic multilayers [6-8].

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