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Spin relaxation in graphene-based systems

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Abstract: Graphene and other novel 2D materials offer new perspectives for spintronic applications. One important spintronic characteristic to judge the material suitability for such applications is spin relaxation. In graphene the electron spin lifetime is surprisingly short, ranging from 0.1 to 10 ns, depending on the sample quality. Because of small intrinsic spin-orbit coupling the underlying mechanism for the fast spin relaxation had been an outstanding puzzle. We showed that the main culprits are resonant magnetic impurities [1], which can be detected, for example, by sublattice-resolved transport in bilayer graphene [2]. Despite lacking a band gap, graphene is very versatile for its ability towards functionalization, e.g., by adatoms [3] , or by proximity to two-dimensional transition-metal dichalcogenides (TMDC) [4]. We have recently shown [5] that graphene on WSe2 exhibits an inverted band structure, which leads to helical edge states in graphene nanoribbons on WSe2, with a bulk spin-orbit gap of about 1 meV, which is giant when compared to 24 micro eV in pristine graphene. Another interesting topic regarding graphene spin relaxation is superconducting coherence, which can naturally disentangle spin-orbit coupling from magnetic moments [6]. In the last part of my talk, I will discuss unique spin relaxation characteristics of graphene proximitized by s-wave superconductors.

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