Wannier pairs in the superconducting twisted bilayer graphene and related systems

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The twisted bilayer graphene (TBG) presents a new setting where superconductivity emerges on the flat bands whoseWannier wavefunctions spread over many graphene unit cells, forming the so-called Moir´e pattern. To unravel how Wannier states form Cooper pairs, we study the interplay between electronic, structural, and pairing instabilities in TBG. For comparisons, we also study graphene on boron-nitride (GBN) possessing a different Moir´e pattern, and single-layer graphene (SLG) without a Moir´e pattern. We compute the pairing eigenvalues and eigenfunctions by solving a linearized superconducting gap equation, where the spin-fluctuation mediated pairing potential is evaluated from materials specific tight-binding band structures. We find an extended s-wave as the leading pairing symmetry in TBG. In contrast, GBN assumes a p + ip-wave and SLG has the d + id-wave symmetry. Moreover, while p + ip, and d+id pairings are chiral, and nodeless, but the extended s-wave channel possesses accidental nodes.

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