Topological superconductivity with mixed singlet-triplet symmetry in twisted bilayer WSe_2

W. Akbar,[1]

A. Biborski,[1] L. Rademaker,[2] and M. Zegrodnik[1,*]

[1]*Academic Centre for materials and Nanotechnology, AGH University of Krakow, Al. Mickiwecza 30, 30-059 Krakow, Poland.*

[2]*Department of Theoretical Physics, University of Geneva, CH-1211 Geneva, Switzerland.*

michal.zegrodnik@agh.edu.pl

Abstract

We study the electronic properties of twisted WSe_2 within a single-band t-J model supplemented with Dzyaloshinskii-Moriya term. In order to take into account the effects of electron-electron correlations the Gutzwiller approach is applied. The calculated phase diagram contains stability regions of the topologically nontrivial superconducting state characterized by a mixed d+id-wave (singlet) and p-ip-wave (triplet) gap symmetry. We also report on the appearance of an additional extedned s-wave and f -wave pairings which reside in the low and high electron concentration regimes. As we show, by changing the displacement field, one can tune the balance between the singlet and triplet contributions to the pairing. We analyze the physical origin of the reported effects and discuss it briefly in the view of new possibilities for designing quantum phases in moiré systems with high degree of tunability.

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References

[1] Y. Cao et al., Nature 556 (2018) 80
[2] Y. Tang et al., Nature 579 (2020) 353
[3] L. Wang et al., Nature Materials 19 (2020) 861
[4] M. Zegrodnik et al., Phys. Rev. B 108 (2023) 064506

Figures

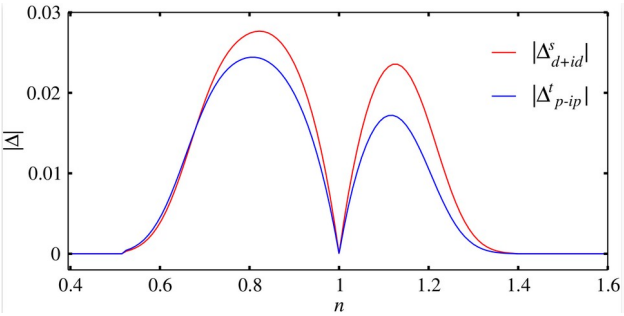

Figure 1: Superconducting gap amplitudes for the spin-singlet d + id and spin-triplet p − ip symmetries as a function of band filling n for selected values of exchange interaction energy J = 2.62 meV and displacement field D = 0.4 V/nm

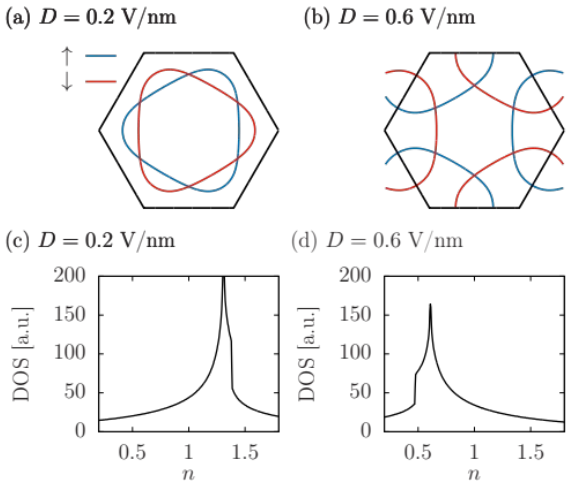

Figure 2: The spin dependant Fermi surfaces at half filling (a,b) and the density of states (c,d) for two selected values of the displacement field, D.