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The effect of electronic correlations on Josephson current and proximity effect in SNS graphene junctions ANNICA BLACK-SCHAFFER, SEBASTIAN DONIACH, Stanford University — Using the self-consistent tight-binding Bogoliubov-de Gennes (BdG) formalism, we investigate the proximity effect and current-phase relationship in SNS graphene Josephson junctions. Both short and long junctions are considered, as well as different doping levels of the graphene. For short junctions at zero doping in the uncorrelated regime our results agree with those found using the non self-consistent Dirac-BdG formalism [1]. We introduce electronic correlations in the Hamiltonian by including the intrinsic nearest-neighbor spin-singlet coupling present in $p\pi$-bonded planar organic molecules. We study the possibility of coupling this intrinsic s- or d-wave superconducting pairing [2] to the extrinsic s-wave order parameter induced by the metal electrodes. The intrinsic d-wave solution, favored in doped graphene, appears for longer doped junctions. For short junctions, the s-wave solution can occur, although the result is sensitive to the type of interface. We also report on the two different intrinsic superconducting states' influence on the supercurrent.

[1] M. Titov *et al.* PRB **74** 041401 (2006)
[2] A. Black-Schaffer *et al.* PRB **75** 134512 (2007)

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