**5-2180**

Emergent Channel over a Pair of Pockets in Strong Density Waves

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Different channels over which electrons scatter between parts of the Fermi surface are the key to various electronic quantum matters, such as superconductivity and density waves. We consider an effective model in higher dimensions where each of the two pockets in the original model maps to (the Landau levels of) two Dirac fermions. We discover an emergent channel when two Dirac fermions from different pairs annihilate, where the presence of a strong density wave is essential. We support our analysis with numerical calculations on model examples in the vicinity of ferromagnetic and antiferromagnetic orders. We also discuss interesting consequences on electron interaction channels that beyond-mean-field fluctuations may induce.
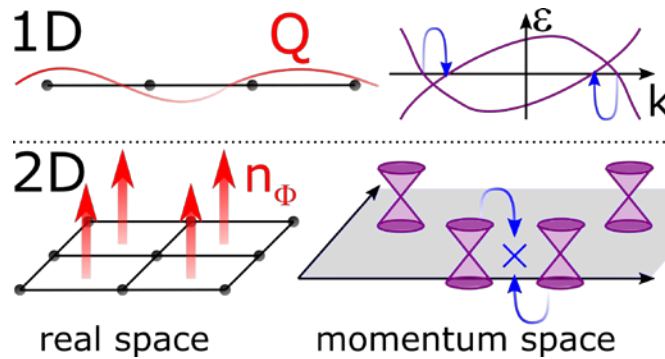
Phase	N	P	S
Dominant channel(s)	$Q_2 = 2k_{F2}$ $Q_1 = 2k_{F1}$ Finite-momentum single-electron scattering	$Q = 2k_{F1} + 2k_{F2}$ Finite-momentum electron-pair scattering	$Q \to 0$ Electron pairing with conserved momentum
Condition	Weak density wave	Strong density wave	Strong density wave + fine tuning
1D example (original)			
2D example (effective)	$n_D = 4$	$n_D = 2$	$n_D = 2$
Stability	High	High	Low

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