Spin-orbit coupling in quasi-one-dimensional Wigner crystals

VIKTORIIA KORNICH, Univ of Wisconsin, Madison, CHRISTOPHER PEDDER, THOMAS SCHMIDT, University of Luxembourg — We study the effect of Rashba spin-orbit coupling (SOC) on the charge and spin degrees of freedom of a quasi-one-dimensional (quasi-1D) Wigner crystal. As electrons in a quasi-1D Wigner crystal can move in the transverse direction, SOC cannot be gauged away in contrast to the pure 1D case. We show that for weak SOC, a partial gap in the spectrum opens at certain ratios between density of electrons and the inverse Rashba length. We present how the low-energy branch of charge degrees of freedom deviates due to SOC from its usual linear dependence at small wave vectors. In the case of strong SOC, we show that spin sector of a Wigner crystal cannot be described by an isotropic antiferromagnetic Heisenberg Hamiltonian any more, and that instead the ground state of neighboring electrons is mostly a triplet state. We present a new spin sector Hamiltonian and discuss the spectrum of Wigner crystal in this limit.

Viktoriia Kornich
Univ of Wisconsin, Madison