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Topological Charge/spin density Wave in InAs/GaSb Quantum Wells under an In-plane Magnetic Field LUN-HUI HU, CHIH-CHIEH CHEN, YI ZHOU, FU-CHUN ZHANG, Zhejiang University, CHAO-XING LIU, Pennsylvania State University — The 2D quantum spin hall (QSH) system, InAs/GaSb quantum wells (QWs), is treated as a bilayer electron-hole system. In this work, we begin with the non-interacting BHZ model under in-plane magnetic field. For dilute carrier density system, we shall study the effect of Coulomb interaction. Phase diagram can be figured out by mean field theory. One possible phase is the indirect s-wave type exciton condensation (EC) phase which opens a bulk gap directly, which makes the system a trivial exciton insulator without edge states. On the other hand, we also find that charge/spin density wave (CDW/SDW) opens a mini-gap through hybridization effect induced by Coulomb interaction. We then derive the low energy effective Hamiltonian to understand each phase with/without helical edge states, and we find the effective Hamiltonian is similar to the non-interacting BZH model with the renormalization of some parameters (inversion gap M, effective hybridization A and in-plane g-factor g). Moreover, an intuitive dispersion with helical edge states is provided as a further confirmation. The relevance to experiments is also discussed.

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