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Quantum anomalous Hall effect with in-plane magnetization in HgMnTe HSIU-CHUAN HSU, XIN LIU, CHAO-XING LIU, Department of Physics, Pennsylvania State University — A quantum anomalous Hall (QAH) insulator carries quantized Hall conductance which is similar to Quantum Hall (QH) effect. However, it originates from the exchange coupling of magnetization instead of Landau levels. It was proposed that QAH effect can be realized in HgTe quantum wells doped with Mn (**Phy. Rev. Lett. 101, 146802 (2008)**) and evidenced by recent experiments. However, Mn is paramagnetic and an external magnetic field, which also leads to Landau levels, is required to obtain Mn polarization. Thus, it is essential to find an experimentally feasible way to distinguish between the two effects. In this study, we propose to distinguish QH effect and QAH effect by inducing the in-plane magnetization of Mn with an in-plane magnetic field. The in-plane magnetic field reduces the QAH effect by tilting the magnetization of Mn into the quantum well plane and reducing the out-of-plane magnetization. In contrast, the in-plane magnetic field has little influence on the conventional QH effect which only depends on the out-of-plane magnetic field. The phase diagram is identified based on the band structure calculation and Landau level calculation with the realistic material parameters of HgMnTe quantum wells, which can serve as the guidance for the future transport experiment.

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