Observation of fractional quantum anomalous hall effect

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The interplay between spontaneous symmetry breaking and topology can result in exotic quantum states of matter. A celebrated example is the quantum anomalous Hall (QAH) effect, which exhibits an integer quantum Hall effect at zero magnetic field due to topologically nontrivial bands and intrinsic magnetism. In the presence of strong electron-electron interactions, fractional-QAH (FQAH) effect at zero magnetic field can emerge, which is a lattice analog of fractional quantum Hall effect without Landau level formation. In this talk, I will present experimental observation of FQAH effect in twisted $MoTe_2$ bilayer, using combined magneto-optical and -transport measurements. In addition, we find an anomalous Hall state near the filling factor -1/2, whose behavior resembles that of the composite Fermi liquid phase in the half-filled lowest Landau level of a two-dimensional electron gas at high magnetic field. Direct observation of the FQAH and associated effects paves the way for researching charge fractionalization and anyonic statistics at zero magnetic field.

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