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Spontaneous valley ordering in SnTe (001) surface states MING XIE, Department of Physics, The University of Texas at Austin, XIAO LI, Condensed Matter Theory Center, University of Maryland, FAN ZHANG, Department of Physics, The University of Texas at Dallas, ALLAN MACDONALD, Department of Physics, The University of Texas at Austin — In this work we study the spontaneous valley ordering in SnTe surface states. SnTe is a topological mirror insulator in which the bulk mirror symmetry allows robust surface states to appear on certain surfaces like (001), (111) and (110). These surface states provide a new platform to study multi-flavor Landau level physics in the quantum Hall regime. Attention has been drawn to the (001) surface by a recent experimental observation of a four-fold degenerate Landau level formed at zero energy [Science 341, 1496 (2013)]. This degeneracy arises because the single-particle bandstructure at low energies consists of four surface Dirac cones. In the presence of electron-electron interactions, however, this four-fold degeneracy is expected to be lifted. In this work we construct a theory to show that at all integer filling factors between -2 and +2 the ground state is a gapped quantum Hall state. We further demonstrate that these ground states are valley nematic phases, and discuss some experimental consequences.

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