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Unconventional Quantum Hall Effect and Tunable Spin Hall Effect in monolayer MoS$_2$

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QIAN NIU, Department of Physics, The University of Texas at Austin — We analyze the Landau level (LL) structure in a monolayer MoS$_2$ and find a field-dependent unconventional quantum Hall plateau sequence $\nu = \ldots -2M - 6, -2M - 4, -2M - 2, -2M - 1, \ldots, -5, -3, -1, 0, \ldots$. Due to orbital asymmetry, the low-energy Dirac fermions become heavily massive and the LL energies grow linearly with $B$, rather than with $\sqrt{B}$. Spin-orbital couplings break spin and valley degenerate LL’s into two distinct groups, and LL crossing effects appear in the valence bands only. In a p-n junction, spin-resolved fractionally quantized conductance appears in two-terminal measurements with a controllable spin-polarized current that can be probed at the interface. We also show that the zero-field spin Hall conductivity has some interesting tunability. For more information, please refer to arXiv: 1207.1205.

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