Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Integer quantum Hall effects of Q-valley electrons in transition metal disulfides ARMIN KHAMOSHI, Department of Physics, University of Texas at Dallas, Richardson, Texas 75080, USA, ZEFEI WU, NING WANG, Department of Physics, Hong Kong University of Science and Technology, Hong Kong, China, FAN ZHANG, Department of Physics, University of Texas at Dallas, Richardson, Texas 75080, USA — In few-layer transition metal disulfides (TMDs), the conduction bands along the GK directions shift downward energetically in the presence of interlayer interactions, forming six Q valleys related by threefold rotational symmetry and time reversal symmetry. In even layers the extra inversion symmetry requires all states to be spin degenerate, whereas in odd layers the intrinsic inversion asymmetry dictates the states to be non-degenerate at each valley. Universally, the 12-fold (6-fold) degenerate Landau levels in even (odd) layers undergo spin (valley) Zeeman splitting at relatively high magnetic fields, yielding 6-fold (3-fold) degenerate Landau levels. Our theoretical analyses are in complete harmony with our experimental observations of the Shubnikov-de Hass oscillations in high-mobility low-density TMD devices. [Reference: Nature Communications 7, 12955 (2016).]

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Date submitted: 13 Nov 2016 Electronic form version 1.4