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Landau levels and Shubnikov-de Haas oscillations in monolayer transition metal dichalcogenide semiconductors ANDOR KORMANYOS, University of Konstanz, PETER RAKYTA, Budapest University of Technology and Economics, GUIDO BURKARD, University of Konstanz — We study the Landau level (LL) spectrum using a multi-band $\mathbf{k} \cdot \mathbf{p}$ theory in monolayer transition metal dichalcogenide semiconductors [1]. We find that in a wide magnetic field range the LL can be characterized by a harmonic oscillator spectrum and a linear-in-magnetic field term which describes the valley degeneracy breaking. The effect of the non-parabolicity of the band-dispersion on the LL spectrum is also discussed. Motivated by recent magnetotransport experiments, we use the self-consistent Born approximation and the Kubo formalism to calculate the Shubnikov-de Haas oscillations of the longitudinal conductivity. We investigate how the doping level, the spin-splitting of the bands and the broken valley degeneracy of the LLs affect the magnetoconductance oscillations. We consider monolayer MoS_2 and WSe_2 as concrete examples and compare the results of numerical calculations and an analytical formula which is valid in the semiclassical regime. Finally, we briefly analyze the recent experimental results [Cui et al., Nat. Nanotechnol. 10 534 (2015)] using the theoretical approach we have developed. [1] New J. Phys. 17, 103006 (2015).

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