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Spatially-Resolved Modeling of Spin and Valley Hall Effects in Two-Dimensional Semiconductors[1] E.J. LENFERINK, Y. JIA, N.P. STERN, Department of Physics and Astronomy, Northwestern University — In monolayers of transition metal dichalcogenides (1L-TMDs), a valley degree of freedom emerges for charge carriers due to the absence of spatial inversion symmetry. Strong spin-orbit interaction couples spin and valley, resulting in correlated spin, valley, and charge transport such as transverse Hall effects. Spatially-resolved measurements of these Hall effects have recently been achieved in monolayer MoS_2 [2], necessitating a detailed picture for understanding transport and relaxation mechanisms in 1L-TMDs that considers carrier, valley, and spin motion and generation processes. Here, we study spin and valley Hall effects in 1L-TMD devices by simulating the transport of spin- and valley-polarized carriers with a generalized drift diffusion model incorporating circularly polarized optical excitation. Spin and valley accumulation and the transverse voltage are analyzed in different device geometries. We compare the electron and hole contributions to the transverse voltage and discuss the potential for a measurement of the valley relaxation times of free carriers in 1L-TMDs.

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[2]K. F. Mak, K. L. McGill, J. Park, and P. L. McEuen. The Valley Hall Effect in MoS_2 Transistors. *Science*, 344(6191):1489–1492, 2014.

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