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Observation of the valley Hall effect in MoS2 transistors

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Two-dimensional (2D) atomic layers of molybdenum disulfide (MoS2) have attracted much recent attention due to their unique electronic properties. In addition to charge and spin, electrons in MoS_2 monolayers possess a new valley degree of freedom (DOF) that has finite Berry curvatures. As a result, not only optical control of the valley DOF is allowed, but each valley is also predicted to exhibit an anomalous Hall effect whose sign depends on the valley index. In this talk, we will discuss our recent observation of this new valley Hall effect (VHE) in monolayer MoS_2 transistors. This is manifested experimentally as a finite anomalous Hall effect when circularly polarized light is used to preferentially excite electrons into a specific valley. We will describe the dependence of the anomalous Hall conductivity on photon helicity, photon energy, doping levels and crystal symmetry, and will compare these observations with theoretical predictions. Possibilities of using the valley DOF as an information carrier in next-generation electronics and optoelectronics will also be discussed.

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