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Floquet-Engineered Valleytronics in Dirac Systems[1] BABAK SERADJEH, ARIJIT KUNDU[2], HERBERT FERTIG, Indiana University — Valley degrees of freedom offer a potential resource for quantum information processing if they can be effectively controlled. We discuss an optical approach to this problem in which intense light breaks electronic symmetries of a two-dimensional Dirac material. The resulting quasienergy structures may then differ for different valleys, so that the Floquet physics of the system can be exploited to produce highly polarized valley currents. This physics can be utilized to realize a valley valve whose behavior is determined optically. We propose a concrete way to achieve such valleytronics in graphene as well as in a simple model of an inversion-symmetry broken Dirac material, such as monolayer transition-metal dichalcogenides. Simulating the system numerically, we find that the effect is robustness against moderate disorder and small deviations in optical parameters. We also study designs for coherent manipulation of valley degrees of freedom suitable for quantum information processing.

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