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Valley entanglement of carriers in monolayers of transition-metal dichalcogenides ALEXEY BELYANIN, Texas A&M University, MIKHAIL TOKMAN, Institute of Applied Physics, Russian Academy of Sciences — The entanglement of two quantum systems or ensembles is usually generated as a result of coupling between them. This coupling can be mediated by classical electromagnetic fields. At the same time, one can also entangle *non-interacting* quantum systems by a quantum field. Here we consider the optical excitation of electron-hole or exciton states near the band gap of a transition-metal dichalcogenide monolayer in two valleys K' and K with opposite valley indices. We show that a linearly polarized single-photon field in a cavity or a stationary stream of linearly polarized single photons gives rise to an efficient entanglement of non-interacting carriers in different valleys, i.e. the generation of electron states entangled with respect to the valley degree of freedom. An intuitive explanation of this effect is that the carriers "view" linearly polarized photons as entangled left- and right-circularly polarized photon states. Valley entanglement of carriers gives rise to peculiar properties of the reemitted optical field and photocurrent fluctuations.

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