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Topological Phases in Perovskite Oxide Heterostructures ROKYEON KIM, CCES, IBS & Seoul National University, JAEJUN YU, Seoul National University, HOSUB JIN, Ulsan National Institute of Science and Technology — Quantum spin Hall (QSH) insulator is a new state of matter characterized by gapless edge states and insulating bulk states. Because the edge states are topologically protected and therefore robust against non-magnetic perturbations, it has a potential to be utilized in spintronics devices. Quauntum vally Hall (QVH) phase, on the other hand, is another class of topological state exhibiting valley-contrasting Berry curvature and spin splitting, which could yield novel transport properties, such as valley Hall effect and valley spin Hall effect. We propose a new kind of perovskite (111) heterostructures which can host both QSH and QVH phases with appropriate choices of composing elements. By carrying out first-principles calculations, we demonstrate that a Dirac cone emerges in a particular choice of heterostructure, and a sizable spin-orbit coupling turns the system into the QSH phase. In addition, the QVH phase with different Berry phases and spin textures in each valley is shown to be realized in the heterostructure with broken inversion symmetry. We porpose that these perovskite heterostructures can provide a feasible platform for spintronics, valleytronics, and topological engineering of the two-dimensional electron system.

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