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Direct Manifestation of the Band Topology via the Zak Shift of the Wannier-Stark Ladder[1] WOO-RAM LEE, KWON PARK, Korea Inst for Advanced Study — Topological phases of matter have been topics of intense interest in modern condensed matter physics. Numerous efforts have been devoted to investigating various exotic properties of materials with non-trivial band topology. The dissipationless transport via gapless helical edge or surface states is one of the defining properties of such materials, which, however, has been very difficult to realize in experiment due to various backscattering sources induced in the sample boundaries. In this work, we show that there is a fundamental connection between the non-trivial topology of the band structure and the Zak shift of the Wannier-Stark ladder emerging under a static electric field. As an application of this connection, we propose a novel spectroscopic method to directly manifest the band topology by counting the winding number of the Zak phase across the first Brillouin zone, which is shown to be robust against electron-impurity scattering.

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