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Topological Domain-Wall Metals in Pyrochlore Iridates

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Emergent quantum phases [1-3] of pyrochlore iridium oxides $R_2Ir_2O_7$ (R: rare-earth elements) have attracted a broad interest. Previous theoretical studies have predicted Weyl semimetals in non-collinear magnetic phases, called the all-in-all-out (AIAO) orders in $Y_2Ir_2O_7$ [1]. The Weyl electrons are, however, easily annihilated in a pair [4]. Recently, we have predicted that magnetic domain walls in the AIAO phase of the pyrochlore iridium oxides host two-dimensional metallic states characterized by a zero-dimensional class A Chern number [5], even after the pair-annihilation of the Weyl electrons. By employing a symmetry adapted effective hamiltonian, we also predict a helical transport emerging from a spontaneous symmetry breaking at the magnetic domain wall as well as a subsequent metal-insulator transition [6]. [1] X. Wan, A. M. Turner, A. Vishwanath, and S. Y. Savrasov, Phys. Rev. B 83, 205101 (2011). [2] E.-G. Moon, C. Xu, Y. B. Kim, and L. Balents, Phys. Rev. Lett. 111, 206401 (2013). [3] I. F. Herbut and L. Janssen, Phys. Rev. Lett. 113, 106401 (2014). [4] K. Ueda, et al., Phys. Rev. Lett. 109, 136402 (2012). [5] Y. Yamaji and M. Imada, Phys. Rev. X 4, 021035 (2014). [6] Y. Yamaji and M. Imada, arXiv:1507.04153.