

Abstract Submitted  
for the MAR14 Meeting of  
The American Physical Society

**Edge states and the quantized Berry phase of general massless Dirac fermions** TOSHIKAZE KARIYADO, YASUHIRO HATSUGAI, University of Tsukuba — Topological properties of massless Dirac fermion systems are investigated in terms of the quantized ( $Z_2$ ) Berry phase. Although the Berry phase is gauge dependent and can take any value in modulo  $2\pi$ , it is quantized with symmetry protection. For this protection, the chiral symmetry is often employed. Here, we show that this symmetry protection is effective in much more general situation, namely, the inversion combined with the time reversal symmetry or the spatial reflection is sufficient for the quantization. Then, the topological stability of the massless Dirac fermions in two dimension is discussed in relation to the quantized Berry phase. We also demonstrate the bulk-edge correspondence of the generic massless Dirac fermions, that is, giving topological reasoning for the existence of edge states, using a model containing the massless Dirac fermion, but having no chiral symmetry [T. Kariyado and Y. Hatsugai, arXiv:1307.7926]. Further generic applications of the symmetry protection for the bulk-edge correspondence will be discussed as well.

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Date submitted: 14 Nov 2013

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