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Decomposition into half-integer quantum Hall numbers from Dirac cones in a graphene-related lattice model HARUKI WATANABE, Department of Physics, University of Tokyo, HATSUGAI YASUHIRO, Institute of Physics, University of Tsukuba, HIDEO AOKI, Department of Physics, University of Tokyo — In field theory it is well-known that the Hall conductivity of a massive Dirac particle is equal to $1/2\ \mathrm{sgn}\,(m)$ (in units of $-e^2/h$) when the Fermi energy lies in the mass gap. By contrast, any lattice model must have an integer quantum Hall number when we consider noninteracting electrons, as dictated by the TKNN formula arising from the periodicity in the Brillouin zone. Usually, this is understood to be consistent with the fact that in lattice models such as graphene honeycomb lattice Dirac dispersions tend to appear in pairs (as dictated by the Nielsen-Ninomiya theorem for chiral cases), but this does obscure a half-integer contribution from each Dirac cone. To resolve this, here we show that it is possible to identify half-integer contributions by constructing a lattice model with systematically shifted Dirac points [1]. Edge-state spectrum also confirms this.

[1] H. Watanabe, Y. Hatsugai and H. Aoki, arXiv:1008.0130, to appear in Phys. Rev. B (R).

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