

Low-density Hall response of two-dimensional electrons with a local and energy-dependent self-energy

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In recent years, various techniques have been developed to control the density of carriers in two-dimensional systems, which led to unexpected results for the Hall effect [1]. On the theoretical side, the Hall effect is not well understood at very low density of carriers, where the Boltzmann description loses validity. We study the Hall constant R_H for systems of 2D correlated electrons in the low-density regime, using a Kubo-formula approach where correlations are described by a local self-energy. Even if the energy-dependence of the self-energy is neglected, we find that the Hall constant deviates from the standard $R_H^0 = -1/(|e|n)$ behavior [2]. Beyond such behavior, several microscopic systems yield a scattering rate that is not independent of energy but vanishes as a power law at low energy. For these models, we compute the Hall effect and find non-universal behaviors in the relation between R_H and n , in particular power laws that reflect the power-law in the self-energy.

[1] F. Wu, I. Gutiérrez-Lezama, S. A. López-Paz, M. Gibertini, K. Watanabe, T. Taniguchi, F. O. von Rohr, N. Ubrig, and A. F. Morpurgo, Quasi-1D electronic transport in a 2D magnetic semiconductor, *Adv. Mater.* 34, 2109759 (2022).

[2] G. Morpurgo, L. Rademaker, C. Berthod and T. Giamarchi, Hall response of locally correlated two-dimensional electrons at low density, *Phys. Rev. Research* 6, 013112 (2024).