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Dynamical scaling analysis of the optical Hall conductivity in the quantum Hall regime TAKAHIRO MORIMOTO, University of Tokyo, YSHAI AVISHAI, Ben Gurion University, HIDEO AOKI, University of Tokyo — We study the optical Hall conductivity $\sigma_{xy}(\varepsilon_F, \omega)$ in two-dimensional electron gas (2DEG) and in graphene in the quantum Hall regime, which is measurable by the Faraday rotation. It was previously demonstrated that both conductivities retain their plateau structure at finite frequency, up to the optical frequency regime. Physically, the robustness of the plateau structure in the ac optical regime can be attributed to the localization of electrons in the QHE. To quantify this picture, a dynamical scaling analysis of $\sigma_{xy}(\varepsilon_F, \omega)$ is performed for the $n = 0$ Landau level in graphene as well as for the conventional quantum Hall system. This analysis examines whether the system size dependence of $\sigma_{xy}(\varepsilon_F, \omega)$ can be captured with a universal scaling function that involves the localization exponent ν and the dynamic critical exponents z. Based on exact diagonalization of these systems with potential disorder, employing the Kubo formula, it is shown that $\sigma_{xy}(\varepsilon_F, \omega)$ obeys a well-defined dynamical scaling behavior. For both systems, the static exponents ν are similar and the dynamical exponents z are found to be ≈ 2. Our quantitative analysis indicates that the plateau structure in the ac Hall conductivity should be robust and experimentally testable in the THz regime.

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