An alternative model of the integer quantum Hall effect

TOBIAS KRAMER, Physics Department Harvard University — Contrary to common belief, the current emitted by a contact embedded in a two-dimensional electron gas (2DEG) is quantized in the presence of electric and magnetic fields. This observation suggests a simple, clearly defined model for the quantum current through a Hall device that does not invoke disorder or interactions as the cause of the integer quantum Hall effect (QHE), but is based on a proper quantization of the classical electron drift motion. The theory yields a quantitative description of the breakdown of the QHE at high current densities that is in agreement with experimental data. Furthermore, several of its key points are in line with recent findings of experiments that address the dependency of the QHE on the 2DEG bias voltage, results that are not easily explained within the framework of conventional QHE models. For additional information, see also http://arxiv.org/abs/cond-mat/0509451 (accepted by IJMPB) and the article references on http://people.deas.harvard.edu/~tkramer

Tobias Kramer
Physics Department Harvard University

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