Local density of states in disordered two-dimensional electron gases at high magnetic field

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Motivated by high-accuracy scanning tunneling spectroscopy measurements on disordered two-dimensional electron gases in strong magnetic field, we present an expression for the local density of states (LDoS) of electrons moving in an arbitrary potential smooth on the scale of the magnetic length, that can be locally described up to its second derivatives.

This result has been derived with a specific Green's function technique based on the use of an over complete semi-coherent basis of states. This formalism allows us to derive the exact Green's function for an arbitrary quadratic potential in the special limit where Landau level mixing becomes negligible. The obtained solution remarkably embraces under a unified form via pure geometric parameters the cases of confining and unconfining quadratic potentials. Whereas confining potentials are naturally characterized by quantization effets, lifetime effects emerge instead in the case of saddle-point potentials as a result of the instability of the dynamics due to quantum tunneling.

The energy-dependence of the LDoS is found to be universal in terms of local geometric properties, such as drift velocity and potential curvature. We also show that thermal effects are quite important close to saddle points of the potential landscape, leading to an overbroadening of the tunneling trajectories, which may explain the broad structures recently observed in experiment.

Refs. :

T. Champel and S. Florens, arXiv:0904.3262 ;

T. Champel and S. Florens, arXiv:0906.3375; to appear in PRB.