Phase space representation of the quantum electron motion in a magnetic field

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In disordered two-dimensional electron gases, the electronic motion at high magnetic fields is essentially decomposed into a fast orbital motion and a slow drifting motion of the orbit center along equipotential lines of the potential landscape. This motion decomposition can be encapsulated in the quantum mechanical language by using a specific basis of semi-coherent states within a Green's function formalism.

We present a generalization of this phase space method suitable to incorporate Landau level mixing processes in a nonperturbative manner. As a result, we derive a generic quantum solution in the phase space embracing all possible cases of electronic motions in quadratic potential landscapes at arbitrary magnetic field strength. This solution allows one to precisely define under which conditions on the magnetic field and the potential landscape the (effective) orbital motion remains related to a discrete quantization.