Highlights

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Quantization of entropy in a quasi-two-dimensional electron gas

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We demonstrate that the entropy per electron of a two-dimensional electron gas (2DEG) exhibits quantized peaks at resonances between the chemical potential and electron levels of size quantization. In the limit of no scattering, the peaks depend only on the sub-band quantization number and are independent of material parameters, shape of the confining potential, electron effective mass, and temperature. The quantization of entropy per electron is a signature of a Lifshitz phase transition in a 2DEG. In the presence of stationary disorder, the magnitude of peaks decreases. Its deviation from the quantized values is a direct measure of the disorder induced smearing of the electronic density of states.

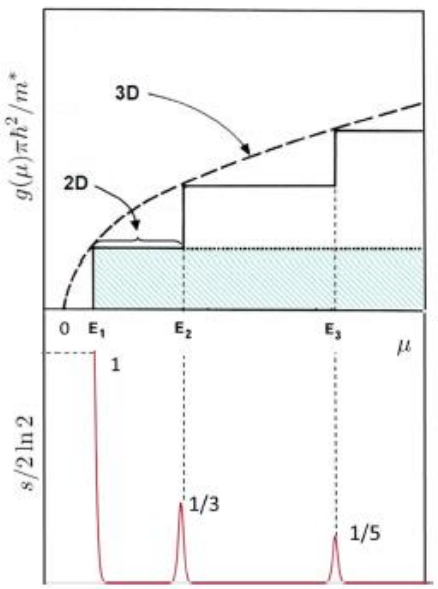

Figure 1. Schematic representation of the dependencies of the electronic density of states (upper panel) and the entropy per electron (lower panel) as functions of the chemical potential.

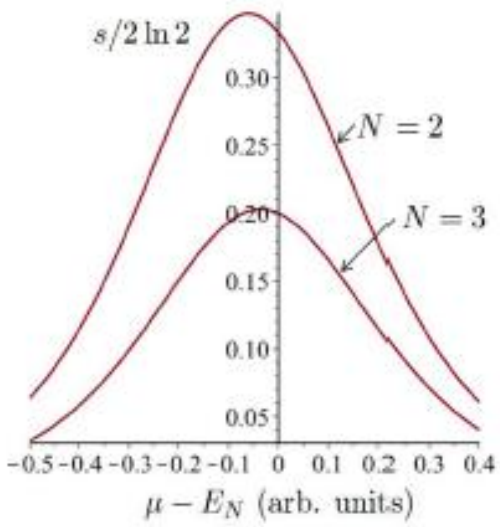

Figure 2. Dependence of the entropy per particle on chemical potential for N = 2,3.