

ENTROPY SIGNATURES OF TOPOLOGICAL PHASE TRANSITIONS

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The behavior of the differential entropy per particle (DEP) in various two-dimensional electronic systems is considered. This quantity is an important characteristic of any many-body system that tells how the entropy of the ensemble of electrons changes if one adds one more electron. Recently, it has been demonstrated experimentally how the DEP of a two-dimensional electron gas can be extracted from the recharging current dynamics in a planar capacitor geometry. Theoretically, the differential entropy per particle is linked to the temperature derivative of the chemical potential of the electron gas by the Maxwell relation. Using this relation, the DEP is calculated in the vicinity of topological transitions in various two-dimensional electronic systems. It is shown that the DEP experiences quantized steps at the points of Lifshitz transitions in a two-dimensional electron gas with a parabolic energy spectrum. In contrast, in doubled-gapped Dirac materials, the DEP demonstrates characteristic spikes once the chemical potential passes through the band edges. The transition from a topological to trivial insulator phase in germanene is manifested by the disappearance of a strong zero-energy resonance in the DEP dependence on the chemical potential. Thus the studies of the differential entropy per particle shed light on multiple otherwise hidden peculiarities of the electronic band structure of novel two-dimensional crystals.