Indications for a Line of Continuous Phase Transitions at Finite Temperatures Connected with the Apparent Metal-Insulator Transition in Two-Dimensional Disordered Systems

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In a recent experiment, Lai and coworkers studied the apparent metal-insulator transition (MIT) of a Si quantum well structure tuning the charge carrier concentration n.[1] They observed linear temperature dependences of the conductivity $\sigma(T, n)$ around the Fermi temperature and found that the corresponding $T \to 0$ extrapolation $\sigma_0(n)$ exhibits a sharp bend just at the MIT. Here, reconsidering the data published by Lai *et al.*, it is shown that this sharp bend is related to a peculiarity of $\sigma(T = \text{const.}, n)$ clearly detectable in the whole T range up to 4 K, the highest measuring temperature in that work.[2] Since this peculiarity seems not to be smoothed out with increasing T it may indicate a sharp continuous phase transition between the regions of apparent metallic and activated conduction to be present at finite temperature. Hints from the literature of such a behavior are discussed. Finally, a scaling analysis illuminates similarities to previous experiments and provides understanding of the shape of the peculiarity and of sharp peaks found in $\mathrm{d}\log_{10}\sigma/\mathrm{d}n\,(n)$.

[1]K. Lai, W. Pan, D.C. Tsui, S. Lyon, M. Mühlberger, and F. Schäffler, Phys. Rev. B **75**, 033314 (2007).
[2]A. Möbius, Phys. Rev. B **77**, 205317 (2008).