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From insulating behavior to quantum Hall liquid at low magnetic fields T.-Y. HUANG, CHI-TE LIANG, National Taiwan University, GIL-HO KIM, Sungkyunkwan University, CHUN FENG HUANG, CMS/NML, ITRI, C.-P. HUANG, J.-Y. LIN, H.-S. GOAN, National Taiwan University, D.A. RITCHIE, Cambridge University — It is an interesting, but unsettled issue whether a direct transition from an insulating (I) state to a $\nu > 2$ quantum Hall (QH) liquid is a genuine phase transition where ν denotes the filling factor [1]. It is argued that the observed low-field direct transition is not a quantum phase transition, but can be ascribed to a crossover from weak localization to Landau quantization (LQ) [1]. We shall show that between the insulating region and the QH regime, multiple temperature (T)-independent points in the longitudinal resistance can be observed in a moderate-mobility two-dimensional electron system containing InAs quantum dots. Interestingly, the amplitudes of the accompanying resistance oscillations can be well approximated by the conventional Shubnikov-de Haas theory, suggesting metallic behavior. Moreover, our data show that LQ can modulate the density of states without causing the formation of a QH liquid, demonstrating that the crossover from insulating behavior to Landau quantization can occur over a wide range of magnetic field. We suggest that to obtain a correct insight into the low-field I-QH transition, the argument raised by Huckestein [1] ought to be modified. Ref: [1] B. Huckestein, PRL 84, 3141 (2000) and references therein.

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