# Berezinski-Kosterlitz-Thouless transition in strongly disordered NbN films near the superconductor-insulator transition

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It is well accepted that, in two dimensions, the zero resistance state should be destroyed by the proliferation of phase fluctuations at a critical temperature $T_{\mathrm{BKT}} < T_{\mathrm{c0}}$, where $T_{\mathrm{c0}}$ is the mean-field transition temperature [1]. Experiments so far showed a strong broadening of the expected universal jump of the superfluid stiffness $J_{\mathrm{S}}(T)$ at the Berezinski-Kosterlitz-Thouless (BKT) transition [2,3].
Here, we report AC and DC transport measurements of meso-scale NbN meanders, revealing a *sharp* BKT transition that is consistent in all experimental observables [4]. Reducing meander width from 20 μm to 200 nm leads to the development of a foot in the resistive transition that clearly scales with the sample width. Our data can be understood in terms of established theory, without resorting to dominant sample inhomogeneity [1,5].
When increasing the normal state sheet resistance $R_{\mathrm{N}}$ up to 15 kΩ, $T_{\mathrm{c0}}$, $T_{\mathrm{BKT}}$ and $J_{\mathrm{S}}(0)$ decrease by nearly two orders of magnitude down to 0.2 K, while the BKT transition remains sharp. For the higher levels of disorder, the phase fluctuation regime $T_{\mathrm{BKT}} < T < T_{\mathrm{c0}}$ covers up to 85% of $T_{\mathrm{c0}}$.
For strong disorder, numerical implementations of mean-field theory predict striking deviations from Anderson's theorem: the spectral gap $E_g$, the pair potential Δ, and the mean-field critical temperature $T_{c0}$ all decrease and start to significantly deviate from each other [6]. The evolution of the measured $J_{\mathrm{S}}(T)$-curves with disorder reveals that another energy scale and not Δ determines $J_{\mathrm{S}}(T)$ in the limit of strong disorder.

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