Comment on "Giant Out-of-Plane Magnetoresistance in Bi-Sr-Ca-Cu-O: A New Dissipation Mechanism in Copper-Oxide Superconductors?"

Recently Briceño, Crommie, and Zettl [1] reported a measurement of out-of-plane magnetoresistivity $\rho_c(T,H)$ in single crystal $Bi_2Sr_2CaCu_2O_8$. As in a previous work [2], their ρ_c data measured in fields H parallel to the c axis follow normal-state resistivity $\rho_{Nc}(T)$ down to a temperature much lower than the zero-field transition temperature T_{c0} and exhibit a huge linear (Ohmic) dissipation over a broad range below T_{c0}. This anomalous behavior in the force-free configuration was attributed by the authors to, as in 1D whiskers, phase-slippage events occurring through possible interlayer weak links. However, they did not clarify the mechanism causing the phase slippage nor did they try to consistently understand their data of in-plane resistivity $\rho_{ab}(T,H)$ which showed a "shoulder" for **H**∥**c**.

In this Comment, we point out that such ρ_c (and ρ_{ab}) data in the Ohmic regime where we have no phase transitions can naturally be explained according to the order-parameter fluctuation theory developed in Ref. [3]. This approach, which is similar to those of previous works for $H=0$ [4], is appropriate to the **H**∥**c** configuration in which complicated effects such as intrinsic pinning are irrelevant. We tried to fit both the ρ_c and ρ_{ab} data of sample 1 of Ref. [1]. As in Ref. [3], the total resistivity ρ_i ($i=ab$ or c) is assumed to be expressed by $\rho_i=\rho_{Ni}/(1+C_i^{-1}\rho_{Ni}\sigma_i)$. Here ρ_{Ni} and σ_i are the (extrapolated) normal resistivity and the fluctuation conductivity derived in Ref. [3], respectively, and an additional parameter C_i is used for fitting together with other material parameters. The theoretical curves we obtained are shown in Fig. 1 together with the sample-1 data of Ref. [1]. Concerning the slight disagreement between the data and the solid curve for ρ_c in 0.5 T, we point out that the positions of the 0.5-T data relative to the zero-field data are inconsistent with those seen in the sample-2 data of Ref. [1]. On the whole the agreement obtained for ρ_c seems satisfactory. For this agreement, it is particularly important that σ_c strongly depends on the out-of-plane coherence length ξ_{0c} [see Eqs. (3.16) and (4.1) in Ref. [3]]. In addition, the theory can explain the well-known "fan-shaped" broadening of ρ_{ab} above the shoulder implying flux flow. Here we emphasize that, as noted in Ref. [3], a different theoretical model which takes account of sample disorder should be required to explain the data below the shoulder where theoretical curves, especially for **I**⊥**H**, deviate from the data. In fact, the resistivity data below the shoulder seem to have a much weaker field dependence than those above it.

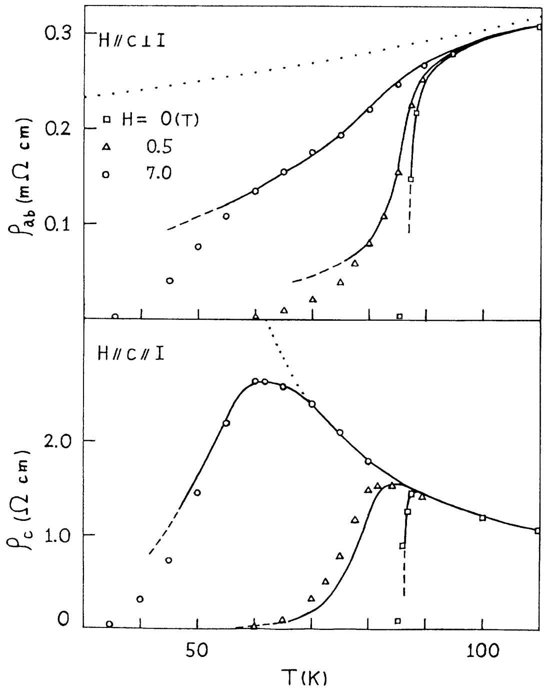

FIG. 1. Comparison of our theoretical curves with the ρ_{ab} and ρ_c data of sample 1 in Ref. [1]. Each dotted curve denotes extrapolated normal-state resistivity. The parameters used for the calculations (solid curves) are $\xi_0=9$ Å, $\xi_{0c}=0.13$ Å, $\kappa=228$, $C_{ab}=6.5$, $C_c=2.7$, and $T_{c0}=86.7$ K for both ρ_{ab} and ρ_c (see Ref. [3] for notations).

We expect that transport and thermodynamic quantities in the fluctuation-dominated regime of the mixed state should be explained by the same theoretical picture. A detailed analysis [5] of twinned and untwinned YBaCuO crystal data seems to support this expectation.

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