

Comment on “Strong Vortex Liquid Correlation from Multiterminal Measurements on Untwinned $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ Single Crystals”

From recent transport experiments Rydh and Rapp [1] (RR) claim that the vortex liquid in untwinned $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ crystals is correlated above the melting transition, in striking contrast to previous work [2]. In this Comment we present new measurements using the same experimental technique on twinned and untwinned $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ crystals with similar overall characteristics as those reported by RR. The comparison of the vortex correlation response in both cases indicates that the central conclusion of the work of RR is not correct. Our results reconfirm the work by López et al. [2] and points on the origin of the misinterpretation in the work of RR.

The results of the voltage response, $V(T)$, for a *twinned* crystal in a magnetic field of $H = 6$ T, are shown in Fig. 1(a). At high temperatures the dissipation at the top, V_{top} is larger than at the bottom, V_{bot} , as a result of the inhomogeneous current distribution acting upon an uncorrelated vortex system. As the temperature is lowered V_{top} equals V_{bot} at T_{th} . This result could be either a trivial consequence of the limited experimental voltage sensitivity (indicating an Ohmic decrease of the resistance in the c direction) or associated with the establishment of vortex velocity correlation which implies vortex phase correlation along the field direction across the sample thickness. In the first case the I - V curves are Ohmic; in the second a non-linear behavior indicates the existence of a finite cutting current [3], I_{cut} , for $T < T_{\text{th}}$. This second case is fulfilled for the twinned sample as shown in the inset of Fig. 1(a). While for $T > T_{\text{th}}$, $\Delta V(I) = V_{\text{top}} - V_{\text{bot}}$ extrapolates to zero at $I = 0$, for $T < T_{\text{th}}$ a well-defined I_{cut} is detected.

For an *untwinned* crystal [4] equivalent results are shown in Fig. 1(b). From the $V(T)$ curves alone one is tempted to conclude, as RR did, that the vortex liquid is *correlated* between T_m and the “apparent” T_{th} . However, the behavior of the I - V curves shows that in this case the result $V_{\text{top}} = V_{\text{bot}}$ is just a consequence of the limited voltage sensitivity. The inset shows linear $\Delta V(I)$ that extrapolates to zero for $I = 0$ at $T < “T_{\text{th}}”$, consistent with a continuous Ohmic decrease of the resistance in the c direction. This absence of I_{cut} is in sharp contrast to the behavior observed in the twinned samples [2] and is the fingerprint of an *uncorrelated* vortex system. Moreover, the local analysis of the parallel and perpendicular resistivities in terms of the Laplace equation [1] is only consistent with this linear behavior [5].

In summary, the information provided by the I - V curves is crucial to give a correct interpretation to the T_{th} extracted

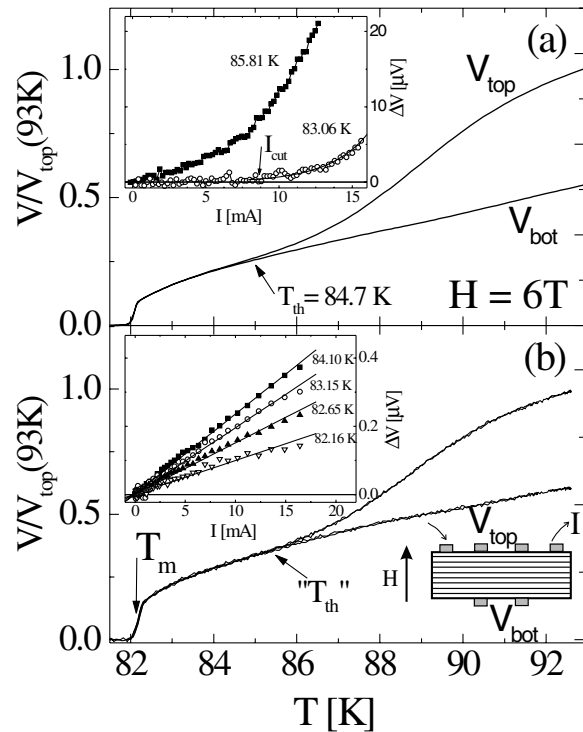


FIG. 1. Normalized $V(T)$ measurements: (a) Twinned crystal; inset: $\Delta V(I)$ curves for $T > T_{\text{th}}$ and $T < T_{\text{th}}$. (b) Untwinned crystal; inset: $\Delta V(I)$ curves for $T < “T_{\text{th}}”$.

from the $V(T)$ curves. This key point is lacking in the results of RR and therefore it cannot be concluded solely from their $V(T)$ curves that the vortex liquid in untwinned samples is correlated. A proper measurement of I - V characteristics would have led RR to the opposite conclusion.

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