Comment on "Low-Temperature Charge Ordering in the Superconducting State of $YBa_2Cu_3O_{7-\delta}$"

In a recent Letter [1], Krämer and Mehring presented Cu(2) copper-plane site nuclear quadruple resonance (NQR) experiments in the superconducting state of highly doped ($T_{sc} \approx 90$ K) $YBa_2Cu_3O_{7-\delta}$. They interpreted their results as evidence for a transition below 35 K to a charge density wave (CDW) ordered state. The authors confirmed the existence of a λ-like peak in the spin-spin relaxation rate, as reported in earlier studies [2], which has never been consistently explained up to now. They also observed an increasing quadrupolar broadening of the Cu(2) NQR line below 35 K, whereas, according to their data, the linewidth is constant for higher temperatures. This new feature confirmed the quadrupolar nature of the mechanism involved in the 35 K anomaly, which is therefore connected with some type of charge redistribution.

In this Comment, we show that the evolution of the charge ordering with temperature below T_{sc}, and even in the normal state, may be more subtle than a simple transition to a CDW below 35 K. The Cu(2) NQR linewidth in slightly overdoped $YBa_2Cu_3O_{7-\delta}$ ($T_{sc}^{midpoint} \approx 89.5$ K) already starts to increase below T_{sc}, and possibly even at higher temperatures ($\approx$130 K within our experimental resolution), as can be seen from our NQR data [3] represented in Fig. 1 (for the sample preparation and experimental conditions, see Ref. [4]). Moreover, the linewidth successively displays a well-defined maximum at $T \approx 60$ K and a minimum at $T \approx 40$ K, and finally increases monotonically for lower temperatures. We note that the data of Krämer and Mehring might possibly agree with our 60 K local maximum within their experimental resolution (see the bottom part of Fig. 1 in Ref. [1]), and that the lack of measurements for $T > 80$ K in their work prevents making a precise analysis of the charge ordering evolution in the superconducting state.

It should be realized that the evidence [5,6] for a charge density wave state in the copper chain layer of $RBa_2Cu_3O_{7-\delta}$ (R = rare earth) calls for a careful analysis of the copper-plane site NQR data. We have shown in previous reports [4,6] that in $PrBa_2Cu_3O_{7-\delta}$, where CuO_2 planes are insulating, the CuO_3 chains undergo a CDW transition below 120 K. In overdoped $YBa_2Cu_3O_{7-\delta}$, our NQR results suggest that this tendency to a CDW state is also present but affected by the interaction with adjacent CuO_2 planes. This mutual interaction between chains and planes is discussed in a forthcoming paper, explaining the origin of the in-plane charge reordering below T_{sc}, and accounting for the complex T dependence of the Cu(2) NQR linewidth.

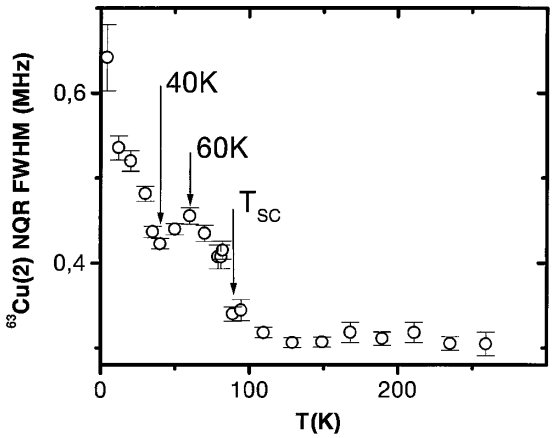

FIG. 1. Full width at half maximum (FWHM) of the ^{63}Cu(2) NQR line ($^{63}\Delta\nu_Q$) in slightly overdoped $YBa_2Cu_3O_{7-\delta}$. In contradiction with Ref. [1], $^{63}\Delta\nu_Q$ is not constant between $T_{sc} \approx 90$ K and 35 K, and already increases below T_{sc}. The arrows indicate T_{sc}, and the local maximum and minimum, respectively, at $T \approx 60$ K and $T \approx 40$ K.

B. Grévin,[1,*] Y. Berthier,[1] and G. Collin[2]
[1]Laboratoire de Spectrométrie Physique
Université Joseph-Fourier Grenoble I, B.P. 87
38402 Saint Martin d'Hères Cedex, France
[2]Laboratoire Léon Brillouin, CEA-Saclay
91191 Gif-surf-Yvette Cedex, France

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*Present address: DPMC, Université de Genève, 24 quai Ernest Ansermet, CH 1211 Genève, Switzerland.

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