

**Krämer and Mehring Reply:** In their preceding Comment [1], Grévin *et al.* presented experimental evidence that the behavior of the  $^{63,65}\text{Cu}(2)$  linewidth in  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  in the superconducting state might be more complex than a simple charge ordering process below 35 K as proposed by us [2]. They called for a careful analysis of the Cu nuclear quadrupole resonance (NQR) data in the full temperature range above and below  $T_c$ . Their experimental data show an increasing  $^{63}\text{Cu}$  linewidth setting well above 35 K in overdoped  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  which, they claim, contradicts our results.

(1) In our original paper [2] we showed that the evidence for a charge ordering state below 35 K in  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  is *not only* based on the increasing  $^{63,65}\text{Cu}(2)$  linewidth *but also* on a narrow peak in the spin-spin relaxation rate of  $^{63,65}\text{Cu}(2)$  and a significant change in the spin-echo decay function. Furthermore, by comparing the results of the different Cu isotopes we were able to identify the mechanism responsible for the line broadening and relaxation peak as of quadrupole, i.e., charge driven origin.

(2) In order to facilitate the  $^{63}\text{Cu}$  linewidth discussion we present in Fig. 1 the  $^{63}\text{Cu}$  linewidth data up to 300 K. Besides the increase of the linewidth below 35 K, which we discussed in our original paper, we see no significant increase of the  $^{63}\text{Cu}$  linewidth between 90 and 35 K within our experimental resolution. There is, however, a difference in the samples used by Grévin *et al.* and ours. Their sample was overdoped, ours were slightly underdoped. Because of oxygen disorder in underdoped  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ , the linewidth observed by us is higher than the one observed in oxygen ordered overdoped  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ . Furthermore, it is well known that the charge distribution and the electric field gradient at the Cu(2) site depends critically on the population of the Cu(2)  $3d$  orbitals which is doping dependent [3]. Therefore any charge ordering process should also depend on doping. Nevertheless, after a slight decrease there is a marked increase of the linewidth observed by Grévin *et al.* below 40 K. It appears to be very close to the charge ordering temperature derived by us from spectral line-shape and relaxation data. This might be a signature of a different process setting in below 40 K.

(3) We agree with Grévin *et al.* that the results obtained so far from Cu NQR in  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  call for further investigations of Cu(2) and Cu(1) in this compound. The doping dependence seems to be very important. In our contribution we wanted to demonstrate that not only the

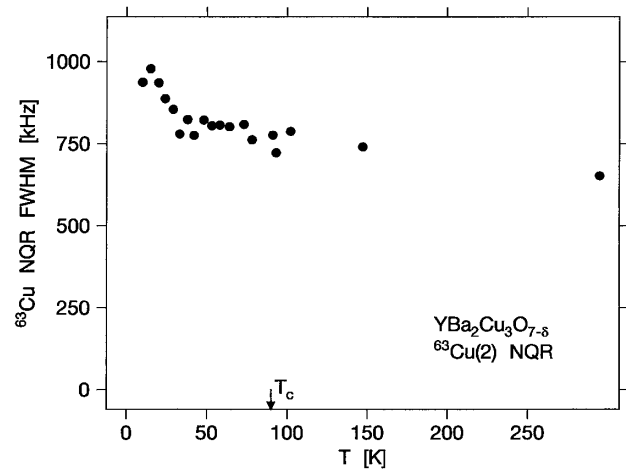


FIG. 1.  $^{63}\text{Cu}$  linewidth in slightly underdoped  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  between 10 and 300 K. A significant increase of the linewidth is clearly visible only below 35 K.

static aspects of charge ordering phenomena, which manifest themselves in spectral line shapes, are significant but also dynamic aspects which become visible in the relaxation data. These aspects have already been pointed out by Teplov *et al.* [4] and more recently by Hunt *et al.* [5]. According to their results the time scale of charge fluctuations is doping and temperature dependent, and charge ordering may appear as a critical slowing down of charge fluctuations with decreasing temperature and may be influenced by pinning due to doping dependent impurities.

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