

Fehér *et al.* Reply: Zheng *et al.* state in their Comment [1] on our Letter [2] that (i) the comparison we made with their NMR data [3] was “inappropriate,” and (ii) our data in the superconducting state cannot be used to draw conclusions regarding the normal-state pseudogap. We show below that these criticisms are based on a misrepresentation of our Letter.

We stated in our Letter that the enhancement of the static spin susceptibility measured by electron spin resonance (ESR) with $B \parallel c$ was of similar magnitude as the enhancement of the static spin susceptibility measured by NMR with $B \parallel ab$ [3]. We would like to point out that it has been shown that the high field Gd^{3+} ESR shift does measure the static spin susceptibility, χ_s [4], and hence the comparison with the NMR data is valid. Since the expectation is that the enhancement of the spin susceptibility is strongly anisotropic, we wrote that our result “differs” from the one published by Zheng *et al.*

Zheng *et al.* have now provided previously unpublished NMR shift data at 16 K, but we show below that this does not affect the analysis of our data. We first note that the NMR shift data at 16 K gives $\delta_{\text{NMR}} = [\chi_s^{ab}(23.2 \text{ T}, 16 \text{ K}) - \chi_s^{ab}(8 \text{ T}, 16 \text{ K})]/\chi_s^c(T_c) = (11 \pm 5)\%$, while the ESR data gives $\delta_{\text{ESR}} = [\Delta\chi_s(15.4 \text{ T}, 16 \text{ K}) - \Delta\chi_s(0 \text{ T}, 16 \text{ K})]/\chi_s^c(T_c) = (10 \pm 7)\%$, where $\Delta\chi_s = \chi_s^c - \chi_s^{ab}$. Assuming an anisotropy of $H_{c2}^{(ab)}/H_{c2}^{(c)} = 7$ [3] and a field dependence of the form $\kappa(B/H_{c2})^\gamma$ with $0.41 \leq \gamma \leq 1$ [5–7], the NMR data predict average δ_{ESR} values of 28%, 39%, and 47% for $\gamma = 0.41, 0.8,$ and $1,$ respectively. For comparison with the Comment by Zheng *et al.* we use $H_{c2} = 70 \text{ T}$ for their sample and $H_{c2} = 100 \text{ T}$ for ours—a lower value would only increase the discrepancy. Note, however, that H_{c2} can be as high as 130 T [8]. The predicted and experimental δ_{ESR} values barely agree for $\gamma = 0.41$ provided we take the minimum δ_{NMR} and the maximum δ_{ESR} . However, a γ of 0.41 is unrealistic at this temperature because it is valid only for $T/T_c \ll B/H_{c2}$ [6]. Rather, $T/T_c \sim B/H_{c2}^{(c)}$ and hence we are in the crossover regime, where a higher value of gamma is appropriate. We estimate that γ is closer to 0.8 than 0.41 [6].

It is correct to state that the sample qualities are different. Our ceramic and single crystal samples showed a full Meissner effect below 80 K. This is comparable to that found in good quality $\text{YBa}_2\text{Cu}_4\text{O}_8$. However, Zheng *et al.* reported data for an aligned $\text{YBa}_2\text{Cu}_4\text{O}_8$ powder sample where T_c had been suppressed to 74 K [3]. They used the same sample previously to deduce H_{c2} [9].

We disagree with the claim of Zheng *et al.* that our data in Fig. 2(b) of Ref. [2] imply a significant field dependence of χ_s^{ab} . As explained in the text, the data in the figure are corrected for the measured zero field splitting but

not for diamagnetism. For Gd^{3+} ESR—contrary to ^{63}Cu NMR—the shift due to diamagnetism has the same sign as the exchange mediated paramagnetic shift and hence the field dependence seen in Fig. 2(b) of Ref. [2] is rather a proof of negligible enhancement in χ_s^{ab} .

Our statement concerning the pseudogap has been misquoted by Zheng *et al.* We stated in our Letter that the small field dependence of χ_s at $T \ll T_c$ suggests that applying a magnetic field of H_{c2} would not suppress the pseudogap. We do not believe the claim that κ could be so small as to render our conclusions invalid [1]. First, we note that Mao and Balatsky [7] predict $\kappa = 0.8$ and the more elaborate calculations by Yasui and Kita [10] imply that κ does not significantly differ from 1. Second, a value of κ significantly lower than 1 is nonphysical as it would require the field dependence of χ_s to have a positive second derivative at higher fields.

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