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Balicas et al. Reply

L. Balicas, K. Behnia, W. Kang, D. Jérôme, L. Hubert, C. Bourbonnais

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Balicas *et al.* Reply: In their comment, Danner *et al.* [1] calls into question the interpretation of anomalous magnetoresistance taking place in $(\text{TMTSF})_2\text{ClO}_4$ and which is based on field-induced one-dimensional (1D) Umklapp scattering [2]. It is pointed out that, if singular Umklapp scattering opens up a sharp Mott-Hubard gap under field, this will affect transverse magnetoresistance as well, which contrasts with observation [3]. This is certainly a relevant remark, but we think that it does not allow one to conclude about the irrelevance of our model for $(\text{TMTSF})_2\text{ClO}_4$. We would like to seize this opportunity to further qualify the implications of our model for different members of the Bechgaard salts series. What should be established at the very outset from our model, however, is that singular longitudinal electronic umklapp scattering is only progressively restored as the field is increased along c^* . Actually, important transient effects remain under field and will preclude the formation of sharp gap that would freeze all degrees of freedom at the Fermi level. Therefore only a partial reduction of density of states can, at best, be expected so that a sizable Fermi liquid component can be stabilized at very low temperature. These one-particle self-energy effects were neglected in our one-loop renormalization group (RG) calculation [2]. The data of Danner *et al.*, showing an unaltered $\rho_c(T, H)$ for \mathbf{H} along c^* does indicate that the field-induced reduction of density of states is small for the perchlorate compound for which the anion gap will directly affect longitudinal nesting conditions and magnify transients. However, although self-energy effects are small, the gradual reactivation of the 1D channel of electronic umklapp scattering is not completely absent, as attested by the sizable noncritical enhancement of the nuclear relaxation rate induced by the field on the temperature scale T_ρ [2], namely, precisely where the deviations to the Kohler's rule for the longitudinal magnetoresistance are known to take place [3].

The comparison with $(\text{TMTSF})_2\text{PF}_6$ under pressure is instructive here since this compound does not present any anion ordering, so that 1D umklapp scattering effects should be more pronounced. This is supported by the temperature profile of $\rho_c(T, H)$ shown in Fig. 1 and obtained on a $(\text{TMTSF})_2\text{PF}_6$ single crystal under 8.5 kbar of pressure and a field of 12.5 T along c^* . The nonmetallic behavior of $\rho_c(T, H)$ is clearly unexpected from the point of view of classical transport theory, and, correspondingly, the amplitude of longitudinal magnetoresistance is apparently more marked (unpublished results). This is shown by the much more rapid progression of T_ρ with H (obtained from the longitudinal magnetoresistance R_a with \mathbf{H} along c^* , inset of Fig. 1) in comparison to the perchlorate compound [2]. The RG calculation of $T_\rho(H)$ in Fig. 1 has been obtained from the same set of parameters used in Ref. [2] but using the reduction of the density

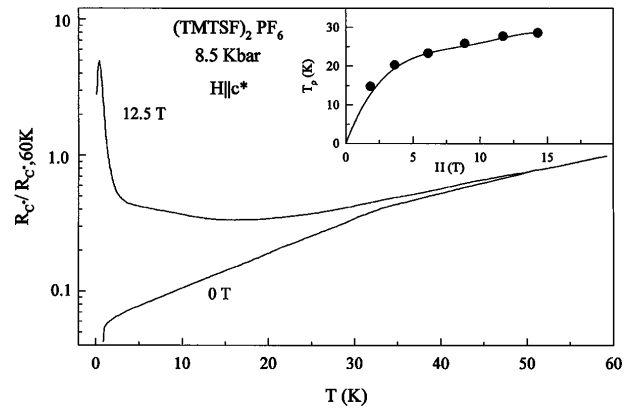


FIG. 1. Transverse (c^*) resistivity curves vs temperature for $(\text{TMTSF})_2\text{PF}_6$ (8.5 kbar) at $H = 0$ and 12.5 T. Inset: observed variation (points) of the temperature scale T_ρ vs H derived from the temperature dependence of the longitudinal resistance. The continuous line corresponds to the RG calculation.

states at the Fermi level under field as an adjustable parameter for one-particle self-energy effects, and which amounts to $\sim 20\%$ or so at 12 T [4].

In conclusion, we think that the restoration of the umklapp scattering is the reason for the anomalous magnetoresistance in all Bechgaard salts, although the presence of two bands close to half-filling makes this effect weaker in $(\text{TMTSF})_2\text{ClO}_4$.

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L. Balicas, K. Behnia, W. Kang, and D. Jérôme
Laboratoire de Physique des Solides (associé au CNRS)
Université Paris-Sud
91405 Orsay, France

L. Hubert and C. Bourbonnais
Centre de Recherche en Physique du Solide et Département
de Physique
Université de Sherbrooke
Sherbrooke, Québec, Canada J1K 2R1

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- [2] K. Behnia *et al.*, Phys. Rev. Lett. **74**, 5272 (1995).
- [3] L. Forro *et al.*, Phys. Rev. B **29**, 2839 (1984).
- [4] It is worth pointing out that a similar rapid progression of T_ρ with H has been recently observed in the NO_3 salt for which no transverse period doubling is found in the anion structure at low temperature. See, for example, A. Audouard *et al.*, Phys. Rev. B **52**, R700 (1995).