

## Reply to a comment published in Physical Review Letters

F. Rullier-Albenque, Dorothée Colson, Anne Forget, Henri Alloul

► **To cite this version:**

F. Rullier-Albenque, Dorothée Colson, Anne Forget, Henri Alloul. Reply to a comment published in Physical Review Letters . Physical Review Letters, American Physical Society, 2015, 115, pp.139702. <10.1103/PhysRevLett.115.139702>. <cea-01494124>

**HAL Id: cea-01494124**

**<https://hal-cea.archives-ouvertes.fr/cea-01494124>**

Submitted on 22 Mar 2017

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**Rullier-Albenque *et al.* Reply:** In the preceding Comment, Ramos-Álvarez, Mosqueira, and Vidal [1] criticize the analysis of our magnetoresistance data in LiFeAs [2] and conclude that this “poses serious doubts about the conclusions drawn in our Letter about the 2D nature of fluctuation effects in LiFeAs”.

To allay these doubts, we argue that LiFeAs is very peculiar among pnictides and it is not *a priori* obvious that superconducting fluctuations should display similar dimensional behavior for all the superconducting pnictides [3].

The authors use the fact that the expected value of fluctuating conductivity  $\Delta\sigma$  would be 2 orders of magnitude smaller than the normal state conductivity  $\sigma_B$  to argue that extracting  $\Delta\sigma$  in these crystals would require a highly precise procedure. Let us notice that Ramos-Álvarez, Mosqueira, and Vidal quote here a paper (Ref. [2] of the Comment) that uses a much less precise procedure to extract fluctuating conductivity from transport measurements. However, we do show that our method, based on the deviation of the quadratic  $H^2$  dependence of the normal state magnetoresistance, allows us to determine  $\Delta\sigma$  very precisely. Consequently, the issue addressed by the authors in the Comment does not call into question the precision of the experimental measurements, but the analysis of the experimental data.

Ramos-Álvarez, Mosqueira, and Vidal claim that the magnetoresistance curves at 45, 50 and 60 K, where no superconducting fluctuations are expected, display a relative rounded behavior quite similar to that seen at 25 K. However, they display our data in a rather misleading way. We argue, on the contrary, that it is dangerous to isolate just one part of the curve to draw a conclusion. Just taking the data points at high magnetic field without considering those at low magnetic field is not very serious. It is clear that the magnetoresistance signal is much smaller at 45, 50, and 60 K and that some experimental noise cannot be avoided. We have reported in Fig. 1(a) in the full field range the high  $T$  magnetoresistance curves plotted in Fig. 1 of the Comment together with two curves taken at lower  $T$  in Fig. 1(b). Contrary to what is claimed by Ramos-Álvarez, Mosqueira, and Vidal, it is obvious that very good linear fits versus  $H^2$  can be accomplished for the three displayed isotherms (45, 50, and 60 K). Given the measurement sensitivity, it is difficult to determine some deviations from a  $H^2$  behavior at any magnetic field. The situation appears very different at low temperature, where the signals are 1 order of magnitude larger, which allows us to determine unambiguously deviations from the high magnetic field  $H^2$  behavior. Let us also notice that deviations are expected to occur at increasing magnetic field with decreasing temperature, which is indeed observed from 45 to 18.8 K. It is worth mentioning here that such deviations from a  $H^2$  behavior have been also reported by Kasahara *et al.* [4] at low temperatures.

Let us note that we had already given different arguments in our Letter [2] to stress that the order of magnitude of the

deviation from the  $H^2$  behavior of  $\Delta\sigma$  cannot be explained in a multiband approach using expression (9) of the Supplemental Material of our Letter. Moreover, the Hall effect remains linear versus  $H$  in this whole temperature range [5]. To make things clearer, we show in the inset of Fig. 1(a) that the Hall effect at 60 K is perfectly linear up to 14 T, while the analysis of our magnetoresistance data by Ramos-Álvarez, Mosqueira, and Vidal should have implied a strong deviation below 10 T.

We have shown in this Reply that the criticism of Ramos-Álvarez, Mosqueira, and Vidal relies on a selective interpretation of the data and does not, in fact, pose a serious critique of our measurements and analysis. Consequently, the conclusions they draw are not well argued and do not allow them to assert that the deviations observed in the magnetoresistance curves are due to a normal state effect.

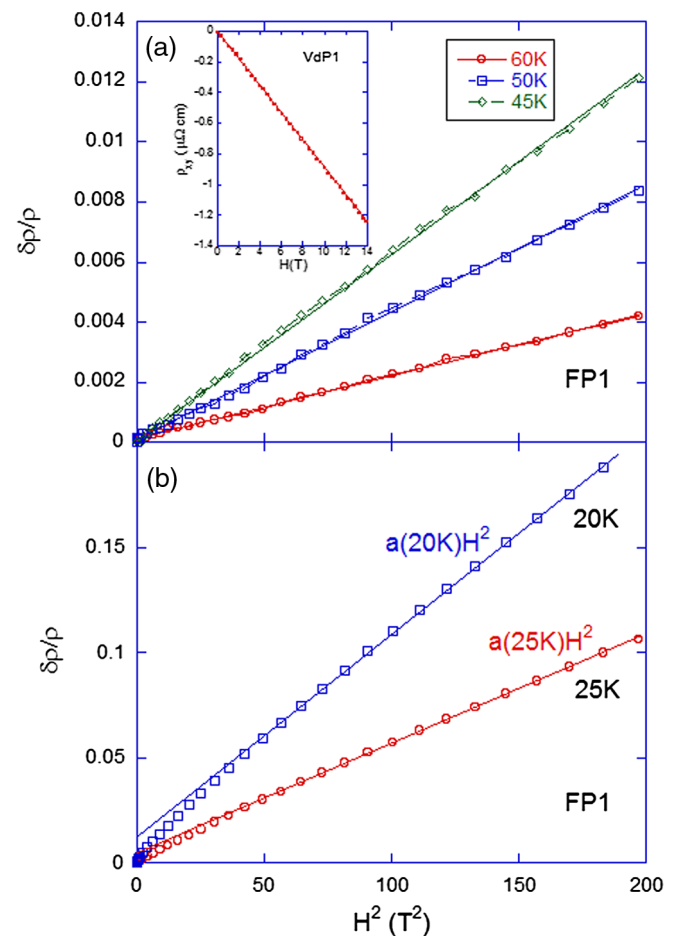


FIG. 1 (color online). (a) Magnetoresistance curves versus  $H^2$  at 45, 50, and 60 K for sample FP1. Straight lines are linear fits of the data. The inset shows the Hall effect data for sample VdP1 at 60 K for magnetic fields up to 14 T. The straight line is a linear fit of the data. (b) Magnetoresistance curves versus  $H^2$  at 20 and 25 K. Straight lines are linear fits of the data at high magnetic fields.

F. Rullier-Albenque,<sup>1,\*</sup> D. Colson,<sup>1</sup>A. Forget<sup>1</sup> and H. Alloul<sup>2</sup><sup>1</sup>Service de Physique de l'Etat Condensé  
Orme des Merisiers, CEA Saclay (CNRS URA 2464)  
91191 Gif sur Yvette cedex, France<sup>2</sup>Laboratoire de Physique des Solides  
UMR CNRS 8502, Université Paris Sud  
91405 Orsay, France

Received 21 August 2015; published 23 September 2015

DOI: [10.1103/PhysRevLett.115.139702](https://doi.org/10.1103/PhysRevLett.115.139702)

PACS numbers: 74.70.Xa, 74.25.F-, 74.25.Jb, 74.40.-n

\*florence.albenque-rullier@cea.fr

- [1] A. Ramos-Álvarez, J. Mosqueira, and F. Vidal, preceding Comment, *Phys. Rev. Lett.* **115**, 139701 (2015).
- [2] F. Rullier-Albenque, D. Colson, A. Forget, and H. Alloul, *Phys. Rev. Lett.* **109**, 187005 (2012).
- [3] L. Fanfarillo and L. Benfatto, *Supercond. Sci. Technol.* **27**, 124009 (2014).
- [4] S. Kasahara, K. Hashimoto, H. Ikeda, T. Terashima, Y. Matsuda, and T. Shibauchi, *Phys. Rev. B* **85**, 060503(R) (2012).
- [5] Even if the curves are not reported in our Letter, we find it unacceptable that Ramos-Álvarez *et al.* [1] could suggest that it is not true in Ref. [4] of their Comment.