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Comment on the paper "Nature of Low-Temperature Phase Transitions in $CaMn_7O_{12}$"

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Resubmitted

We insist on saying that the anomalies observed in magnetization, specific heat and thermal expansion of $CaMn_7O_{12}$ at T_S = 89 K and T_M = 49 K reported in O. Volkova et al., Pis'ma v ZhETF **82**, 498 (2005) [JETP Lett. **82**, 444 (2005)] and mentioned in Pis'ma v ZhETF **82** 724 (2005) [JETP Lett. **82**, 642 (2005)] are both of magnetic origin.

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Recent papers by Vol'kova et al. [1, 2] describe the nature of low-temperature phase transitions in $CaMn_7O_{12}$. The authors [1] clearly show the existence of anomalies at T_S=89 K and T_M=49 K in $CaMn_7O_{12}$ by using three complementary techniques: magnetization, specific heat and thermal expansion measurements. The conclusion given in [1] is that the transitions at T_M=49 K and T_S=89 K are of magnetic and structural origin, respectively. These conclusions are based on the differences of $CaMn_7O_{12}$ magnetization $M(T)$ measured with field cooling (FC) and zero field cooling (ZFC). A behavior characteristic for spin-glass with differences between ZFC and FC magnetization measurements was observed below T_M=49 K [1]. At T>49 K there was no difference between FC and ZFC magnetization measurements, there was a kink on the $M(T)$ curve at T_S=89 K and a Curie-Weiss behaviour above 89 K [1]. We do not agree with the conclusion of the authors of [1] that the transition at T_S = 89 K in $CaMn_7O_{12}$ is not of magnetic origin.

The microstructure may influence the physical properties of $CaCu_xMn_{7-x}O_{12}$ [3 – 5] compounds. It would be helpful if the authors of [1] could give more details about the microstructure of the $CaMn_7O_{12}$ sample used and about possible impurity phases. This is especially important for the Mn_3O_4 impurity phase which becomes ferrimagnetically ordered at 45 K [6], i.e. near T_M=49 K.

Secondly, we would like to emphasize some of our earlier $CaMn_7O_{12}$ neutron scattering [7, 8] and synchrotron radiation (SR) [9] results:

- The appearance of new Bragg peaks in the $CaMn_7O_{12}$ neutron diffraction patterns at 89 K is associated with a decrease of the background level [7] characteristic for a transition between a paramagnetic state (above 89 K) and a magnetic long range ordered state (below 89 K).
- The Bragg peaks observed in small angle neutron scattering (SANS) $CaMn_7O_{12}$ studies corresponding to an interspacial distance of d=52 Å disappear at 89 K [8].
- There is no change of the intensity, position, nor width of the nuclear (structural) Bragg peaks observed in the $CaMn_7O_{12}$ neutron diffraction patterns [7] and high resolution SR diffraction patterns [9] below and above 89 K [7].

In conclusion, we insist on saying that we do not see any structural changes of $CaMn_7O_{12}$ at T_S=89 K and that this phase transition is of magnetic origin. Our neutron diffraction data [7, 8] and magnetization measurements by Vol'kova et al. [1] can be explained together by assuming a long-range magnetically ordered state between 89 K and 49 K which do not show spin-glass type behavior.

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