RESEARCH OF MAGNETIC PHASE TRANSITIONS IN FRUSTRATED *FCC*-IRON ALLOYS BY μSR-METHOD

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A lot of magnetic systems with competing exchange interaction between spins are found to exhibit a transition from the long range ferro- or antiferromagnetic phase into a spin glass state (or into a short range mixed phase) with decrease of temperature. Despite of extensive experimental and theoretical studies of the systems the nature of such reentrant transition is not quite clear yet, especially, for Heisenberg magnets. According to current theoretical predictions it should be realized like the succession of two transitions [1]. The first of them leading to the appearence of a nonergodic noncollinear long range ordered phase is expected to occur below T_c (or T_N) on the known Gabay-Toulouse (GT) line of the magnetic phase diagram [2]. This state should be transformed into the short range spinglasslike phase in result of the second transition taking place on the Almeida-Thouless (AT) line. During past few years the noncollinear long range ordered state preceding the reentrant spin glass was experimentally found using, mainly, a neutron scattering and μSR-method [3, 4]. But no significant spin's dynamics was detected near the GT line while it was observed close to T_c (T_N) and AT. So, the search of the spin's dynamics (including a non spin wave one) inside long range ordered phase is very important to find out the real nature of reentrant transition.

With the hope to see this process the investigation of $(Fe_xMn_{1-x})Pt_3$ alloys was started on PNPI muon beam using μSR-method. These alloys can be considered like ideal systems of knots with competing exchange interactions in the simple cubic lattice because magnetic atoms of Fe and Mn are randomly situated in coners of the cube and J_{MnMn}, $J_{MnFe} > 0$ but $J_{FeFe} < 0$ [5]. Nonmagnetic atoms of Pt are placed in the center of the cubic's planes. The magnetic phase diagram based on data of the magnetic methods and of the neutron scattering is represented in Fig.1 (lines).

In this work depolarization of muons stopped inside the sample under investigation was studied in the alloys with $x = 0.45$, 0.55, 0.60 and 0.65. Only the depolarization caused by the dynamical local fields was considered. So, the experimental μSR spectra were fitted using the following approximation of the muon depolarization function: $G(t) = \exp(-\lambda t)$.

The temperature dependencies of the relaxation rate $\lambda(T)$ measured without an external magnetic field showed narrow peaks close to temperatures of transitions into AF- and F-states (arrows denoted by T_c and T_N in Fig.2 and circles in Fig.1). In addition to its third broader peak in $\lambda(T)$ was found between T_c and T_N in the samples with $x < 0.65$. It, perhaps, indicated another phase transition which has not been detected by other methods. But bellow the temperature of the peak's maximum (denoted by T_A in Fig.2 and by stars in Fig.1.) a weak irreversibility of the magnetic susceptibility was observed to appear in the studied samples. The dependence of T_A on the external magnetic field was obtained for the sample with $x = 0.60$ (Fig.3). It rather corresponds to the Gabay-Toulouse dependence then to the Almeida-Thouless one.

So, it is natural to suppose that the observed near T_A significant spin's dynamics is due

to the transition of the system from the long range F-state to the noncollinear nonergodic phase. The wide temperature region of the transition can probably be caused by the strong spatial disperse of the exchange energy because of the statistical distribution of iron and manganese atoms. It is expected that the analysis of the static local fields distribution could permit to do more specific conclusion about the state of the spin system in $(Fe_xMn_{1-x})Pt_3$ alloys.

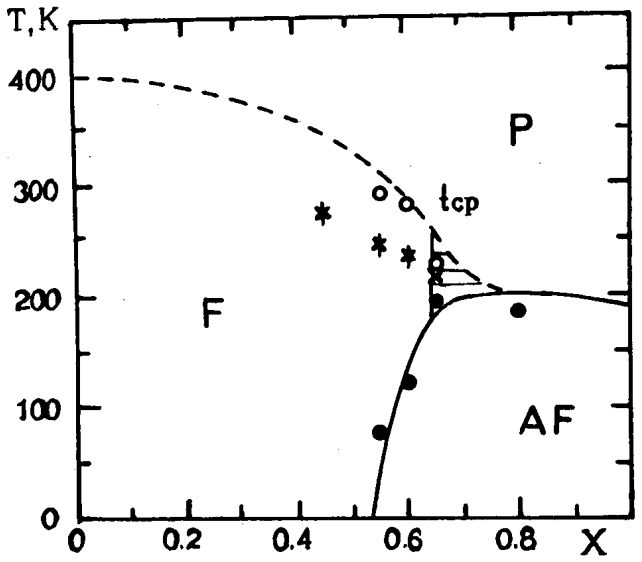

Fig.1. Magnetic phase diagram of $(Fe_xMn_{1-x})Pt_3$ alloys based on magnetic and neutron data (solid and dashed lines) [5]. T_{cp} is shadowed region close to tricritical. point [5]. Points correspond to T_c (open), T_N (black) and T_A (stars) obtained from this experiment

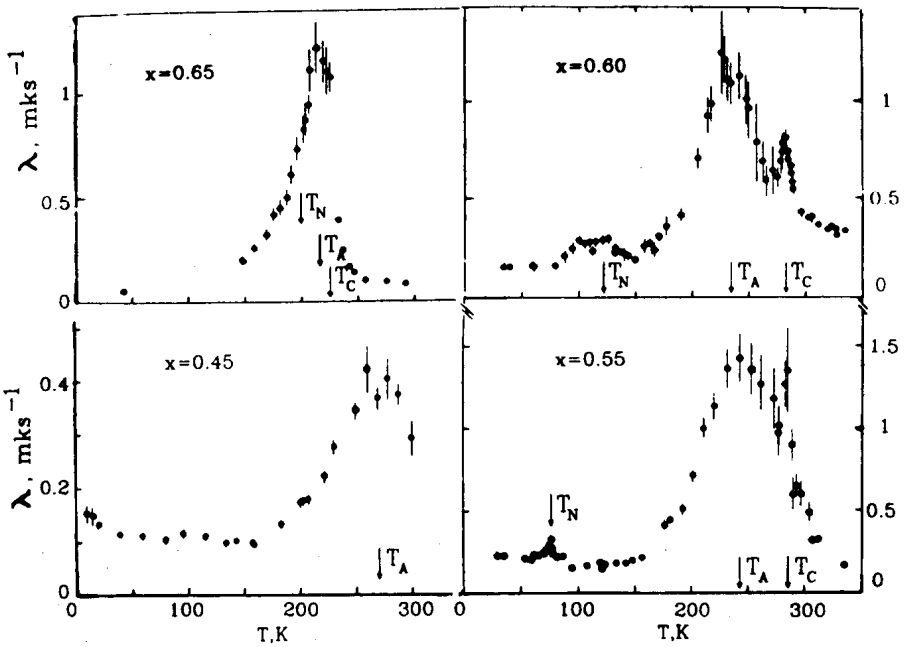

Fig.2. Temperature dependencies of muon depolarization rate in $(Fe_xMn_{1-x})Pt_3$ alloys measured at zero external magnetic field. Arrows indicate T_c and T_N temperatures from phase diagram (see Fig.1). T_A temperature corresponds to maximum of wide peak

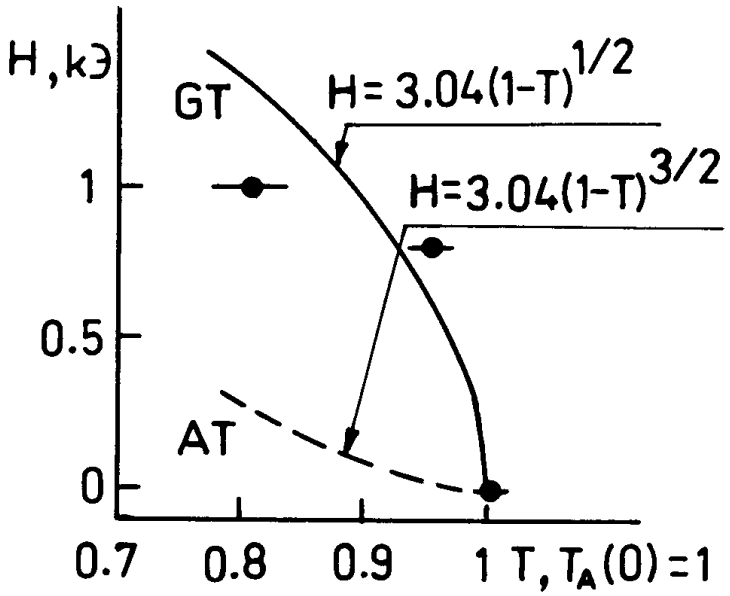

Fig.3. Dependence of T_A on external magnetic field value for sample with $x = 0.6$

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