ESRF	**Experiment title:** Magnetic structure of ultra-small ε-Fe_2O_3 nanoparticles	**Experiment number:** SC-4708
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Names and affiliations of applicants (* indicates experimentalists):

Iurii Kniazev[1], Dmitrii Balaev[1], Natalia Kazak[1], Valerio Cerantola[2]

[1]*Kirensky Institute of Physics, Siberia Branch of Russian Academy of Science Akademgorodok 50/38, Krasnoyarsk, 660036 Russia*

[2]*European Synchrotron Radiation Facility, CS 40220, F-38043 GRENOBLE Cedex 9, France*

Report:

Trivalent iron oxide ε -Fe_2O_3 attracts much interest because of its giant magnetic hardness (20 kOe), high temperature of transition into the magnetically ordered state (490 K) and the magnetoelectric effect [1-3]. This makes ε-Fe_2O_3 a promising functional material for data storage with high density recording and high-resolution probes in magnetic force microscopy. The origin of these unique properties, however, is still not understood, and the magnetic structure is not exactly known. The polymorph ε-Fe_2O_3 exists in the form of nano-particles up to 25–100 nm in size.

We focus our experiment on ε-Fe_2O_3 nanoparticles with average size of 5 nm (5FX) and 10 nm (20FX) which are well structurally and magnetically characterizied. The purpose of this experiment was to found out the peculiaruty of the magnetic ordering for different iron sublattices.

Experimental details

The ε-Fe_2O_3 nanoparticles was sinthezied on silica gel by incipient wetness impregnation with the Fe(II) sulphate solutions [4]. This technique allowed obtaining for the first time the systems of ε -Fe_2O_3 particles with an average size of few nanometers without any other iron oxide polymorphic phases, which is much smaller than in the above-cited studies. To perform the nuclear forward scattering studies, a ε-Fe_2O_3 nanoparticles was powdered. The NFS time spectra from ^{57}Fe nuclei was recordered at 4, 80, 90, 100, 110, 120, 30, 140, 150 and 290 K with applying an external magnetic fields up to 4 T. Measurements were performed in the 4-bunch mode of operation.

Results

The time spectra of resonance NFS from the ^{57}Fe nuclei in 5FX and 20FX samples of ε-Fe_2O_3 nanoparticles at T=4 and 290 K are shown in Fig.1. There are several notable features: i) at the fixed temperature spectra of the 5FX and 20FX samples are differed due to the size effect and magnetic relaxation effect. ii) When the temperature rises, the quantum beats disappear, testifying to the disappearance of the hyperfine magnetic field at the ^{57}Fe nuclei. iii) The noticeable difference in the spectra recorded for H=0 T and 4 T is observed. The NFS spectra show the field-induced change of the period of quantum beats and consequently the field magnetic field at the iron nuclei. In order to inside into the magnetic structure of ε-Fe_2O_3 the detaled analysis of obtaned spectra is need. It will be done at nearest future.

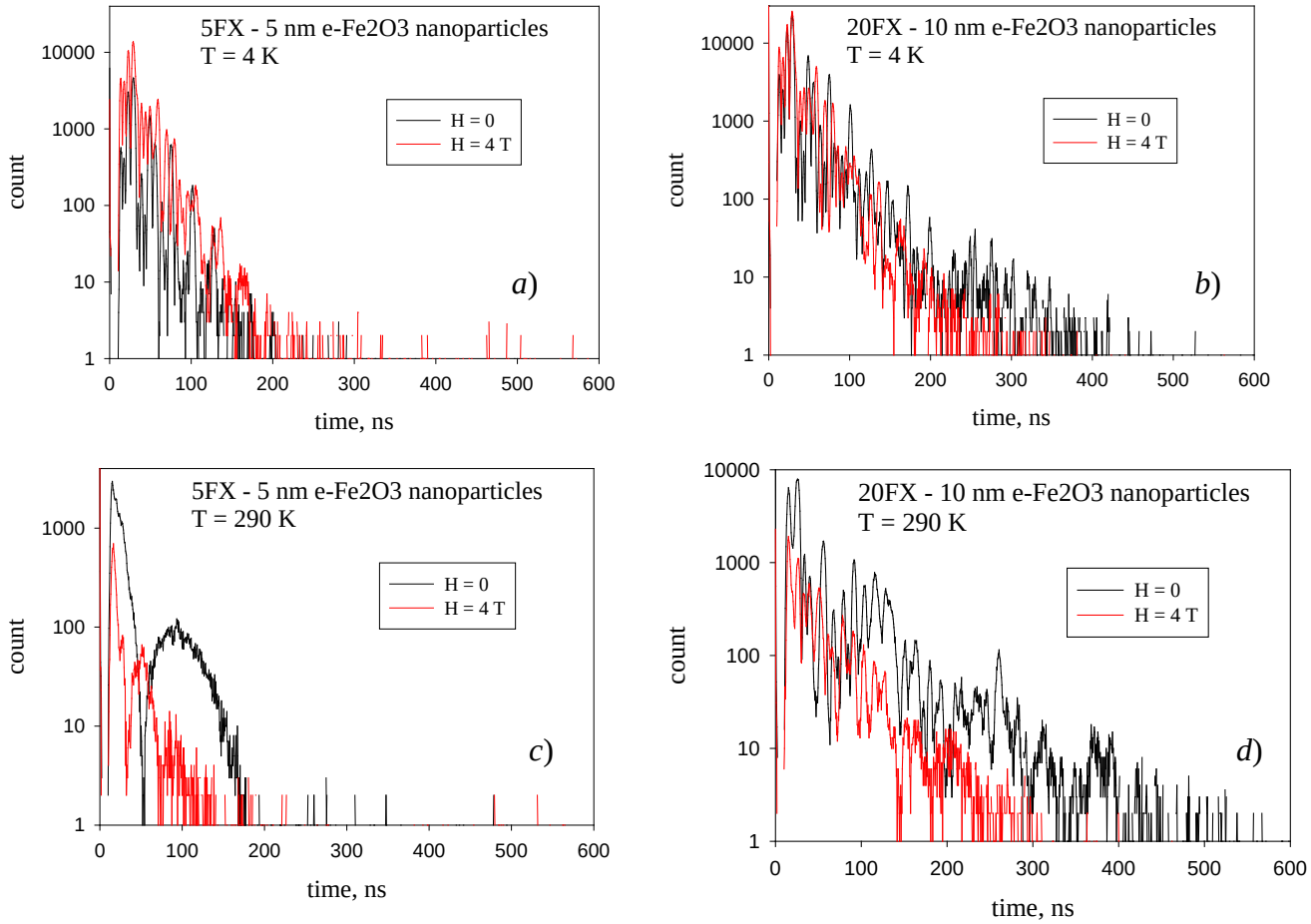

Fig. 1. Time spectra of resonance NFS from the ^{57}Fe nuclei in 5FX (*a*, *c*) and 20FX (*b*, *d*) samples of ε-Fe_2O_3 nanoparticles at T=4 and 290 K. The dependence of the scattered radiation intensity on the time elapsed after the SR shot is represented on a logarithmic scale. The spectra are recorded with applying an external magnetic field.

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