ESRF	**Experiment title:** Spin polarons in EuO	**Experiment number:** HC-3379
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Report:

In this experiment we used nuclear inelastic scattering (NIS) to measure the Eu-partial density of phonon states as a function of temperature (from 4 K up to 300 K) and external magnetic field (up to 1.1 T). When being measured, the samples were under vacuum ~10^{-6} mbar in a helium flow cryostat, furnished with kapton window for X-ray beam. The grazing incidence geometry was used with the wave vector of the incident photons parallel to [010] as well as [110] directions of the EuO(001), that corresponds to ΓKX and ΓX directions of the Brillouin zone, respectively. The incident X-ray energy was tuned to the resonant transition energy (21.54 keV) of the ^{151}Eu nuclei with an energy resolution ~ 1 meV. The spectra were recorded using the total delayed fluorescence yield. In addition, time spectra of nuclear forward scattering were recorded, allowing determination of the Eu magnetic state.

We carried out the entire experimental program: we measured Eu NIS spectra on high-guality $Eu_{1-x}Gd_xO$ films, MBE-grown on both Si and YSZ with different doping level, in a wide temperature range. However, unlike basic result received previously by the other group, we have not observed any broadening of the TA phonon density peak at low temperature, ascribed to giant spin-phonon coupling. On the contrary, the peak demonstrates an opposite behaviour, becoming narrower below the ferromagnetic transition (Fig. 1).

Encouraging aspect, however, can be found in the temperaure dependence of the forward scattering spectra. Oscillating character of the time decay points to certain magnetic ordering within the sample, while in paramagnetic matter it is expected to show up as an exponential decay. In our case oscillating structure is detected even above the ferromagnetic transition (Fig. 2). We believe, this feature is indicative of magnetic polarons in $Eu_{1-x}Gd_xO$ film. Thorough analisys of the spectra is being carried out.

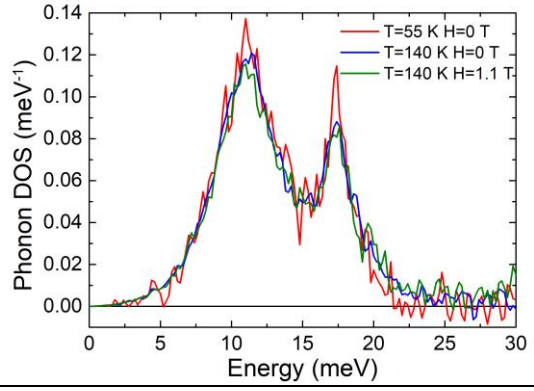

Figure 1. The $Eu_{1-x}Gd_xO$ [010] projected Eu-partial density of phonon states, measured below (red) and above Curie temperature in zero magnetic field (blue) and in magnetic field of 1.1 T (green).

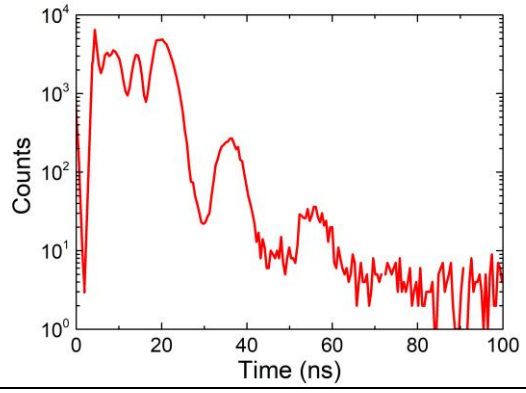

Figure 2. Time spectra of the nuclear forward scattering in $Eu_{1-x}Gd_xO$ film on Si(001) at T=75 K.