ESRF	**Experiment title:** Investigation of charge fluctuations in Eu_3S_4 by nuclear resonance scattering and of phonon density of states in Eu compounds by inelastic nuclear scattering	**Experiment number:** HE591
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Report:
Here we report on nuclear resonance scattering experiments at the 21.54 keV resonance of ^{151}Eu. We performed both nuclear forward scattering (NFS) on a polycrystalline sample of Eu_3S_4 and nuclear inelastic scattering (NIS) on a single crystal of EuP_5O_{14}.

The NFS experiments used a 7 meV high resolution monochromator as described in /1/. Time spectra are shown in Fig. 1. The full lines are simulations assuming two coexisting charge states – Eu^{2+} and Eu^{3+} – which appear to be static at low temperatures up to about T = 134 K. At higher temperatures faster charge fluctuations accelerate the nuclear decay, the frequencies obtained from the simulations applying a stochastical model are as indicated in the figure. According to literature a single resonance line was expected at T = 383 K, however, the time spectrum cannot be fitted with this assumption.
NFS spectra (not shown) recorded at low temperatures (10K<T<50K) in an external field of 3.7T prove the paramagnetic behaviour of the Eu ions in the Eu^{2+} state.

For the NIS experiments a high resolution monochromator consisting of two channel cut crystals in nested configuration was designed and commissioned in the frame of this experiment. The theoretically expected energy resolution of 1.6 meV was achieved. In Fig. 2 the experimental data from a single crystal of EuP_5O_{14} at 122°C are shown together with the phonon density of states derived from these data. The elastic peak (zero phonon line) directly reveals the energy resolution of the monochromator and is compared with the theoretically expected transmission curve (full line in Fig. 2a).

[a] Block allocation with proposals HE 590 and HE 592

The phonon density of states (cf. Fig. 2b) reveals a Debye-like behaviour at low energy transfer.

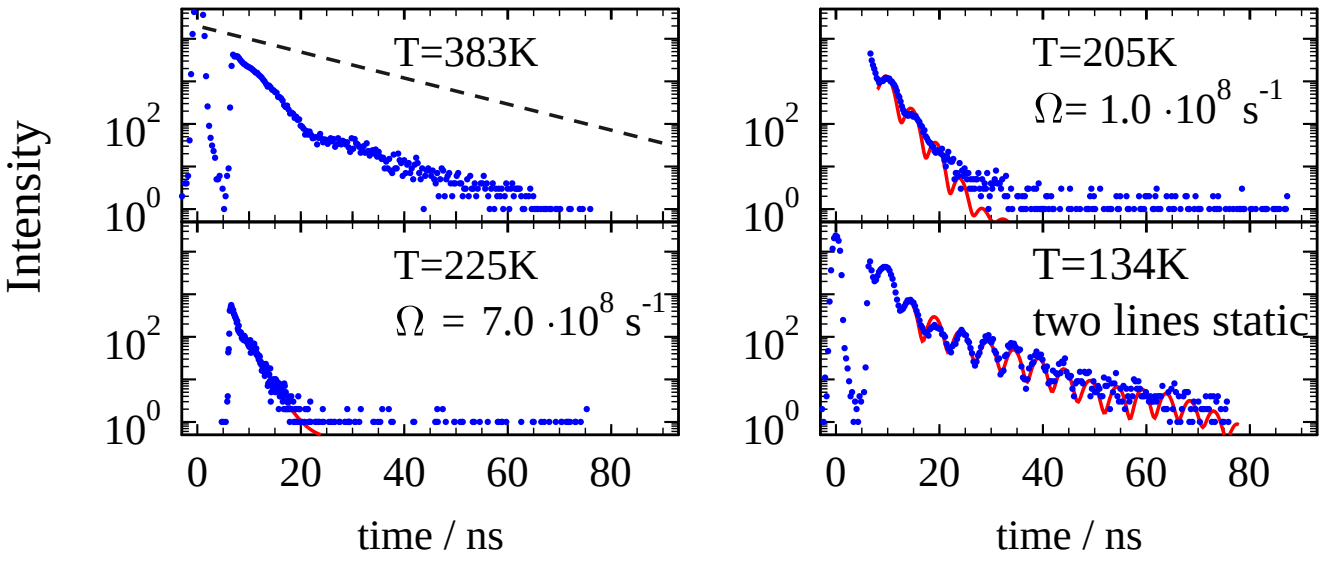

Fig. 1: NFS spectra of Eu_3S_4 for different temperatures between 134 K and 383 K. Full lines are simulations performed with the program package CONUSS /2/ including a stochastical relaxation model.
The dashed line visualizes the natural decay.

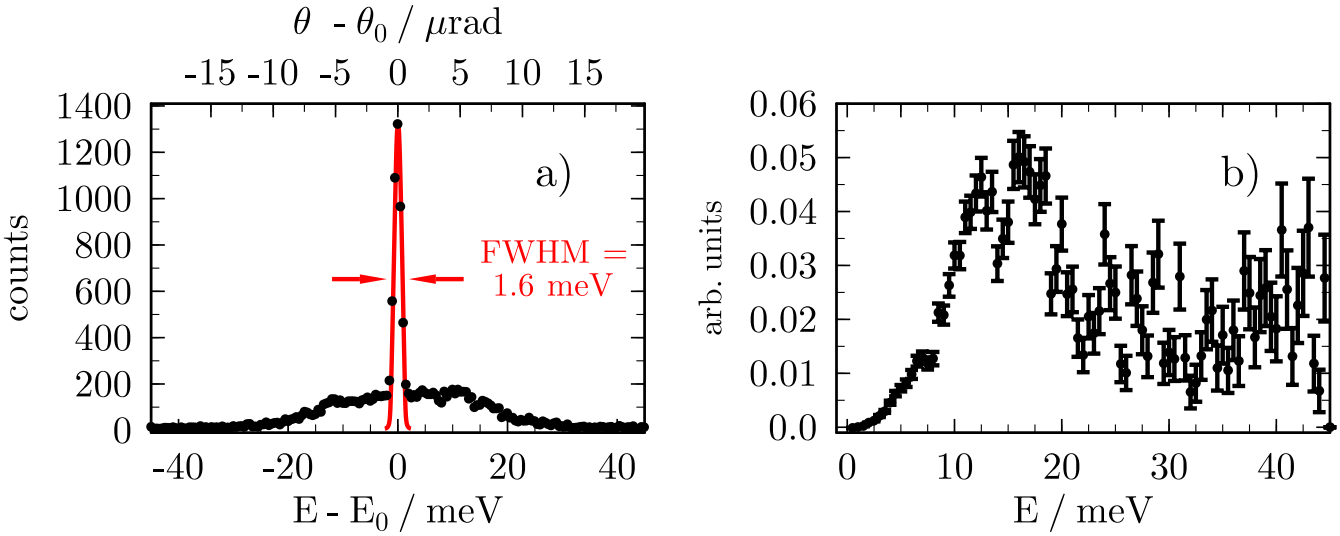

Fig. 2: NIS on a single crystal of EuP_5O_{14}.
a) Data measured at 122°C; the full line displays the theoretical transmission curve of the high resolution monochromator.
b) Derived phonon density of states (cf. /3/).

References:

/1/ O. Leupold et al., Europhys. Lett. 35(1996), 671
/2/ W. Sturhahn, E. Gerdau, Phys. Rev. B49(1994), 9285
/3/ A.I. Chumakov, R. Rüffer, Hyp. Int. 113(1998), 59