ESRF	**Experiment title:** Study of the valence transition of Eu compounds using nuclear resonant scattering: First results	**Experiment number:** He-175
Beamline: ID18	**Date of Experiment:** from: 15. July 97 to: 21. July 97	**Date of Report:** 29. August 1997
Shifts:	**Local contact(s):** Dr. R.Rüffer	***Received at ESRF:*** 1 SEP. 1997

Names and affiliations of applicants (*indicates experimentalists):

M.M. Abd-Elmeguid *, H. Winkelmann *, J. Plessel *, H. Micklitz

II.Physikalisches Institut der Universität zu Köln
Zülpicher Str.77, D- 50937 Köln, Germany

Report:

The experiment no. HE-175 was originally planed to be performed on Fe_3Pt using high pressure and external magnetic field in a cryostat which had to be installed at ID18 at the beamtime allocated in July 1997. This special cryostat, however, was not yet available. The beam line leader (Dr. R.Rüffer) and the groups O.Leupold (Hamburg) and G.Wortmann (Paderborn) offered us to use our beamtime in performing new experiments using nuclear resonant scattering at the 21.5 keV resonance of ^{151}Eu, since we have a longstanding experience in the field of valence instability and related phenomena.

Here, we want to show first experimental results on Eu intermetallic compounds which are known to reveal valence transitions as a function of temperature. We have used a monochromatic beam with a 7 meV bandwidth and a detecting system with a time resolution of about 1.4 nsec. The performed measurements required 5 shifts in 16 bunch mode.

EuPtP is an inhomogeneous mixed valent compound (Ni_2In-structure) which undergoes two temperature-induced structural phase transitions at T_1 = 235 K and T_2 = 190 K, where the ratio of the static mixture Eu^{2+}/Eu^{3+} changes at the phase transitions. In Fig. 1 we demonstrate a modulation of the time structure of the nuclear exitation. Above T_1 one has only a Eu^{2+} signal from the EuPtP sample. In order to have quantum beats in the spectrum at this temperature (300 K) we measured EuPtP together with a EuF_3 reference which has a stable valence with a different isomer shift. Below T_1 the ratio Eu^{2+}/Eu^{3+} changes to 2:l and below T_2 to 1:l. The spectrum at 105 K exhibits the most intense quantum beat pattern due to the 1:l ratio.

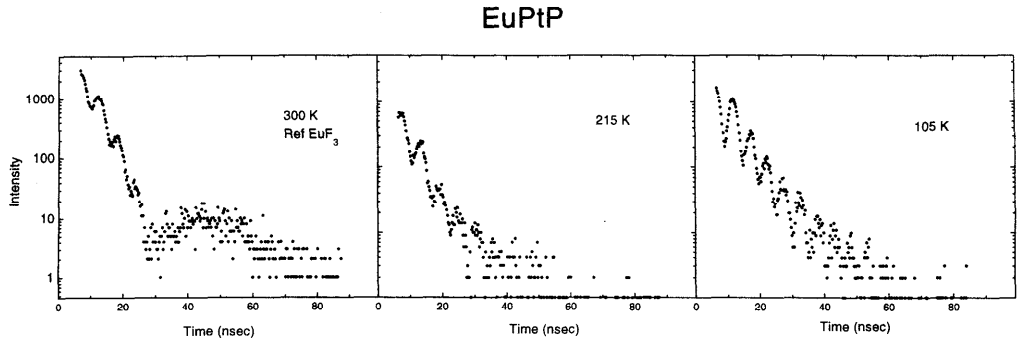

Fig. 1: Nuclear resonant scattering spectra of EuPtP at three different structural phases with different ratios of the static mixture of Eu^{2+}/Eu^{3+}.

$EuPd_3B$ is another inhomogeneous mixed valent compound ($AuCu_3$-structure) where a possible charge ordering occurs below T $\approx$ 115 K (similar to Eu_3S_4). In Fig. 2 one can clearly see a pronounced change of the modulation of frequency of the time spectra below 115 K (at 88 K and 25 K) where the Eu ions are ordered into a static mixture of Eu^{2+} and Eu^{3+}. The small decrease of the linewidth of the nuclear resonance between 159 K and 300 K indicates increasing fluctuation rate as the temperature increases.

$EuNi_2P_2$ is a homogeneous intermediate valent compound ($ThCr_2Si_2$-structure). As shown in Fig. 3 the increase of the frequency shift of the time spectra with decreasing temperature relative to the Eu^{2+} reference absorber (EuS) is consistent with a valence shift from a nearly Eu^{3+} state to an intermediate valence state closer to the Eu^{2+} state.

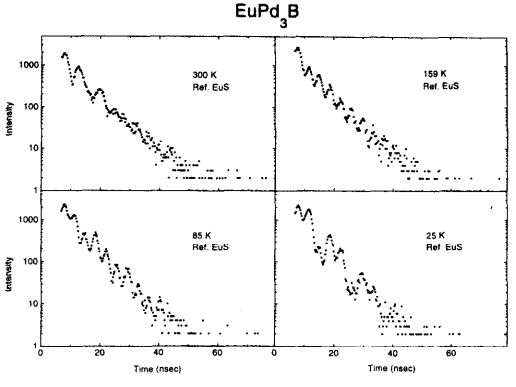

Fig. 2: Nuclear resonant scattering spectra of $EuPd_3B$ above and below T = 115 K where a possible charge ordering takes place.

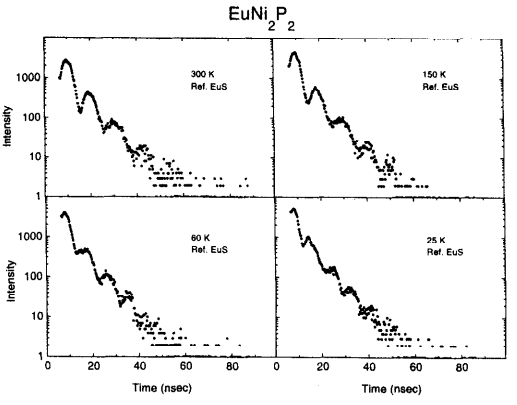

Fig. 3: Nuclear resonant scattering spectra of $EuNi_2P_2$ as a function of temperature.