**Experiment title:**

1 MAR. 2000

ExperimentInvestigation of the structural phase transitions in ternary Eu phosphides using nuclear inelastic scattering of synchrotron radiation by ^{151}Eu nuclei**number:**
HS-1020**Beamline:**
ID22N**Date of experiment:**

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Shifts:
15**Local contact(s):**

O. Leupold

*Received at ESRF:***Names and affiliations of applicants** (* indicates experimentalists):

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

II. Physikalisches Institut, Universität zu Köln, Zùlpicher Str. 77, 50937 Köln, Germany

A. Barla*

ESRF

J. P. Sanchez

CEA / Grenoble

Report:

The aim of experiment HS-1020 was to study the effects of different bonding states on the lattice dynamics of Eu ternary phosphides and arsenides. The selected system, $\text{EuRh}_2(\text{P}_{1-x}\text{As}_x)_2$ [1], is characterized for $x=0$ by a strong P-P bonding (single bond state, β -phase), while for $x=1$ the bonding interaction between neighbouring As atoms is negligible (non-bonding state, α -phase). At the critical composition $x=0.15$ the system undergoes an $\alpha \rightarrow \beta$ structural phase transition accompanied by a volume collapse of about 9%. Within this series we have first studied the two extreme cases $x=0$ and $x=1$ at $T=100$ K, and then we have investigated the effect of the magnetic ordering at $T=4$ K in the case $x=0$.

The experiment has been carried out in 16-bunch mode at ID22N (first experiment at this energy for the beamline). A new high resolution monochromator (designed by O. Leupold) delivered a flux of $\sim 6 \cdot 10^7$ photons/s in an energy bandwidth of ~ 1.3 meV (at a storage ring current of 90 mA). The beam was vertically collimated by a Be compound refractive lens in order to match the angular acceptance of the monochromator. The samples were mounted in a He-flow cryostat. Typical count rates were ~ 10 Hz at resonance and $\sim 1 - 2$ Hz out of resonance.

[1] G. Michels et al., J. Phys. C 8, 4055 (1996)

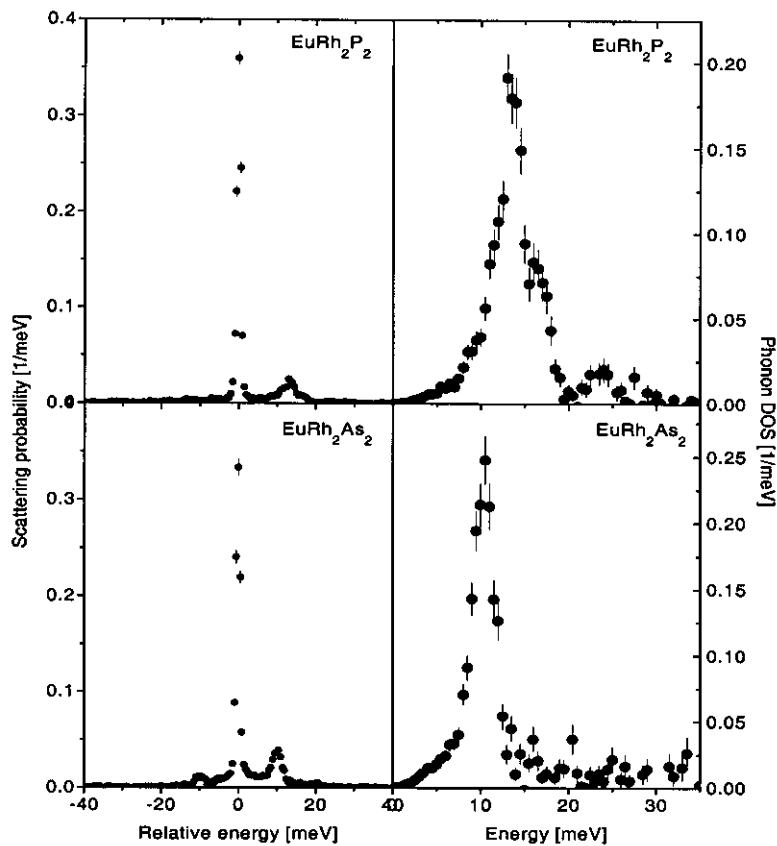


Fig. 1: Normalized NIS spectra (left) and phonon DOS (right) of $\text{EuRh}_2(\text{P}_{1-x}\text{As}_2)_2$ at $T = 100 \text{ K}$

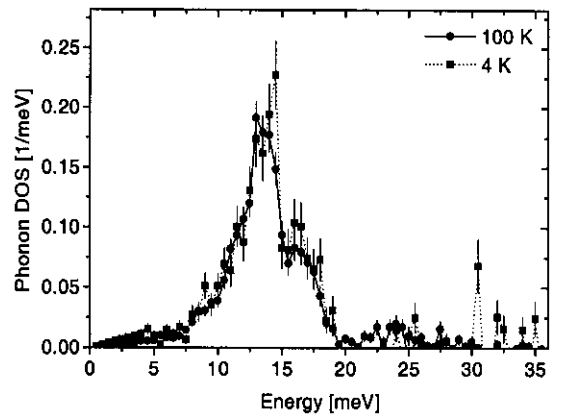


Fig. 2: Phonon DOS of EuRh_2P_2

Fig. 1 (left) shows the measured NIS spectra at $T = 100 \text{ K}$ after normalization, from which the phonon DOS showed in the right part of fig. 1 are obtained. Two phenomena are mainly to be observed:

- (i) a pronounced shift of the symmetric peak (slightly above 10 meV in EuRh_2As_2) towards higher energies ($\sim 13 \text{ meV}$ in EuRh_2P_2) due to a smaller volume;
- (ii) the appearance of new modes at energies above and below the peak at 13 meV .

Theoretical calculations based on lattice dynamics in these systems are now in progress in order to relate these modes to specific vibrations associated with Eu nuclei.

Fig. 2 shows the phonon DOS obtained for EuRh_2P_2 in the paramagnetic state ($T = 100 \text{ K}$) and in the magnetic state ($T = 4 \text{ K}$): no effect of the magnetic ordering can be seen in the lattice dynamics within the experimental error.