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III.e. Quadrupole Interactions of Ge-Nuclei In Zn and Ga Following Nuclear Reactions

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(Presented by R. Sielemann)

The method of time-differential perturbed angular distribution (TDPAD) following a nuclear reaction was applied for studying quadrupole interaction on isomeric levels with lifetimes of nano- and microseconds. Recent results with similar techniques on nanosecond isomers were reported by J. M. McDonald *et al.*[1]

Polycrystalline Zn and Ga targets were bombarded with 13 MeV α particles and 6.5 MeV protons, respectively, from the 7 MV pulsed Van de Graaff at the Hahn-Meitner-Institut in Berlin, and the quadrupole interaction of the isomeric 9/2 levels of ^{67}Ge and ^{69}Ge and the 5/2 level of ^{71}Ge has been studied. As an example Fig. 1 shows the modulation spectra for the 9/2 level of ^{69}Ge in Zn and Ga. The ratio of the quadrupole moments was determined as $Q(^{67}\text{Ge}, 9/2)$: $Q(^{69}\text{Ge}, 9/2)$: $Q(^{71}\text{Ge}, 5/2) = 1.22: 1: 0.219$ within 2% accuracy which can be compared with the known ratio $Q(^{73}\text{Ge}, 9/2)$: $Q(^{69}\text{Ge}, 5/2) = 1: 0.152$ from atomic beam studies.[2]

Some aspects of our experiment should be stressed:

(1) The target temperature was always near the melting point, no relaxation effect was observed over the whole range of 8 μs.

(2) The interaction in hcp Zn could be fit with an axially symmetric electric field gradient

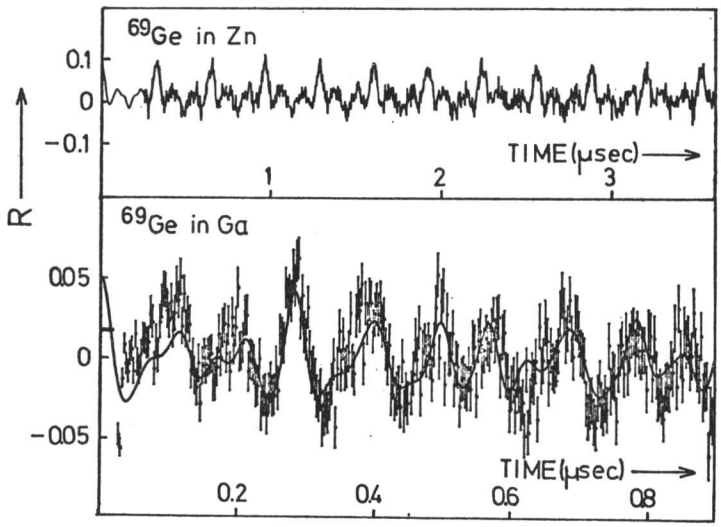

Fig. 1

(EFG), *i.e.*, $\eta=0$. In orthorhombic Ga, $\eta=0.697$ was deduced, which differs considerably from the known asymmetric parameter for the interaction of Ga in Ga.

(3) The Ge isotopes are impurities in Zn and Ga with different excess charges Δz. The EFG at these impurity sites depends on the role of the conduction electrons in shielding the crystal field.

Measurements at different temperatures, especially on the long-lived ^{69}Ge level should give opportunities for studying these aspects in more detail.

References

1) J. M. McDonald, P. M. S. Lesser and D. B. Fossan: Phys. Rev. Letters **28** (1972) 1057.
2) W. J. Childs and L. S. Goodman: Phys. Rev. **141** (1966) 15; A. F. Oluwole, S. G. Schmelling, and H. A. Shugart: Phys. Rev. **C2** (1970) 228.

Discussion

G. D. SPROUSE (Stony Brook): As an extension of this technique we have used polarized ^{19}F implanted in the single crystals. And this allows the additional information that you can extract the sign of this quadrupole interaction.