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Gama-gama angular correlation measurements for γ -transitions in ^{72}Ge

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Nuclei in the region of Ge ($Z=32-36$, $N=34-38$) are situated rather away from both, the proton and neutron shell closures at particle numbers 28 and 50 respectively, and their structure may be described as resulting, in part, from surface vibrations. In particular for ^{72}Ge , some of the low-lying states agree with the vibrational model. The 2^+ state at 834 keV could be identified as the one quadrupole phonon state, the levels at 1464 keV (2^+) and 1728 keV (4^+) are consistent with the expected pattern of a two-phonon triplet and also the 2025 keV (3^+) and 2464 keV (4^+) states may be members of three quadrupole phonon group. However, several experiments, including nuclear reactions, $\gamma\gamma$ and $\beta\gamma$ angular correlations [1,2] have been performed to explore the nuclear structure of the ^{72}Ge and they have shown that its structure is rather complex and cannot be explained in the framework of the vibrational model. Besides, the knowledge of the multipole character of the γ - rays was far from complete. In view of this, the present study was undertaken to measure the angular correlation of a large number of additional γ cascades in ^{72}Ge , including transitions of intermediate intensities using two Ge detectors in order to determine the multipole mixing ratios for as many gamma transitions as possible and to better define the spins of some levels. The multipole mixing ratios are important parameters which serve to determine the relative importance of the collective and single-particle effects in any attempt to describe the level structure of the nucleus.

The samples of ^{72}Ga were obtained by ($n\gamma$) reaction of natural Ge in the reactor at IPEN/SP. The samples were stored for 3 hours to allow for the decay of ^{70}Ga ($T_{1/2} = 21\text{min}$), formed during the irradiation. A total of 40 sources were used for the entire experiment. The $\gamma\gamma$ spectrometer consisted of two HPGe detectors. The fixed and the movable detectors had volumes of 89 and 50 cm^3 , respectively. The measurements were carried out at angles of 90° , 120° , 150° and 180° .

Measurements have been carried out for 44 γ -cascades, 32 of them for the first time, resulting in the determination of multipole mixing ratios for 40 γ -transitions. The results show that a large number of γ -transitions are predominantly of electric dipole character, which is difficult to explain in terms of a simple vibrational model. The present results permitted assignments of spins all the levels involved.

References

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