High Spin States and Multiquasiparticle Excitations in Odd-Odd $^{114,116}$Sb Nuclei

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Excited states of $^{114,116}$Sb have been investigated in the $^{111,113}$Cd ($^7$Li,4$n$) reactions. In both level schemes, two independent parts have been exhibited with, mainly, a negative parity band based on $8^-$ or $7^-$ states and a positive parity sequence based on a $11^+$ state. The interpretation of the significant levels has been performed in the core-particle model and in term of quasiparticle configurations mixing, this last approach being able to give a kind of unified description of the whole spectrum.

I. Introduction

This work is a part of systematic investigation of odd-odd nuclei around the $Z=50$ shell closure [1, 2].

Generally speaking, odd-odd nuclei combine the features of odd proton and odd neutron nuclei into a more complex system. The odd-odd Sb nuclei are attractive due to the proximity of the proton shell closure and then one would expect relatively easier interpretation of the excitation modes. However, in a phenomenological approach, the core would be the even Sn nuclei. These nuclei exhibit very particular features. Indeed, the usual vibrational-like low-lying states coexist with a collective $\Delta J=2$ band based on an excited $0^+$ state. Whereas the former states originate mainly from neutron quasiparticle excitations, the latter ones have been recently interpreted in term of 2 proton-hole, 2 proton-particle clusters coupled to quadrupole vibrations. Then we expect to find the consequences of these two different aspects in the neighbouring nuclei, and especially in the high spin levels of the odd-odd Sb nuclei.

Since the heavy ion reactions feed mainly the collective states, we have performed the $^{111,113}$Cd($^7$Li,4$n$) reactions, in order to investigate the high spin levels of the $^{114,116}$Sb nuclei. When this work was initiated, only the low spin states were known [5, 6] but no information was available for the high spin states of $^{114,116}$Sb. The first experimental level scheme recently appeared in the Groningen KVI annual report [7], obtained from ($\alpha,3n\gamma$) reactions and our results will be compared with this work.

II. Experimental Procedure and Results

2.1. Production and Standard Measurements

Excitation functions, prompt and delayed $\gamma$ ray spectra, $\gamma$-$\gamma$ coincidences and angular distributions were measured in residual nuclei produced with a $^7$Li ion beam from the I.S.N. Grenoble Cyclotron. The targets consisted of self-supporting metallic Cd foils of about 4mg/cm$^2$ enriched in $^{113}$Cd and $^{111}$Cd to 95%. Excitation functions were performed from 32 to 50 MeV and a beam energy of 40 MeV was used in most of measurements in order to favour the ($^7$Li,4$n$) reactions. Examples of single and coincident spectra are shown in Fig. 1 and Fig. 2.
2.2. Linear Polarization Measurements

The measurements of γ-ray linear polarization are very useful to determine the high-spin states parities because they are sensitive to the electric or magnetic character of the transitions. The polarimeter consisted of five intrinsic planar Ge detectors (FWHM ≈ 2.5 keV at 1.33 MeV) placed inside the same cryostat, the central one has a $17 \times 17 \text{mm}^2$ section whereas the four analysers (of the Compton effect scattered γ-ray) have a $30 \times 18 \text{mm}^2$ section. The experimental value of the polarization \( p \) is deduced from the coincidence intensities \( N_h \) (scatterer plus horizontal analysers) and \( N_v \) (scatterer plus...