2.8 Investigation of the Low-Lying Levels in ^{125}La

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The ^{125}La level scheme has been already investigated via in-beam reaction studies [1-2] as well as via the β^+/EC decay of on-line mass-separated ^{125}Ce [3]. However, the low energy part of the scheme still can not be considered as a final one. The 107 keV, E3 isomeric transition with halflife $T_{1/2}$=390 ms, observed in the radioactive decay of ^{125}Ce and assigned firmly to ^{125}La, has not yet been placed in this level scheme [3]. It is worth noting that no common transitions were observed in this radioactive decay study and the in-beam studies [1-2]. Also systematics presented in Fig. 1 shows that the position of the $3/2^+$ level considered as the lowest state of the $3/2^+$ rotational band in ^{125}La, both in relation to the $11/2^-$ state and in relation to other members of the $3/2^+$ rotational band, does not follow the trend observed in the heavier La nuclei, in contrast to smooth behaviour E(I) - E($11/2^-$) energy difference in the decoupled band. It supports suggestion that the lowest part of the ^{125}La level scheme is not a complete one.

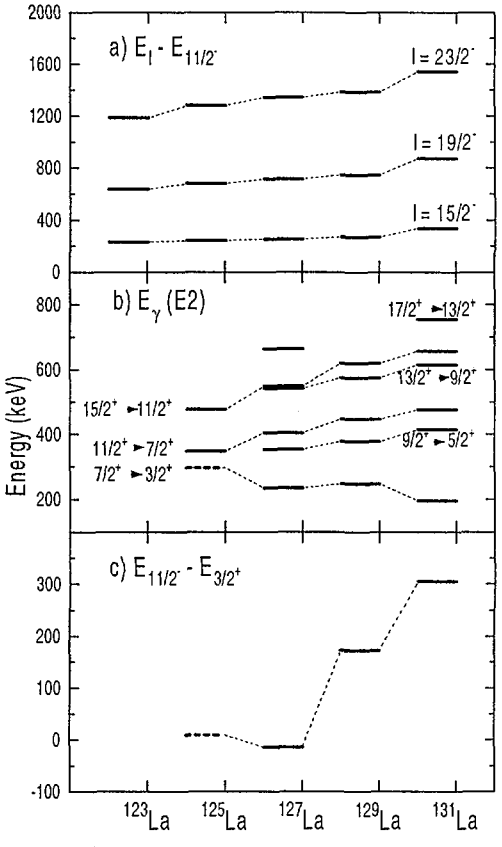

Fig. 1 a) Systematics of rotational level energies relative to energy of the $11/2^-$ state for the $1/2^-$[550] rotational band in odd La isotopes; b) energies of the E2 transitions within the band built on the $3/2^+$ level; c) energy difference between the rotational $11/2^-$,$1/2^-$ [550] state and $3/2^+$ band head.

Low energy part of the ^{125}La level scheme has been investigated at Heavy Ion Laboratory in Warsaw with the aim to resolve still existing ambiguities as well as to identify possible isomeric states with low excitation energies in ^{125}La.

High spin states in ^{125}La were populated with the ^{112}Sn(^{16}O,p2n)^{125}La reaction at an incident beam energy of 80 MeV. The macro structure of the beam with macro pulses of 1.3 ms and separation periods of 3.7 ms was utilised in search for isomeric transition. Two ^{112}Sn targets of thickness 3 and 10 mg/cm^2 were used. The prompt and delayed γ-radiation was studied using the OSIRIS array which comprises 7 Compton-suppressed HPGe detectors. The experimental setup was carefully optimised to ensure in-beam observation of the low energy γ-rays, down to energy of about 30 keV. The γ-ray singles spectra and γ-γ coincidences were collected in the list mode during and between the beam macro-pulses. The prompt and delayed coincidence events were sorted off-line into two-dimensional coincidence matrices.

Two new γ-transitions, 57.2 and 299.4 keV, were assigned to ^{125}La. In addition, a delayed 107 keV γ-transition, already identified as an isomeric transition in ^{125}La [3], was observed also in our experiment. Intensity relations derived from our data suggest that this transition deexcites the lowest state of the decoupled band built on the $h_{11/2}$, $1/2^-$[550] proton configuration in ^{125}La. At this moment, these three transitions are not yet firmly placed in the ^{125}La level scheme. It is interesting to note that the energy difference, $E_{11/2^-}$ - $E_{3/2^+}$, decreases in ^{127,129,131}La isotopes with decreasing mass number (see Fig. 1c). If this trend persists further to ^{125}La then the $11/2^-$ state in this nucleus would be positioned well below the $3/2^+$ state. A detailed data analysis is in progress.

[1] K.Starosta et al., Phys.Rev. C53 (1996) 137
[2] D.J.Hartley et al., Phys.Rev. C60 (1999) 14308
[3] G.Canchel et al., Eur. Phys. J. A5 (1999) 1

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