THE DECAY OF NEUTRON DEFICIENT $^{117,119m+g,\ 121m+g}$Cs. LOW LYING LEVEL STRUCTURE IN ^{117,119,121}Xe NUCLEI

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Abstract

The decays of neutron-deficient ^{117}Cs, $^{119m+g}$Cs, $^{121m+g}$Cs have been investigated at the Isolde facility. Systematics of low-lying energy levels, both in cesium and xenon nuclei are presented.

1. Introduction

The decays of even-mass cesium isotopes from A = 124 to A = 116 have already been studied by our group [1] at the Isolde facility. Until recently, little was known about the decay of odd-A cesium nuclei with A < 125.

Earlier this year our study of the decay of $^{123m+g}$Cs was published [2] and here, we present preliminary results concerning the β-decay of neutron deficient $^{117,119m+g,\ 121m+g}$ Cs to the related xenon levels. Systematics of low-lying energy levels in odd-A cesium and xenon nuclei are presented, including our own data and published results.

2. Experimental procedure

Cesium isotopes were produced at the Isolde separator using the target of molten lanthanum [3] bombarded by the 600 MeV proton beam of the CERN synchrocyclotron. The on-line mass separated cesium sources were collected and carried in front of the detectors using a tape transport system. They were analyzed through a complete set of spectroscopic on-line measurements including studies with high resolution Ge(Li) and Si(Li) detectors, a 4πβ plastic scintillator, γ-γ-t, γ-e$^-$-t, 4πβ-γ coincidences, an e-γ multipolemeter experiment, and multianalysis of the gamma-rays. The data were recorded with a Plurimat 20 computer.

3. ^{121m}Cs decay and odd-A Cs level structure

Preliminary results have been published previously [4]. The half-lives of ^{121m}Cs($T_{1/2}$=122±3s), ^{121g}Cs($T_{1/2}$ = 155 ± 4s), ^{119m}Cs($T_{1/2}$ = 29 ± 2s), and ^{119g}Cs($T_{1/2}$ = 44 ± 2s) were measured with better accuracy. In the e-γ multipolemeter experiment for A = 121, a 68.5 keV line was found, with α_L and α_M values which indicated a $\Delta\ell$ = 3 character. The presence of K_α - (Cs) X-rays does not allow us to measure its α_K value nor to distinguish between E3 and M3 multipolarity for this transition. However, it may be pointed out that the Weisskopf estimate for the lifetime of a 68.5 keV M3 line is in agreement with the measured half-life of ^{121m}Cs ; hence this line probably represents the isomeric transition between the $9/2^+$ level and the ground state.

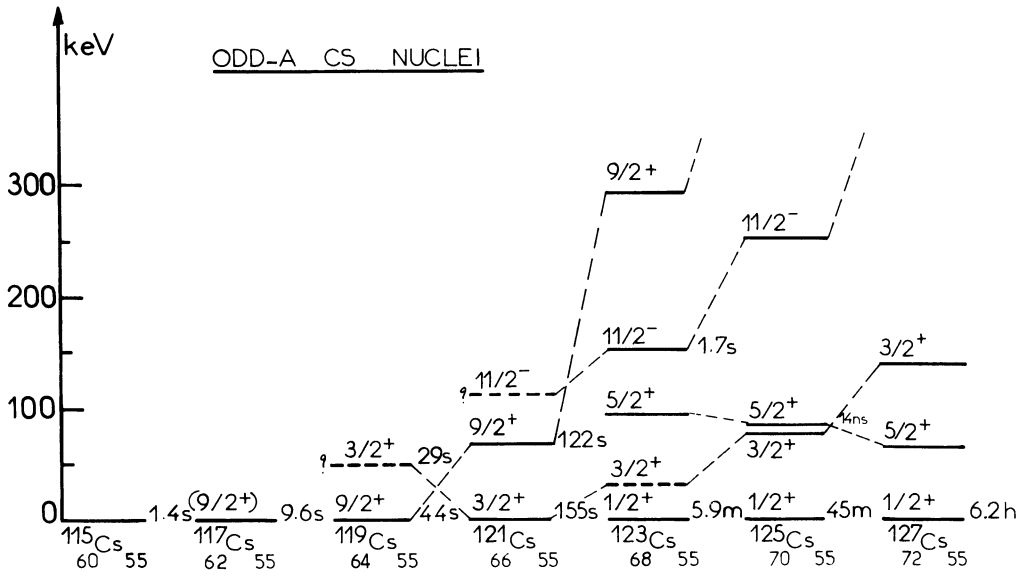

Figure 1

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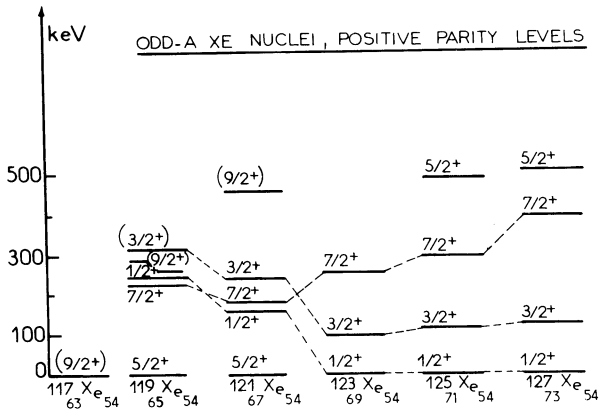

Figure 2

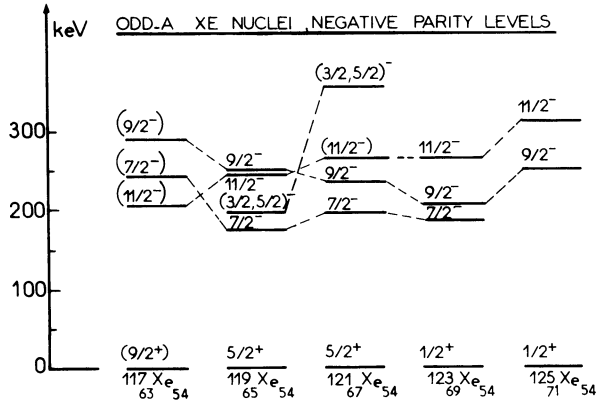

Figure 3

Fig. 1 shows the systematics of odd-A cesium nuclei. It includes spin measurements from Ekstrom et al [5], Fisher et al[6] and data from Garg et al[7], d'Auria et al[8] as well as the present results. The $(9/2^+)$ spin and parity for ^{117}Cs was tentatively proposed according to the β-decay of this nucleus (see section 4). No half-life greater than 1s belonging to a hypothetical isomeric state, has been found in ^{117}Cs.

4. Level structure in ^{117,119,121}Xe

Decay schemes for $^{117,119m+g,121m+g}$Cs have been built from available experimental data. From these, we propose a spin $5/2^+$ for the ground state of ^{119}Xe and ^{121}Xe. A few details of the level structure at low excitation are shown in figs.2 and 3, which present the systematics of the series of odd-A Xe isotopes. It may be seen that the $1/2^+$ state, which was the ground state for nuclei with $A \geq 123$ lies at an excitation energy of 153.9 keV in ^{121}Xe and 246.9 keV in ^{119}Xe. It decays to the ground state by an E2 transition. The half-life of this line was found to be $\sim$ 80 ns in both nuclei, in agreement with the Weisskopf estimate. As in heavier isotopes, the $3/2^+$ level lies $\sim$ 90 keV above the $1/2^+$. The first members of $\Delta I = 2$ bands built on these levels (clearly seen in ^{123,125}Xe [9,10]) are found in ^{121}Xe with energy spacings close to those in the ^{120}Xe core. The $7/2^-$ state $(g_{7/2}^{-1})$ was also identified, and a $\Delta I = 1$ sequence built on it was observed.

For the negative parity states ($h_{11/2}$ system) in odd-A $^{123-129}$Xe a level pattern was proposed by Gizon and Gizon [11], and Luukko et al [9,10]. In ^{121}Xe the same arrangement was established in our decay study and from in-beam experiments [12]. The tendency for the $9/2^-$ level to rise in energy and for the $11/2^-$ level to fall as A is decreased is confirmed by their relative position in ^{119}Xe (our measurements) and ^{117}Xe [13].

In this last nucleus, two E1 transitions are observed in the decay studies. The first (E_γ=205keV) which de-excites the $11/2^-$ level was also observed by Chowdhury et al[13], although the second, from the $7/2^-$ level (E_γ = 243 keV) was not observed in that in-beam experiment. This permits us to establish the excitation energy of the $7/2^-$ level and to propose, tentatively, $9/2^+$ for the spin and parity of the ground state of ^{117}Xe. This ground state is strongly fed by an allowed β transition from ^{117g}Cs, which may also have $J^\pi = (9/2^+)$.

A complete report on this study will soon be published.

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