LEVELS IN EVEN NEUTRON-DEFICIENT XENON NUCLEI

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Abstract

The decays of 118,120,122Cs have been investigated at the new ISOLDE facility. Level schemes of 118,120,122Xe including the main quasi-rotational bands have been obtained.

1. Introduction

Up to now, little is known about the even xenon nuclei far from the stability. Recent data concerning 124,126xe 1) include the quasi-gamma band in addition to the quasi-ground state band. On the other hand, only the g.s. band has been identified in 118,120,122xe 2,3). It seems of interest to investigate more extensively the levels schemes of those nuclei. In particular, the investigation of the band structure could provide some indication of a possible phase transition in even xenon nuclei.

2. Experimental

The decays of 118,120,122Cs have been investigated at the new ISOLDE facility at CERN. The mass separated cesium isotopes were produced by bombardment of a lanthanum target with 600 MeV protons from the synchrocyclotron. The cesium activities are carried from the collecting point to the detectors using a tape transport system. Two Ge(Li) detectors having a resolution of about 2.5 keV at 1332 keV and a Si(Li) detector of 2.5 keV resolution were used. Suitable collection and counting times were chosen depending on the isotope or on the type of experiment. Gamma spectra and electron spectra, both singly and in coincidence (γ - γ and e- γ), were recorded using standard devices. The spectra were analyzed using the computer program SAMPO⁴).

$$8^{+} \underbrace{2073} \qquad 8^{+} \underbrace{2098} \qquad 8^{+} \underbrace{2217} \qquad 8^{+} \underbrace{2331}^{(7^{+})} \underbrace{2463} \qquad 8^{+} \underbrace{2435} \qquad 6^{+} \underbrace{2214} \qquad 6^{+} \underbrace{2097} \qquad 5^{+} \underbrace{1903} \qquad 6^{+} \underbrace{1396}^{(4^{+})} \underbrace{1440} \qquad 6^{+} \underbrace{1467}^{(5^{+})} \underbrace{1403} \qquad 6^{+} \underbrace{1548}^{(5^{+})} \underbrace{4^{+}} \underbrace{1437} \qquad 3^{+} \underbrace{1247} \qquad 3^{+} \underbrace{1317} \qquad 4^{+} \underbrace{1488} \qquad 3^{+} \underbrace{1317} \qquad 4^{+} \underbrace{1488} \qquad 3^{+} \underbrace{1317} \qquad 4^{+} \underbrace{1491} \qquad 6^{+} \underbrace{1491} \qquad 4^{+} \underbrace{1497} \qquad 3^{+} \underbrace{1247} \qquad 3^{+} \underbrace{1247} \qquad 2^{+} \underbrace{1388} \qquad 2^{+} \underbrace{337} \qquad 2^{+} \underbrace{322} \qquad 2^{+} \underbrace{331} \qquad 2^{+} \underbrace{354} \qquad 2^{+} \underbrace{388} \qquad 0^{+} \qquad$$

3. Isomeric states in 118,120,122Cs

Previously known half-lives of 118Cs (16 sec.), 120Cs (60 sec.) and 122Cs (21 sec. + 4 min.) were confirmed from our decay studies. No other 118,120,122Cs activity with half-life greater than 5 sec. was observed. However, the population of the g.s. band in 118,120Xe (see next section) seems to be inconsistent with the decay of seems to be inconsistent with the decay of only one state in 118,120Cs. As a matter of fact, these ground state bands are populated up to 8+ with decreasing intensities. Moreover, it has been found that the spin of the main component of the 120Cs activity produced at ISOLDE is two 5) which is in desagreement with the direct feeding of the 8 g.s. state. This situation could be explained by the existence of two isomeric states with similar half-lives in 118,120Cs. At ISOLDE the relative population of such isomers favor a low spin component due to the initial proton interactions. In spite of a careful examination, no evidence for a half-life difference between the decays of the g.s. band transitions could be obtained, due to the low statistics of transitions connecting high-spin levels.

4. The 118,120,122 Xe level schemes. Discussion

Level schemes based on available experimental evidence have been built including the most intensive transitions of the decays. In addition to the g.s. band, evidence for the quasi-gamma band was obtained for every nucleus. Those bands are presented in the figure in a systematic fashion including the levels of 124,126% data from reference 1). We can notice the slight decrease in the energies of the levels of the g.s. band from \$126\text{Xe}\$ to \$120\text{Xe}\$. On the other hand, the \$2^{+}g\$ and \$4^{+}g\$ energies are increasing for \$118\text{Xe}\$. According to Batsch et al.\$6\$) this trend may be confirmed in \$116\text{Xe}\$ (possible \$2^{+}\$, \$4^{+}\$ and \$6^{+}\$ levels located at \$393\$, \$918\$ and \$1514\$ keV). The examination of the quasi g.s. band is of interest. The small level spacing between the \$3^{+}\gamma\$ and \$4^{+}\gamma\$ levels especially in \$118\$,120\text{Xe}\$ could be indicative of softness. The invercould be indicative of softness. The inversion at 122 Xe between the 4⁺g and 2⁺ γ levels is possibly an indication of a phase transition between prolate and oblate shapes. A number of other levels have been found. In particular it should be noted the existence of a quasi-beta band in 118 Xe and 120 Xe with band heads situated respectively at 830 and 908 keV. A complete report on this study will be published.

References

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