A tentative 4^- isomeric state in ^{98}Sr

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In the frame of our systematic investigations of nuclear structure properties of neutron-rich A≃100 nuclei at the isotope separator ISOLDE at CERN, an isomeric level at 1619 keV with the surprisingly long $t_{1/2} = 85$ ns was observed in ^{100}Sr [1, 2]. In analogy to a K^π=4 rotational band observed in the isotone ^{102}Zr [3], the half-life could be interpreted as a ΔK = 4 hindered decay from the two quasi-neutron configuration (ν[411]3/2⊗ν[532]5/2)4^-. These configurations are supported by quantum Monte-Carlo deformed shell calculations, further indicating a strong weakening of the pairing residual interaction [4].

This initiated a reexamination of γ-γ-t coincidence data on the β-decay of ^{98}Rb collected at the former OSTIS separator at the ILL (Grenoble) and during the experiment on ^{100}Rb decay. As a first result, the halflife of the 0_2^+ level of ^{98}Sr at 215 kev could be remeasured with higher precision [5, 6]. In addition, an evaluation of the centroid shifts of the intense transitions revealed the existence of lifetimes related to the transitions at 140, 145 and 1693 keV, respectively (see Fig. 1 of Ref. [5]). The delay of $t_{1/2} = 7$ ns for the 140-1693 keV time distribution was attributed to the 1838 keV level (see Fig. 2 of Ref. [5]). However, I^π=3^+ was assigned to this level after a new analysis of the data, leading to a revision of the earlier level scheme of ^{98}Sr [6]. In accordance with quantum Monte-Carlo pairing calculations, this isomeric state could now be explained as the deformed two quasi-neutron configuration (ν[404]9/2⊗ν[411]3/2)3^+ [6].

In order to search for an analogue to the 4^- state at 1619 keV in ^{100}Sr and 1821 keV in ^{102}Zr, respectively, centroid shifts of higher energy transitions are displayed in Fig. 1. This figure is an extension to Fig. 3 of Ref. [6] and detailed information can be found therein. Apart from the 1693 kev line, only two transitions show a detectable delay: 2498 keV ($t_{1/2}$ = 3±1 ns) and 2526 keV ($t_{1/2}$ = 5±1 ns), respectively. Whereas the line at 2498 keV was placed in the decay scheme of ^{98}Sr, the line at 2526 keV could (up till now) not be attributed to any of the nuclei in the A=97 and 98 decay chains following the β- and β-delayed neutron decay of ^{98}Rb. K-hindered decays should exist in the strongly deformed A=98 Sr and Y isotopes, but feeding from β-decay of the 0^+ ground-state of Sr ought not feed high-spin states in Y. A placement of the 2526 keV line as a ground-state transition in ^{98}Sr, possibly fed by a hinderd low-energy transition, seems a plausible explanation.

The 2498 keV line is in coincidence with the 129 and 289 keV transitions in ^{98}Sr, exclusively deexciting the 2932 keV level to the 4^+ member of the ground-state band. This single decay branch and the hindrance of the 2498 keV transition suggest an analogy with the 1619 keV level in ^{100}Sr [1, 2]. The higher excitation energy is in the range expected for such a level due to the lowering of the Fermi level for neutrons with respect to ^{100}Sr. Consequently, we propose the (ν[411]3/2⊗ν[532]5/2)4^- configuration for the 2932 keV level.

Further studies with new technologies are needed to firmly (dis)prove these assumptions. New measurements ought to be performed using the higher beam intensities and better detection systems now available at CERN-ISOLDE. With the installation of big Ge-arrays, the studies of prompt deexcitation of fission products have gained new interest [7], offering a complementary approach to decay studies. In the particular case discussed here, they could be used to search for the band expected to be built on the isomer.

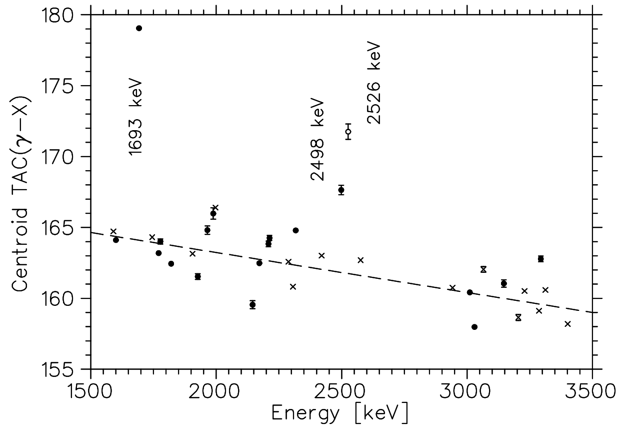

Figure 1: Centroid-shift plot from γ–γ–t coincidences in ^{98}Sr (filled circles). The scattering of the points gives an indication of the systematical errors. The prompt curve (dashed line) is obtained by an interpolation using transitions in the A=97 and 98 chains (crosses).

References

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