

Beta-decay study of the self-conjugate odd-odd nuclei ^{62}Ga and ^{70}Br

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Nuclei in the mass 70 region exhibit a variety of nuclear structure effects such as rapid shape changes and shape coexistence. Whereas the nuclei around the doubly-magic nucleus ^{56}Ni are considered to be spherical in shape, oblate-deformed ground states have been found in a region around ^{69}Se ($Z = 34$) [1], and prolate-deformed ground states in the proton-rich Sr ($Z = 38$) isotopes [2]. The deformed shapes are well-stabilized by the competing $Z = 34, 36,$ and 38 gaps in the single-particle energies. To explore the evolution of the nuclear shape along the $N = Z$ line and their influence on the competition of $T = 0$ and $T = 1$ isospins in odd-odd nuclei, the β -delayed γ -ray emission of the self-conjugate nuclei ^{62}Ga and ^{70}Br has been investigated. The measurements were performed at the on-line mass separator of GSI Darmstadt. Experimental details were reported earlier [3], and preliminary results of the data analysis have been communicated at several conferences [4, 5].

In the experiment on the β^+ decay of ^{62}Ga , an intense 511 keV annihilation peak originating from the $0^+ \rightarrow 0^+$ Fermi ground-state decay [6] and the much weaker 954 keV $2^+ \rightarrow 0^+$ yrast transition in ^{62}Zn have been identified. If a coincidence gate is set on this 954 keV line, weak γ transitions at 1388 and 2225 keV show up. Thus, the transitions may depopulate levels at 2342 and 3179 keV in ^{62}Zn . From a previous (p,t) reaction study [7], levels at 2330 (0^+) and 3160 keV (2^+) are known in ^{62}Zn which are close in energy to the levels populated in β decay. However, due to limited statistics, no reliable half-life for the β -delayed 954 keV γ ray could be deduced.

The occurrence of the 954, 1388, and 2225 keV transitions can result from two different scenarios: (i) from the β decay of a low-lying isomeric state in ^{62}Ga or (ii) from a non-analog decay branch of the 0^+ ground state in ^{62}Ga to higher-lying 0^+ and/or 1^+ states in ^{62}Zn which are de-excited by the emission of γ rays. If we assume that the observed 954 keV line intensity results from a non-analog decay branch, then a branching ratio of $(0.106 \pm 0.017)\%$ can be estimated. This ratio agrees quite well with a previously reported value of $(0.120 \pm 0.021)\%$ [8]. Since almost the same ratio has been obtained in two very different measurements, the interpretation as a non-analog branch is favoured.

In the study of the lightest proton-bound bromine isotope, ^{70}Br , extensive β - γ - γ coincidences have been measured for the decay of the known $T_{1/2} = 2.2(2)$ s isomer [9]. The analysis reveals a complex decay scheme with about 74% of the β feeding populating the 4606 keV level in ^{70}Se which is known as a $(8,9^+)$ state from previous in-beam work [10]. This level was found to be depopulated by transitions of 569.0 and 690.2 keV. However, we observe additional γ rays of 958 and 1604 keV which link

this level further to the yrast 6^+ and the $6^+_{2/2}$ states in ^{70}Se , and thus restrict spin and parity to $I^\pi = 8^+$. Furthermore, the yrast sequence in ^{70}Se has been observed up to the 10^+ state at 5207 keV for the first time in β decay. The deduced β feeding of the 10^+ level is about 1.2(2)%. The spectrum of γ rays in coincidence with the 1169 keV $10^+ \rightarrow 8^+$ transition is displayed in Fig. 1 which clearly shows all lower-lying transitions of the yrast sequence in ^{70}Se . Thus, the β -decaying isomeric state in ^{70}Br must

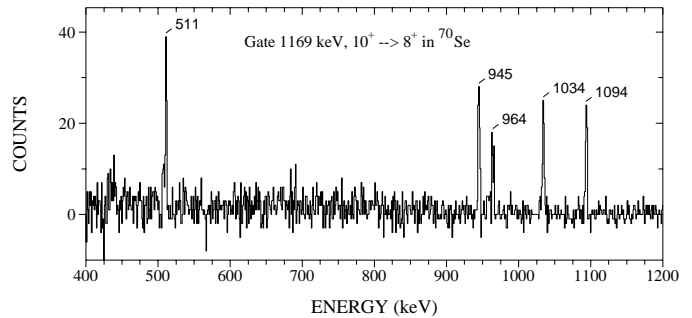


Figure 1: Background-corrected γ -ray spectrum in coincidence with β rays and the $10^+ \rightarrow 8^+$ γ transition in ^{70}Se .

have a high spin, and we propose spin and parity of 9^+ , the only assignment being consistent with all experimental results. The high spin of the isomer is interpreted as arising from the Nilsson configuration $(\pi 9/2^+[404], \nu 9/2^+[404])$ at an oblate deformation of $\beta_2 \approx -0.3$. Our findings are in agreement with very recently reported conclusions from another experiment [11] where also a 9^+ assignment is proposed. However, this is at variance with the earlier assignment of 5^+ given by the same group [12].

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