# Beta Decay Studies of Neutron-Deficient Tin Isotopes

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Studies of nuclei in the $^{100}$Sn region offer the possibility to test nuclear models describing structure and decay properties of nuclei in which protons and neutrons occupy identical orbitals near a double shell closure. An insight into the structure of nuclei close to $^{100}$Sn can be gained by studying their $\beta$ decay which is dominated by $\pi g_{9/2} \rightarrow \pi g_{7/2}$ Gamow-Teller (GT) transitions. An attractive feature of such nuclei is that most of the GT strength lies within the $Q_{EC}$-value window. Such a concentration of strength has recently been observed in a series of light indium and silver isotopes (see [1] and references therein) as well as in $^{102}$Sn [2,3]. $^{100}$Sn has been predicted to decay by one GT transition to a single $1^+$ 1p-1h state in $^{100}$In at an excitation energy of about 1.8 MeV, while the closest even-even neighbours of $^{100}$Sn, $^{98}$Cd and $^{102}$Sn, show a spreading of the GT strength over a number of $1^+$ states in the daughter nucleus.

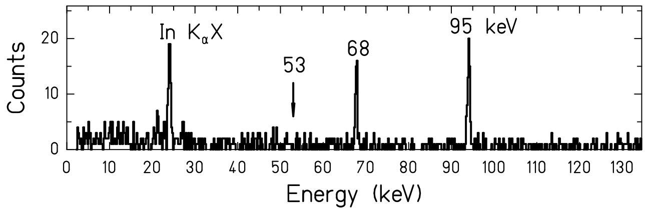


Fig. 1: Low energy $\gamma$-ray spectrum obtained for mass 102. An arrow shows the expected position of the 53 keV line which remained unobserved in this experiment.

In the recent experiments at the GSI-ISOL facility we used the FEBIAD-B3C ion sources with the addition of $CS_2$ [4] for the mass separation of $SnS^+$ ions. In this way routinely about 60% of the intensity of the $Sn^+$ beam was shifted to the $SnS^+$ molecular side-band, where the strong suppression of contaminants [4] cleaned the beams from In, Cd, and Pd isobars. Only the strongly produced activities of Ag were traced in on-line experiments, the suppression of which was 4-5 times lower than the anticipated value of $10^4$ found in off-line studies. The latter effect may be due to an operation of the ion source at lower temperature compared to the off-line measurement, which was made to enhance the $SnS^+$ intensity. We measured $\beta-\gamma-\gamma$ decay properties of $^{101-105}$Sn with two complementary setups, namely (i) the Total Absorption Spectrometer (TAS) for the measurement of GT strength distributions and (ii) an array of germanium detectors (including a Cluster and two GSI-Clover detectors) operated in coincidence with silicon $\beta$-detectors. Beta-delayed protons of $^{101}$Sn were measured by using $\Delta$E-E silicon telescopes. The intensities of the mass-separated $^{101-105}$Sn beams were obtained from the experimental decay properties. By using a 40 particle-nA $^{58}$Ni beam, a 3 mg/cm$^2$ $^{50}$Cr target, and a catcher of $ZrO_2$ fibers inside the FEBIAD source, we reached a secondary beam of 30 at/min for $^{102}$Sn, about 40 times more than in the FRS experiment [2], but of course there remains some isobaric contamination.

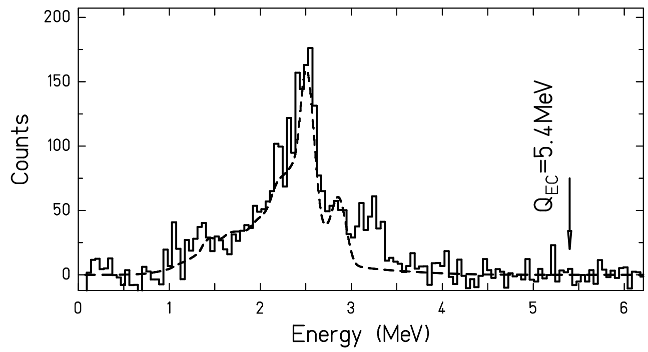


Fig. 2: $\beta$-gated TAS spectrum of $^{102}$Sn from the experiment (solid line) and from a GEANT simulation based on the modified level scheme of [2] (dashed line).

The data on the $^{102}$Sn decay collected with the high resolution setup (ii) as well as spectra obtained by the small germanium detector in the TAS confirm the main features of the $^{102}$Sn decay scheme proposed by Stolz [2] on the basis of an FRS experiment. But we do not confirm the 53 keV transition (see Fig. 1), which was previously [2] placed at the very bottom of the $^{102}$In level scheme. Removing this transition from the decay scheme may affect the spin assignment of the ground state of $^{102}$In. Figure 2 presents the $\beta$-gated TAS spectrum of $^{102}$Sn after subtraction of contributions from daughter activities which were determined in separate measurements. The maximum occurring at a recorded TAS-energy of about 2.5 MeV is interpreted as being due to the $\pi g_{9/2} \rightarrow \pi g_{7/2}$ GT resonance at an $^{102}$In excitation energy of about 1.5 MeV, in good agreement with [2].

In summary, the development of $SnS^+$ beams at the GSI ISOL allowed us to study in detail the $\beta$-decay properties of $^{101-105}$Sn. These data, in particular those on $\gamma-\gamma$ coincidences, are under evaluation. An extrapolation of the experimental beam intensities, yields 8 at/h for $^{100}$Sn indicating that the measurement of $\beta$-delayed $\gamma$-rays of this nucleus will indeed be a very challenging task.

## References

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