Improved value for the Gamow-Teller strength of the ^{100}Sn beta-decay†

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The main aim of experiment NP0702-RIBF09 was to improve the value for the Gamow-Teller strength of the ^{100}Sn beta-decay. This is important because ^{100}Sn is the heaviest self-conjugate doubly-magic nucleus. The data have now been evaluated and published.

With about 2500 nuclei the number of detected ^{100}Sn nuclei was about ten times higher than in previous experiments and new isotopic species towards the proton dripline were discovered at the RIKEN Nishina Center.[1)]

Decay spectroscopy has been performed with the high-efficiency detector arrays WAS3ABi and EURICA. The half-life of ^{100}Sn was measured more precisely than the literature values[2)] using two methods: a) β-decays correlated with identified mother nuclei and b) correlated β-decays were in coincidence one of the known γ-rays following the beta-decay was observed. Both results agreed yielding an average of $T_{1/2} = 1.18 \pm 0.08$ s. This value agrees with and has about half the error compared to the average of the previous values.

Similarly, the β-decay endpoint energy was determined for two data sets, the β-spectrum after a ^{100}Sn implantation and by requiring, in addition, a γ-ray from the decay. The method was tested by analyzing also the ^{98}Cd decay Q-value. Both ^{100}Sn data sets yielded consistent results which give as average $Q_\beta = 3.91 \pm 0.15$ MeV. This value is more precise and larger than the best previous result[2)] by about twice the summed error bars. This discrepancy may be due to unaccounted systematic uncertainties in either measurement.

The value and the uncertainty of the resulting strength for the pure $0^+ \to 1^+$ Gamow-Teller decay is improved to $B_{\rm GT} = 4.4^{+0.9}_{-0.7}$. In Fig. 1 we compare a number of theoretical calculations of BGT with experimental values: an extrapolation of the $B_{\rm GT}$-values of the heavier even-even Sn isotopes (the error bar seems too small) and the values measured in the two previous experiments at GSI. Of all theories the chiral effective field theory seems to describe the data best.

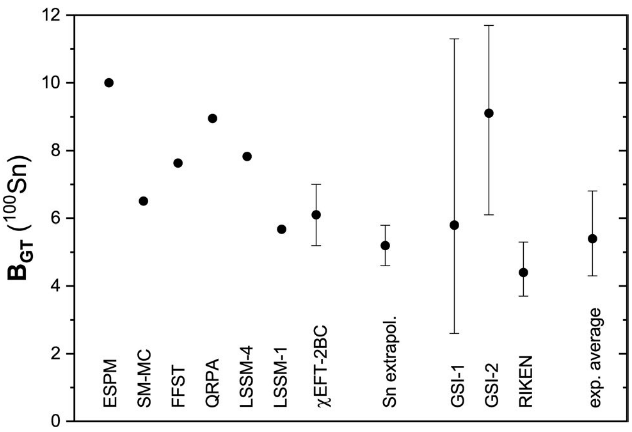

Fig. 1. Comparison of experimental and predicted GT transition strengths of ^{100}Sn. The theoretical values on the left side are from: Extreme Shell Model,[3)] Shell Model - Monte Carlo,[4)] Finite Fermi Systems and Quasiparticle Random Phase Approximation,[5)] Large Scale Shell Model with transitions to the four and one lowest 1^+-states,[2)] the range of recent work explaining GT-quenching with calculations using Effective Field Theory combined with 2-Body Currents.[6)] Experimental values are: an extrapolation from heavier even Sn-isotopes,[7)] first[8)] and second[2)] GSI experiment, the present result and the average of all available experimental data. For the weighted average of Q_β its error has been inflated by a factor 1.8 to account for the too large χ^2.

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