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Review

A RISING g-factor measurement of the $19/2^+$ isomer in ^{127}Sn

L. Atanasova[a,*], D.L. Balabanski[b,c], M. Hass[d], F. Becker[e], P. Bednarczyk[e,f], S.K. Chamoli[d], P. Doornenbal[e], G. Georgiev[g], J. Gerl[e], K.A. Gladnishki[c], M. Górska[e], J. Grebosz[e,f], M. Kmiecik[f], S. Lakshmi[d], R. Lozeva[a,h], A. Maj[f], G. Neyens[h], M. Pfützner[i], G. Simpson[j], N. Vermeulen[h], H.J. Wollersheim[e] and the g-RISING Collaboration

[a] Faculty of Physics, University of Sofia, BG-1164 Sofia, Bulgaria
[b] INRNE, Bulgarian Academy of Sciences, BG-1784 Sofia, Bulgaria
[c] Universitá di Camerino and INFN-Perugia, 62032 Camerino, Italy
[d] Weizmann Institute of Science, Rehovot 76100, Israel
[e] GSI, Planckstrasse 1, D-64291, Darmstadt, Germany
[f] IFJ PAN, PL-31-342 Kraków, Poland
[g] CSNSM, F-91405 Orsay Campus, France
[h] IKS, K.U. Leuven, 3001 Leuven, Belgium
[i] IEP, Warsaw University, PL-00-681 Warsaw, Poland
[j] LPSC, 38026 Grenoble Cedex, France

Abstract

The g-factor of the $19/2^+ T_{1/2} = 4.5(3)$ μs isomer in ^{127}Sn, which was populated in relativistic projectile fragmentation, was measured within the g-RISING campaign at GSI, utilizing the time-differential perturbed angular distribution method. The deduced g-factor $|g| \approx 0.16$ is in agreement with theoretical estimates based on the empirical g-factors.

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* Corresponding address: Department of Atomic Physics, Faculty of Physics, University of Sofia, 5 James Bourchier Blvd, BG-1164 Sofia, Bulgaria. Tel.: +359 2 8161 834.
E-mail address: liliya@phys.uni-sofia.bg (L. Atanasova).

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The g-factor measurement of the $19/2^+$, $T_{1/2} = 4.5(3)$ μs isomer in ^{127}Sn [1,2] aims at a study of the structure of the neutron-rich nuclei in the vicinity of the doubly-magic ^{132}Sn. The experiment was done in relativistic projectile fragmentation of a ^{136}Xe beam at $E/A =$ 600 MeV on a thin Be production target within the RISING (Rare ISotope INvestigations at GSI) project [3] at the GSI laboratory, Germany. The fully-stripped ions were separated, tracked and identified on an event-by-event basis. They were implanted in a high-purity Cooper plate, which provided a perturbation-free environment for the isomeric decay. Ion–γ coincidences were recorded and analyzed with the CRACOW software [4]. The experimental set-up is discussed in detail in [5].

The Time-Differential Perturbed Angular Distributions (TDPAD) method, based on the measurement of the Larmor precession of a spin-oriented nuclear ensemble in an external magnetic field B, was applied; the Larmor frequency $\omega_L = -\frac{g\mu_N B}{\hbar}$ is measured in the experiment. The magnitude and sign of alignment of the ensemble depend on the longitudinal momentum distribution [6] of the fragments. In order to preserve the orientation produced in the reaction, fully-stripped ions are separated at relativistic energies. Note that ions heavier than $A = 80$ produced and separated as fully-stripped fragments are available only at GSI.

To extract the g-factor, the γ-decay time spectra, measured at ±45° and ±135° with respect to the beam axis in a horizontal plane, were combined and compared with the theoretical $R(t)$ function, $R(t, \omega_L) = \frac{3a_2}{4+a_2} \sin(2\omega_L t)$, where a_2 depends on details of the γ decay and the amount of orientation. The $R(t)$ functions of the 1095 and 715 keV γ-rays for the outmost wing of the momentum distribution are presented in Fig. 1. They are out of phase, which is in disagreement with the published level scheme [1]. For the $R(t)$ function of the 715 keV transition $\sim 10^4$ photopeak events were used in the data analysis, which sets a limit for such experiments.

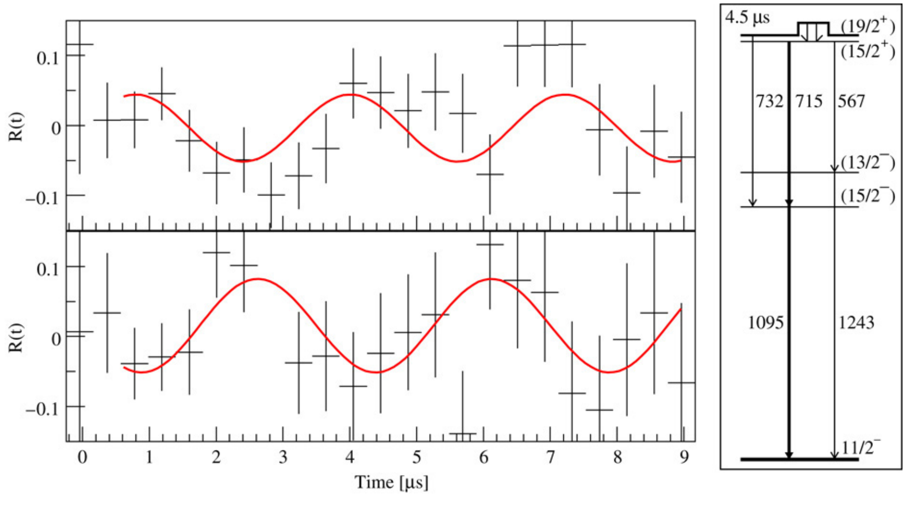

Fig. 1. Left: $R(t)$ functions for the 1095 keV transition (up) and for the 715 keV transition (down) at the wing of the momentum distribution. Right: partial level scheme of ^{127}Sn, revealing the decay of the $19/2^+$ isomer [1].

The deduced value of the g-factor, $|g| \approx 0.16$, is in agreement with theoretical expectations based on the empirical g-factors, which yield a value $g(s_{1/2}^{-1}h_{11/2}^{-2}) \approx -0.156$ for the main component of the wave function, and with large-scale shell model calculations. These results will be discussed in detail elsewhere [7].

First results from the g-RISING campaign for the g-factor of the $19/2^+$ isomer in ^{127}Sn from relativistic fragmentation demonstrate that significant alignment (∼10%) is observed in the outmost wing of the momentum distribution. The present experiment provides a benchmark (in terms of intensity of the isomer beam and number of detected γ-rays) for further studies of electromagnetic moments of isomers in nuclei yet farther away from stability.

Acknowledgments

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