g Factor of the 2_1^+ State and Lifetimes of Several Excited States of Radioactive ^{68}Ge from In-Beam Measurements ◇

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With the advent of low-intensity radioactive beams studies of the nuclear structure of exotic nuclei become feasible following projectile Coulomb excitation in inverse kinematics [1]. As an alternative to this conjecture it is possible to produce radioactive nuclei in particle transfer reactions between stable nuclei by maintaining the merit of inverse kinematics: α transfer to stable beams was found to be particulary successful for achieving this goal. Measurements were carried out on ^{44}Ti ($T_{1/2}$ = 60 y) [2] and ^{62}Zn ($T_{1/2}$ = 9.2 h) [3]. In both cases the g factors and the lifetimes of their 2_1^+ states have been determined for the first time.

In the same fashion ^{68}Ge ($T_{1/2}$ = 270 d) was produced in α transfer from a carbon target to a ^{64}Zn beam at an energy of 180 MeV. The beam was provided with sufficient intensity by the Munich tandem accelerator. The multilayered target consisted of ^{nat}C-Gd-Ta-Cu where essentially the 2_1^+ state of ^{68}Ge was formed in the carbon layer; the excited nuclei passed through the Gd layer to experience spin precessions in the transient field and were finally stopped in the Cu backing. Deexcitation γ rays were measured with NaI(Tl) scintillators in coincidence with the two α particles (from the decay of ^{8}Be) registered in a Si detector at 0° relative to the beam direction.

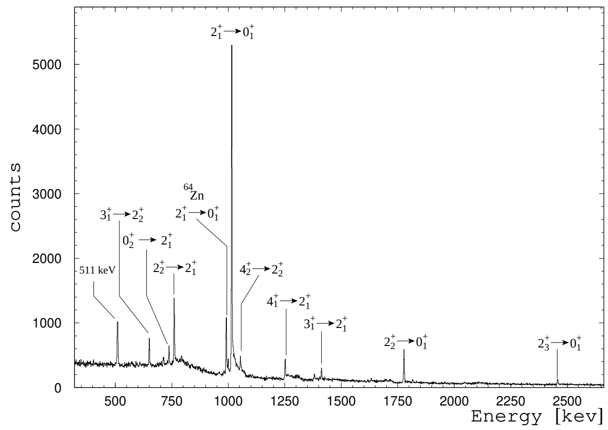

Fig. 1: *γ-coincidence spectrum of ^{68}Ge*

In addition, a Ge detector placed at 0° served as monitor for contaminant lines and allowed to measure nuclear lifetimes via the Doppler-Shift-Attenuation-Method by analyzing the Doppler-broadened lineshapes. Fig.1 shows a coincidence spectrum of the Ge detector exhibiting various γ transitions in ^{68}Ge with a dominant ($2_1^+ \rightarrow 0_1^+$) γ line.

In the same measurements the ^{64}Zn nuclei were Coulomb excited and spin precessions of the 2_1^+ state were determined simultaneously. The analysis for both ^{68}Ge and ^{64}Zn was done in a conventional way by using the linear parametrization of the TF attenuated by the beam ions with G_{beam} = 0.61(6) (see also [3] and contribution about ^{64,68}Zn).

The g factor deduced,

$$g(2_1^+) = +0.54(14),$$

has been displayed in Fig.2 together with all stable even-A Ge isotopes [4].

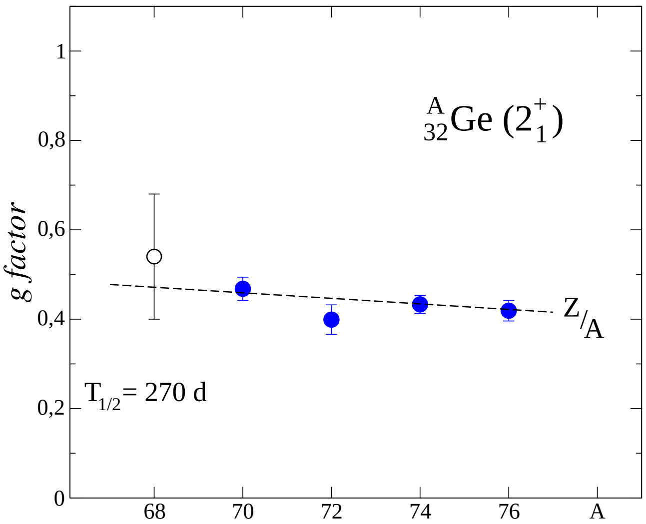

Fig. 2: *g factor result (open circle) together with all stable even-A Ge isotopes; collective Z/A is drawn by dashed line*

The value agrees very well with an assumed collective Z/A behaviour. The newly determined lifetimes of several excited states in ^{68}Ge are only partially in good agreement with those quoted in the literature [5]. The lifetime of the 2_3^+ state at 2.457 MeV has been determined for the first time:

2_1^+: τ = 3.1(2) ps vs lit. 2.6(3) ps;
4_1^+: τ = 1.2(1) ps vs lit. 1.2(2) ps;
2_2^+: τ = 2.9(3) ps vs lit. 6.1(10) ps; and
2_3^+: τ = 1.9(6) ps

References

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