The Experimental g Factor and B($E2$) Value of the 4_1^+ State in Coulomb Excited ^{66}Zn Compared to Shell Model Predictions ◇

J. Leske [a], K.-H. Speidel [a], S. Schielke [a], J. Gerber [b], P. Maier-Komor, T. Engeland [c], and M. Hjorth-Jensen [c]

[a] Helmholtz-Institut für Strahlen- und Kernphysik, Univ. Bonn

[b] Institut de Recherches Subatomiques, F-67037 Strasbourg, France

[c] Dept. of Physics and Center of Mathematics for Applications, Univ. Oslo, N-0316 Oslo, Norway

The g factor of the 4_1^+ state in ^{66}Zn has been measured for the first time employing the technique of projectile Coulomb excitation in inverse kinematics combined with transient magnetic fields. This measurement was in particular motivated by the surprising result recently obtained for the corresponding state in ^{68}Zn yielding a negative g factor, $g(4_1^+) = -0.37(17)$ [1]. In interpreting this result within the framework of the spherical shell model it was argued that the neighbouring ^{66}Zn might be of transitional character resulting in a small positive or eventually also negative g value like in ^{68}Zn.

In the experiment the same target as used for the spectroscopy of ^{70}Ge (see contributed paper) was bombarded with a ^{66}Zn beam of 180 MeV provided by the Munich tandem accelerator. De-excitation γ rays were measured in coincidence with recoiling carbon ions by NaI(Tl) scintillators for the spin precessions in ferromagnetic Gd of the multilayered target, and a Ge detector at 0° for the nuclear lifetimes using the Doppler-Shift-Attenuation method (see Fig. 1).

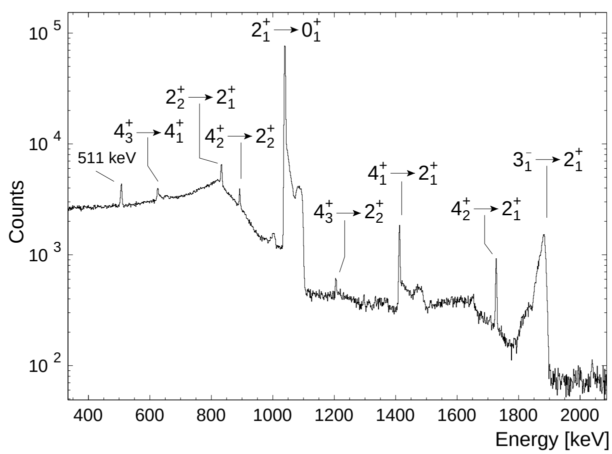

Fig. 1: Ge γ-coincidence spectrum. Most of the γ lines are attributed to known transitions in the low-level scheme of ^{66}Zn.

The carbon ions were detected in a Si detector placed at 0° shielded by a Ta stopper foil against the beam ions. The newly determined lifetime of the 4_1^+ state, $\tau = 1.1(2)$ ps, was found to be twice as large as a previous value, $\tau = 0.52(2)$ ps [2], which was obtained from measurements of the Coulomb excitation cross-section. Both the deduced $B(E2; 4_1^+ \rightarrow 2_1^+) = 133(24)$ e^{2}fm^4 and the g factor, $g(4_1^+) = +0.65(20)$, were interpreted together with results for the 2_1^+ state in the framework of shell model calculations based on a closed ^{56}Ni core. The results were also compared with those of neighbouring ^{64}Zn and ^{68}Zn which were obtained in previous measurements [1,3] (see also Figs. 2 and 3). These results provide clear evidence for the important role played by neutron $g_{9/2}$ components in the nuclear wave functions. With these wave functions the dependence of $g(4_1^+)$ on neutron number, and in particular, its dramatic decrease from ^{64}Zn to ^{68}Zn is fairly well reproduced. However, a negative value of $g(4_1^+)$ could not be obtained. In summary, the accumulated experimental information on g factors and B($E2$) values for stable Zn isotopes calls for further theoretical examination.

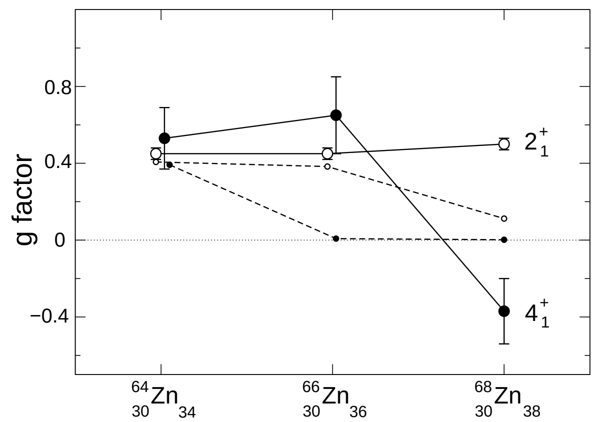

Fig. 2: Experimental g factors of the 2_1^+ and 4_1^+ states in ^{66}Zn in comparison to corresponding values in ^{64}Zn and ^{68}Zn. The dashed lines connect the calculated values for corresponding open and closed circles.

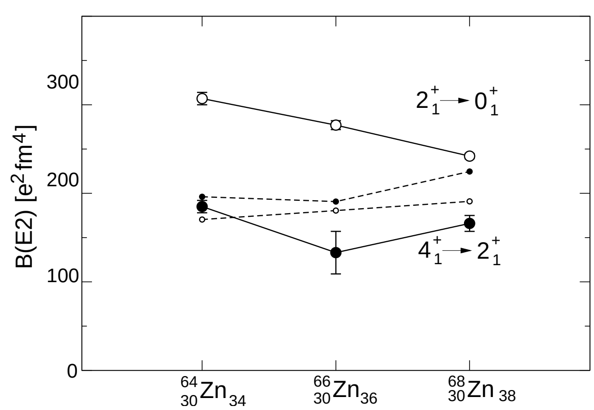

Fig. 3: Experimental deduced B($E2$) values of the 2_1^+ and 4_1^+ states for ^{66}Zn in comparison to ^{64,68}Zn. Results from shell model calculations are also displayed by the corresponding small symbols. The lines are to guide the eye.

References

[1] J. Leske *et al.*, Phys. Rev. **C 72** (2005) 044301

[2] M. Koizumi *et al.*, Eur. Phys. J. **A 18** (2003) 87

[3] J. Leske *et al.*, Phys. Rev. **C 71** (2005) 034303

◇ work supported by DFG and BMBF