g Factor and $B(E2)$ Measurements on the 2_1^+, 4_1^+, 2_2^+ and 3_1^- States of ^{64,68}Zn in Comparison with Shell Model Predictions ◇

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Results of recent measurements of the g factors and $B(E2)$'s of the first 2^+ states of all even-A stable Zn isotopes have been compared with large-scale shell model calculations [1]. Two types of fp shell calculations using either a ^{40}Ca or a ^{56}Ni core yielded good agreement with the measured $g(2_1^+)$ values of the lighter isotopes ^{62,64,66}Zn but with significant deviations in the $B(E2;\, 0_1^+ \rightarrow 2_1^+)$'s whereby the experimental values were generally underestimated. For the heavier Zn nuclei ^{68,70}Zn the $g_{9/2}$ orbital becomes an important component in the wave function which is evident from the g factors as well as the $B(E2)$'s. In this case the calculations with a ^{56}Ni core are more realistic as the $g_{9/2}$ orbital is explicitely included.

In a further experimental campaign higher excited states have been studied to test the different shell model predictions: for ^{64}Zn the 4_1^+ and 3_1^- states and for ^{68}Zn the 4_1^+, 2_2^+ and 3_1^- states have been investigated. For Coulomb excitation the energies of the Zn beams were increased from 160 to 180 MeV provided by the Munich tandem accelerator. The target consisted of ^{nat}C-Gd-Ta-Cu layers in sequence. Deexcitation γ rays were measured with NaI(Tl) scintillators in coincidence with forward scattered carbon ions which were detected in a Si detector. A Ge detector at 0° served as monitor for contaminant lines and provided Doppler-broadened lineshapes for the lifetime determinations.

The g factors and lifetimes deduced for the states in question of both isotopes are summarized in Table 1. The results are compared with shell model predictions. The deduced $B(E2)$'s of the $(4_1^+ \rightarrow 2_1^+)$ transitions are displayed together with the results of shell model calculations in Fig.1. Evidently, for ^{68}Zn the ^{56}Ni core calculations yield excellent agreement with the new data in contrast to the ^{40}Ca core results.

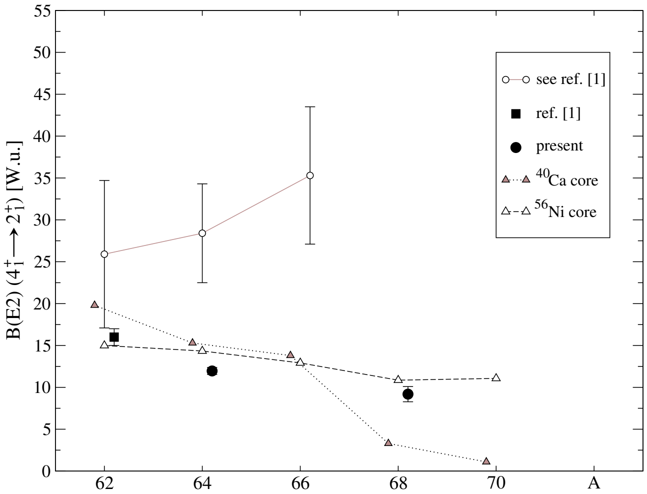

Fig. 1: *B(E2) values of the $(4_1^+ \rightarrow 2_1^+)$ transitions in even-A Zn isotopes (solid circles and squares) compared to other data (open circles) and shell model calculations (triangles)*

Moreover, the $g(4_1^+)$ value of ^{64}Zn tends to be larger than that of the 2_1^+ state as predicted by the ^{40}Ca core calculations. The g factors of the 3_1^- states of both isotopes and the $g(2_2^+)$ value of ^{68}Zn, which are all consistent with Z/A, seem to be of more collective nature. This feature is also consistent with the strong octupole excitation. Higher accuracy of these data is certainly desirable but very difficult to achieve as the angular correlations of the observed $(3_1^- \rightarrow 2_1^+)$ γ rays have very weak anisotropies. Finally, the g factors of the 2_1^+ states of both isotopes have been very well reproduced providing evidence for the large reliability of the measurements [1].

References

[1] O.Kenn *et al.*, Phys. Rev. **C65** (2002) 034308

Table 1: *Preliminary experimental g factors and lifetimes compared to shell model predictions based on ^{40}Ca and ^{56}Ni cores*; [a] ref.[1]

	^{64}Zn			^{68}Zn			
	2_1^+	4_1^+	3_1^-	2_1^+	4_1^+	2_2^+	3_1^-
E_x[MeV]	0.922	2.307	2.999	1.077	2.417	1.883	2.750
τ[ps]	2.8(1) 2.70(8)[a]	1.14(4)	0.212(7)	2.29(6) 2.32(7)[a]	1.3(1)	1.5(2)	0.38(3)
$g(I^\pi)$	+0.469(47) +0.445(46)[a]	+0.66(24)	+0.4(3)	+0.504(50) +0.436(47)[a]	-	+0.54(17)	+0.5(3)
$g(^{40}$Ca)	+0.48	+0.73		+0.58	+1.08		
$g(^{56}$Ni)	+0.448	+0.362		+0.733	+0.404		

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