

ANGULAR DISTRIBUTIONS OF GAMMA RAYS FROM THE (p, γ) REACTION
ON SEMITHICK $^{66,68}\text{Zn}$ TARGETS

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Targets of 4mg/cm^2 98% enriched in ^{66}Zn and ^{68}Zn have been bombarded by 3 MeV protons. The angular distributions of the gamma rays deexciting levels below 2 MeV in ^{67}Ga and ^{69}Ga have been measured with Ge(Li) detectors and were found to be symmetric around 90° . The normalized even order Legendre polynomial coefficients derived from the least squares fit to the experimental angular distributions may be written:

$$A_k^{\text{exp}} = B_k(J_1) \cdot f(J_1, J_2, \delta) \quad (1)$$

where $B_k(J_1)$ describes the nuclear alignment of the state J_1 and the function f describes the distribution of the emitted γ -rays.

Since the structure of the low lying states in both ^{67}Ga and ^{69}Ga is known to a great extent^{1,2,3}, eq(1) can be used to extract the nuclear alignment coefficients of the $^{67,69}\text{Ga}$ states. From the analysis of the data it has been found that the alignment coefficients are characteristic of the spin of the level and do not vary significantly with excitation energy.

Theoretical values for the B_k 's can be calculated with the following arguments: a) resonant states are excited with $l_{\text{max}}=3$ b) all the excited resonant states have the maximum alignment coefficient (target $J^\pi=0^+$) c) the resonant states decay to lower lying states predominantly with pure M1 and E1 transitions⁴⁾ d) the feeding of lower lying states from the resonant ones is accomplished by direct decay and by two or more step γ -decays and e) no interference terms arise to the angular distributions.

Based on the above, the calculated B_k values are presented in Table I together with the experimental ones.

Table I. Calculated and experimental B_k parameters as a function of the spin J of the low lying state.

No. of cascades	J=3/2		J=5/2		J=7/2		J=9/2	
	B_2	B_4	B_2	B_4	B_2	B_4	B_2	B_4
I	-0.27	-	-0.73	-0.05	-0.94	+0.54	-	-
II	-0.14	-	-0.37	+0.04	-0.67	0.04	-0.87	0.405
III	-0.10	-	-0.24	0.0	-0.43	0.08	-0.65	0.08
IV	-0.03	-	-0.07	0.0	-0.15	0.0	-0.23	0.03
EXPER.	-0.23		-0.37		-0.60		-0.69	

From the comparison of the theoretically predicted values with the experimental data it is concluded that the observed alignment in the low lying states of the $^{67,69}\text{Ga}$ nuclei must be a consequence of the significant feeding of these states by direct or two step gamma cascades from the resonant states.

Since the numbers derived in Table 2 do change slowly with energy or atomic mass, the (p, γ) reactions on semithick targets in the medium mass region may provide valuable information on low spin states as much as the (α ,n γ) reaction provides information on high spin states.

Currently the method is used to obtain information on previously unknown levels of ^{69}Ga and is extended to $^{65,51}\text{Ga}$ nuclei.

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