JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN VOL. 34, SUPPLEMENT, 1973
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR MOMENTS AND NUCLEAR STRUCTURE, 1972

VI–9 Quadrupole Moments of ^{11}C, ^{11}B and ^{12}B*

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Using the Cohen Kurath wavefunctions, the quadrupole moments of ^{11}C and ^{11}B are calculated. They are expressed as

$$Q_0(A=11, t_3) = 2.187(1+\delta e_p+\delta e_n) + 2t_3(0.807)(1+\delta e_p-\delta e_n)$$

in units of e fm^2, where δe_p and δe_n are additional charges of proton and neutron, respectively. The observed values are 4.06 e fm^2 for ^{11}B and 2.89 e fm^2 for ^{11}C. The Sternheimer correction is not taken into account in the latter. According to Sternheimer, the correction may increase the value of quadrupole moment of ^{11}C by 3%. We therefore assume two values for ^{11}C; 2.89 and 3.00.

We obtain the following values of δe_p and δe_n;

(i) $\delta e_p = 0.16$ and $\delta e_n = 0.43$ when $Q_0(^{11}\mathrm{C}) = 2.89$

(ii) $\delta e_p = 0.14$ and $\delta e_n = 0.48$ when $Q_0(^{11}\mathrm{C}) = 3.00$.

We clearly see that δe_p is smaller than δe_n. This fact is consistent with the theoretical prediction in which one takes into account the quadrupole core polarization. Since δe_p is smaller than δe_n, the iso-vector quadrupole giant resonance should contribute to the effective charges.

We express the wavefunction of the lowest $T=1$ $J=1$ state of mass 12 nuclei as follows:

$$\psi(T=1, J=1, A=12) = \psi_1 + \alpha\psi_2 + \beta\psi_3\,,$$

where ψ_i are the Cohen Kurath wavefunctions. Here we allowed the excited states ψ_2 and ψ_3 to mix in ψ_1, because the magnetic moments of ^{12}B and ^{12}N are sensitive to small admixtures of them. The magnetic moments limit the values of α and β. (Table I).

We estimate the quadrupole moments of ^{12}B and ^{12}N (Table I). The calculated value agrees with the observation.

Table I.

	μ(n.m.)		Q(e fm^2)			
			$\delta e_p = 0.16$ $\delta e_n = 0.43$		$\delta e_p = 0.14$ $\delta e_n = 0.48$	
α, β	^{12}B	^{12}N	^{12}B	^{12}N	^{12}B	^{12}N
0 0	0.762	0.611	1.71	0.86	1.70	0.93
.02 −.05	0.967	0.407	1.60	0.76	1.58	0.82
.04 −.07	0.950	0.420	1.45	0.66	1.44	0.72
obs.	1.00 +.001	0.457 +.0005	1.71		1.71	

* This work is supported by U.S. Atomic Energy Commission.