Contribution ID: **51** Type: **Poster report**

THE ALIGNMENT OF THE $^{16}O(3^-; 6.131$ MeV) NUCLEUS FORMED IN SOME NUCLEAR REACTIONS AT $E_x \approx 7.5$ MeV/NUCLEON

Tuesday 21 September 2021 18:25 (5 minutes)

Experimental and calculated the $F_2(\theta_y)$ and $F_4(\theta_y)$ alignment angular dependences of the ^{16}O nucleus in the excited state 3^- (6.131 MeV), formed in the reactions $^{16}O(\alpha,\alpha)^{16}O$, $^{14}N(\alpha,d)^{16}O$, $^{15}N(\alpha,t)^{16}O$ and $^{19}F(p,\alpha)^{16}O$ at energies $E_\alpha = 30.3$ MeV and $E_p = 7.5$ MeV are presented. The orientation parameters F_k ($k = 1,\ldots,2J, |F_k| \leq 1$) are polynomials in the mean values of the powers $\langle J_z \rangle$ and are included in the expression for the interaction energy of nuclei with an electromagnetic field [1]. The parameter of the dipole orientation F_1 is called polarization, and the quadrupole F_2 is the alignment of the nuclei. Since the method of angular correlations used in this work makes it possible to experimentally determine only even components, we consider the parameters of the quadrupole F_2 and hexadecapole F_4 orientations. In the case of an isotropic spin distribution, the alignment is zero. The maximum value of the parameters is achieved at the maximum value of the spin projection $M = J$ onto the quantization axis:

$F_2 = \frac{2J+1}{\sqrt{5}}\sqrt{\frac{(J+1)(2J+3)}{J(2J-1)}}T_{20}$, $F_4 = \frac{2J+1}{6}\sqrt{\frac{(2J+3)(2J+2)(2J+4)(2J+5)}{J(J-1)(2J-1)(2J-3)}}T_{40}$, $T_{k0} = \frac{1}{2J+1}\frac{\rho_{k0}(\theta_y)}{\rho_{00}(\theta_y)}$,

where $\rho_{k0}(\theta_y)$ is the spin tensor component of the nucleus density matrix.
Experimental information was obtained on the basis of previously retrieved [2-5] spin-tensors $\rho_{kK}(\theta_y)$ density matrices of the ^{16}O nucleus (3^-; 6.131 MeV) by measuring of the angular particle-gamma correlations.
The experimental orientation parameters are compared with the calculated ones under the assumption of the mechanisms of stripping or pickup a nucleon cluster by the coupled channel method (FRESCO code [6]) and a compound nucleus (TALYS code [7]). The features of the behavior of the orientation parameters of the ^{16}O nucleus (3^-; 6.131 MeV) formed in various reactions are discussed and compared.

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Session Classification: Poster session (Experimental and theoretical studies of the properties of atomic nuclei)

Track Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei.