Clustering Phenomena in the $(\alpha,^7\text{Li})$ Reaction at $E_\alpha = 27.2 \text{ MeV}$ (*).

F. Bonsignore (1), P. D’Agostino (1), G. Fazio (1), G. Giardina (1)
O. Yu. Goryunov (2), A. A. Shvedov (2) and R. Sturiale (1)

(1) INFN and Dipartimento di Fisica dell'Università
Salita Sperone 31, Vill. S. Agata, 98166 Messina
(2) Institute for Nuclear Research, Ukrainian Academy of Sciences
Prospekt Nauki 47, 252028 Kiev, Ukraine

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**Summary.** — The $^{11}\text{B}$, $^{15}\text{N}$ and $^{19}\text{F}(\alpha,^7\text{Li})$ reactions have been studied at $E_\alpha = 27.2 \text{ MeV}$ to investigate the cluster structure of the above target-nuclei. The measured $^7\text{Li}_{0.18}$ and $^7\text{Li}_{0.478}$ angular distributions are analyzed with the contributions coming from the statistical and direct processes. The spectroscopic factors of the studied cluster configuration for the target-nuclei were deduced. The results are compared with the ones deduced by other authors at various incident energies.

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PACS 24.50. – Direct reactions.

1. – Introduction.

In one of our recent works[1] we studied the cluster configurations for the $^{10}\text{B}$, $^{14},^{15}\text{N}$ and $^{19}\text{F}$ target-nuclei by the $(\alpha,^6\text{Li})$ processes at $E_\alpha = 27.2 \text{ MeV}$. The obtained results have been interpreted with a two-nucleon cluster transfer. We estimated the statistical- and direct-process contributions for all the reactions and attempted to describe the experimental data with them.

Now, although the multinucleon transfer reactions have been performed to obtain information on the nuclear structure in these past twenty years, knowledge about the reaction mechanisms is limited[2-4]. Moreover, the deduced angular distributions of the above reactions often show fluctuations with the incident energy. This strong dependence on the energy appears both in processes that predominantly proceed by a direct reaction mechanism[5] and in other processes where the statistical theory well explains the experimental data with a compound nucleus reaction[6].

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Therefore we decided to study the transfer of three-nucleon clusters performing 
$^{11}$B, $^{15}$N and $^{19}$F($\alpha$, $^7$Li) experiments by detecting $^7$Li in the ground and 0.478 MeV excited states to obtain the following:

i) estimation of the contributions of the $^3$H direct pick-up processes and of the ones of the $^7$Li statistical emission from the ($\alpha + A$)* compound nuclei;

ii) possible transferred angular momenta;

iii) spectroscopic factors for the $^{11}$B, $^{15}$N and $^{19}$N target-nuclei and for the ($\alpha$, $^7$Li) processes.

The statistical contributions to the cross-sections were obtained by STATIS code [7] in the framework of the Hauser-Feshbach formalism [8] while the direct ones were carried out by LOLA code [9] in the framework of the DWBA formalism that includes the exact finite-range interaction and recoil effects. Later we assumed that the ($\alpha$, $^7$Li) cross-sections can be contributed from both the direct and statistical processes and compared our results with the ones deduced at various incident energies [10,11].

2. – Experimental procedure and results.

The ($\alpha$, $^7$Li) experiments were carried out with an $\alpha$-particle beam of 27.2 MeV energy at the U-120 isochronous cyclotron of the Institute for Nuclear Research of Kiev. The $^{11}$B target was evaporated onto a 100 $\mu$g·cm$^{-2}$ thick Ni backing. The $^{19}$F one was obtained by evaporating CaF$_2$ onto 100 $\mu$g·cm$^{-2}$ of the Ni backing; the thickness of CaF$_2$ was about 120 $\mu$g·cm$^{-2}$. The $^{15}$N target was obtained by evaporating Ti in atmosphere of $^{15}$N on NaCl backing. An immersion in warm water