

## SOME NEW RESULTS IN THE STUDY OF MULTIPARTICLE BREAK-UP REACTIONS ON LIGHT NUCLEI INDUCED BY 14.4 MeV NEUTRONS

B. Antolković and M. Turk

*Institute "Rudjer Bošković", Zagreb*

Correlation measurements of several multiparticle break-up reactions on light nuclei have been performed in our laboratory in order to study the mechanism of multiparticle reaction processes. So far these investigations have been investigated in view of the sequential decay mechanism, usually anticipated as a dominant process in the low-energy region of the bombarding particles. It has, however, been found that the role of quasi-free processes cannot be ignored. Analysis of the data on the  ${}^7\text{Li}(n,\alpha)t$  reaction in the frame of the PWIA<sup>1)</sup> has shown that a considerable fraction of the total cross section may be attributed to quasi-free n-alpha scattering. The momentum distribution of tritons, i.e., spectator particles, has been determined using Li-loaded nuclear emulsions as a radiator and detector. The influence of FSI processes has been avoided by excluding all events that proceed via the strongly excited  ${}^7\text{Li}$  and  ${}^5\text{He}$  states. The measured triton momentum divided by the phase space distribution in momentum variable<sup>1)</sup> and by the free n-alpha cross section is shown in Fig.1. This experimentally extracted momentum distribution  $|\phi(p)|^2$  has a shape which is expected on the basis of the known relative angular momentum  $\ell=1$  of the alpha particle and triton cluster motion in  ${}^7\text{Li}$ . To compare the experimental data with theory, the Fourier transform of the radial part of the relative wave function Li was calculated using a harmonic oscillator (solid line in Fig.1) and a Hankel function with a cut-off radius  $R = 1.5A^{1/3}$  (dashed line in Fig.1) to describe alpha-t relative motion in the  ${}^7\text{Li}$  wave function. A good fit to the experimental data was obtained with the harmonic oscillator wave function, which supports the evidence for quasi-free n-alpha scattering to be present in the  $n + {}^7\text{Li}$  reaction at 14.4 MeV.

Correlation measurements of multiparticle break-up reaction have also proved to be a valuable tool for extracting spectroscopic data on unstable nuclear states involved in the

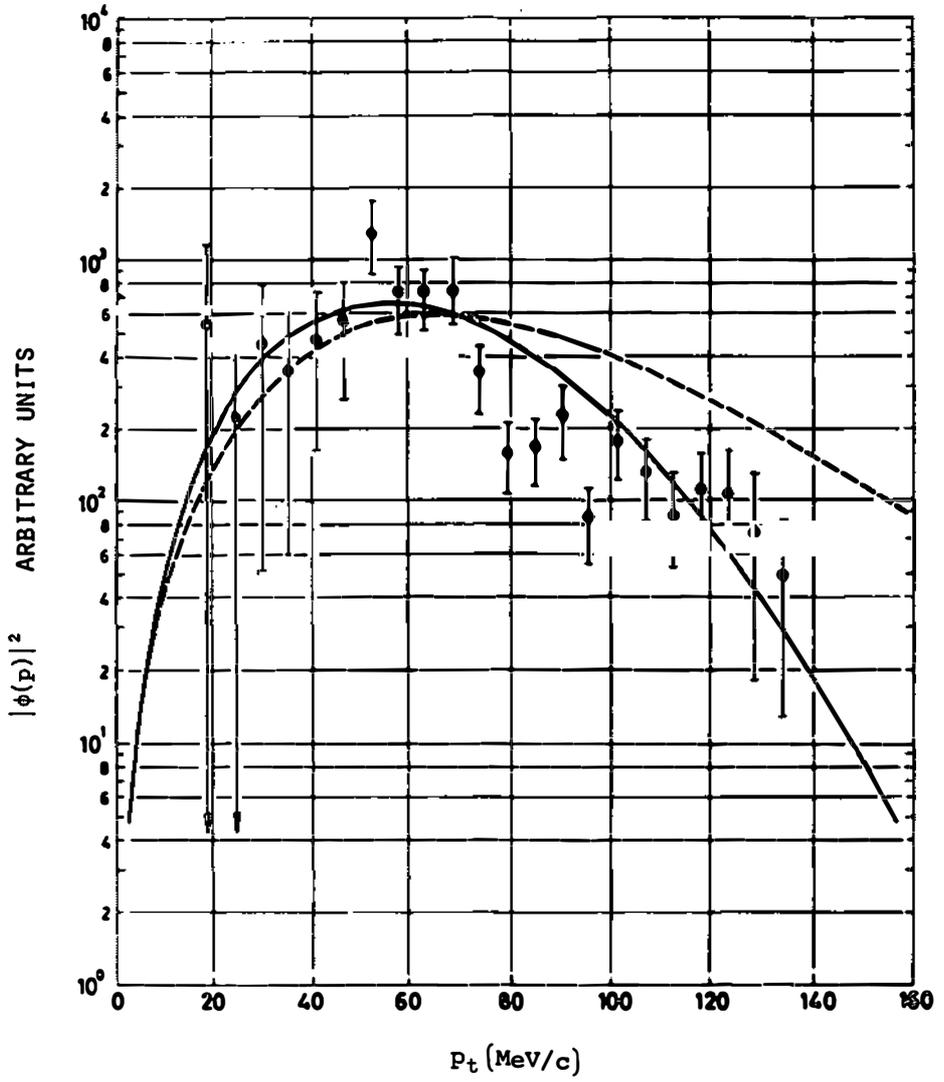


Fig. 1.

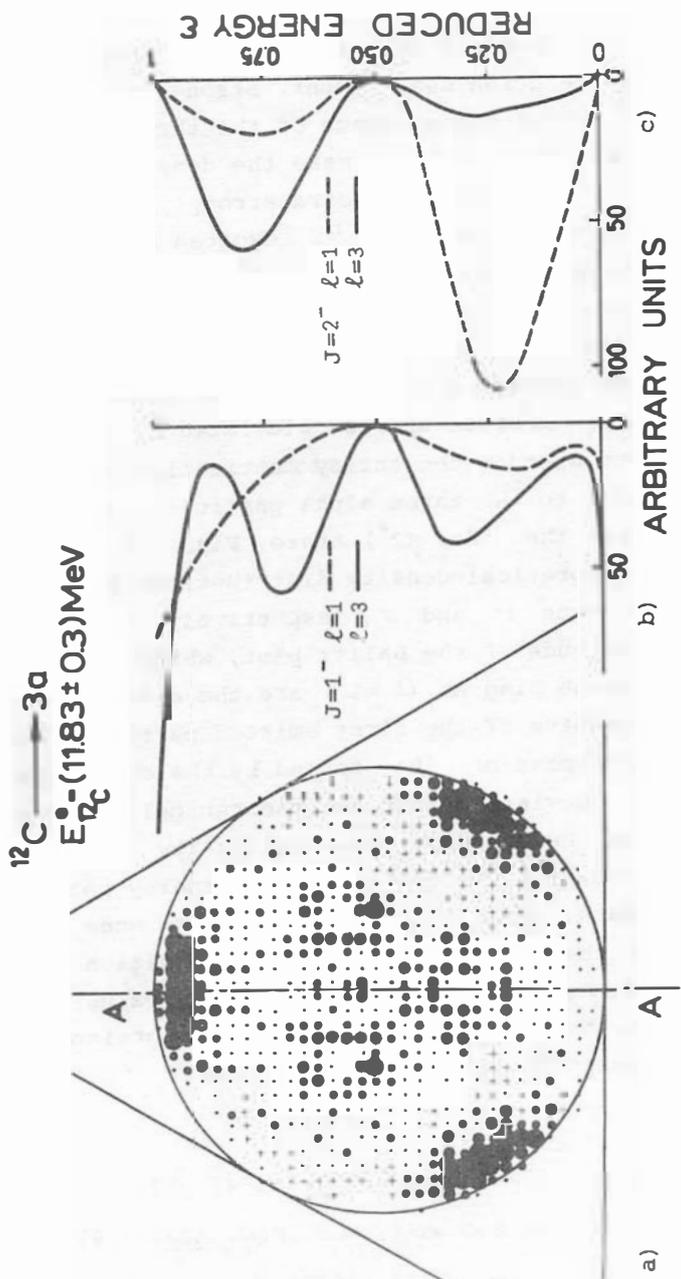


FIG. 2.

reaction. This fact has been explored in the  $n + {}^{12}\text{C} - n+3 \alpha$ -reaction to extract the spin and parity value of the 11.83 MeV state of the  ${}^{12}\text{C}$  nucleus from the density distribution of the alpha-alpha correlation measurement. Strong interference effects are involved<sup>2)</sup> due to the presence of the three undistinguishable alpha-particles. These effects make the density distribution of the alpha-alpha correlation spectra strongly dependent on the spin and parity values of the  ${}^{12}\text{C}$  excited state. The main feature of the experimental alpha-alpha density distribution, shown in a triangular Dalitz plot representation in Fig.2a, is clustering ring of the experimental points at the maximum energies of the three alpha particles. The theoretical density distribution for the  ${}^{12}\text{C}_{11.83} - 3\alpha$  break-up was calculated by the expression<sup>3)</sup> that takes into account the antisymmetrization of the exit channel with respect to the three alpha particles, assuming a sequential decay via the  ${}^8\text{Be}_{2.9}(2^+)$  state. Figs. 2b and 2c show the shape of the theoretical density distributions for both tentative spin assignments  $1^-$  and  $2^-$ , respectively, at the cut AA through the altitude of the Dalitz plot, which is a good representative of whole diagram ( $\ell = 1, 3$  are the allowed values of the angular momentum of the first emitted particle with respect to the centre of mass of  ${}^8\text{Be}$  formed by the other two alpha particles). It is visible that the theoretical density distribution based on the unnatural spin and parity  $2^-$  for the  ${}^{12}\text{C}_{11.83}$  state cannot reproduce the high-energy peaking of the experimental data, since it decreases to zero when approaching the contour of the Dalitz plot, and the transition via the  ${}^8\text{Be}_{gs}$  is not allowed. Assuming the spin and parity value  $1^-$ , a satisfactory fit to the experimental data can be obtained supporting the  $1^-$  assignment for the 11.83 MeV state of  ${}^{12}\text{C}$ .

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