ENTRANCE-CHANNEL EFFECTS NEAR THE THRESHOLD FOR DEEP INELASTIC COLLISIONS IN LIGHT NUCLEAR SYSTEMS

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In this contribution an experimental evidence concerning the significant role of deep inelastic processes in $^{19}F + ^{24}Mg$ system at 72 MeV incident energy of ^{19}F nuclei will be firstly reported. Further there will be presented some of the results obtained with a postaccelerated ^{19}F beam at 87.9 MeV showing a marked increase of inelastic processes. Finally, results of measurements on $^{16}O + ^{24}Mg$ interaction at 64 MeV incident energy of ^{16}O nuclei will be shown. This latter energy was choosen in order to correspond to about the same energy/nucleon over the Coulomb barrier as in the case of 72 MeV ^{19}F nuclei. A substantial difference in populating Z=uneven products between the adjacent $^{19}F + ^{24}Mg$ and $^{16}O + ^{24}Mg$ systems can be noticed from the presented results. A tentative discussion based on Q_{gg} consideration will be presented as a basis to understand this difference.

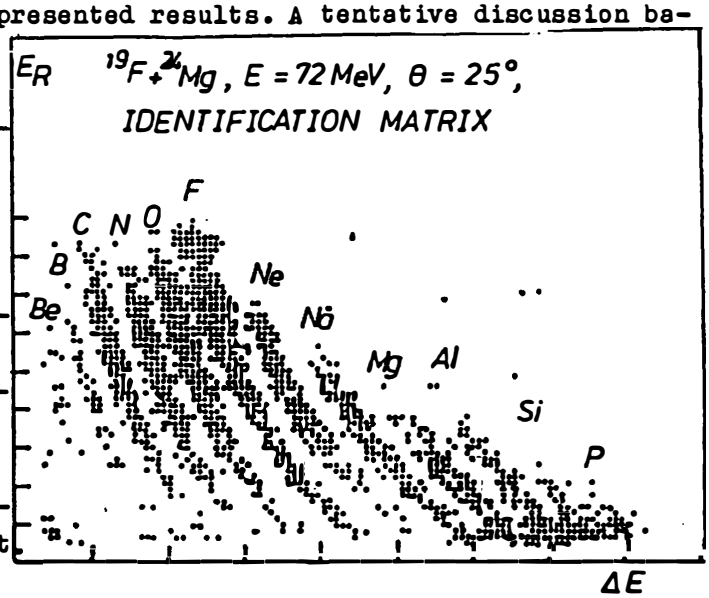

Fig. 1

The first measurements quoted above were performed by using a 72 MeV ^{19}F beam accelerated in the 8^+ charge state at the tandem accelerator in Bucharest At the tandem accelerator was obtained also the 64 MeV ^{16}O beam. The measurements at 87.9 MeV incident energy of ^{19}F were accomplished by using the new

postaccelerator in operation at IPNE Bucharest. In order to obtain this energy a group of 8 cavities, each supplied with 20 kw RF power at 108.48 MHz was used.

The detection and identification of reaction products was performed by the aid of a (ΔE,E) ionization chamber described elsewhere[1]. In this chamber ΔE is determined by means of ionization processes in gas and the residual energy E is determined by the use of a surface barrier detector. The magnesium target 1.6 mg/cm^2 was selfsupported and deposited by a thin 16μg/cm^2 gold layer in order to facilitate the monitoring.

The pulses from the (ΔE,E) chamber were registred in a 2 parameter regime by means of a PDP 11/34 computer. The used programme (BIPAR) allows to be used a number of 64 channels for the E coordinate and a number of 128 channels for the ΔE coordinate. In fig.1 there is shown a (ΔE,E) matrix for ^{19}F + ^{24}Mg reaction reproduced from the display of the computer by the aid of a plotter. As can be seen in fig.1 one can easily separate the product elements up to Z=15. In processing these matrices, after the energy calibration of the E and ΔE coordinates the E and ΔE were summed and thus the energy spectra for 7 angles between 15^0 and 45^0 (LS) and for 11 elements were

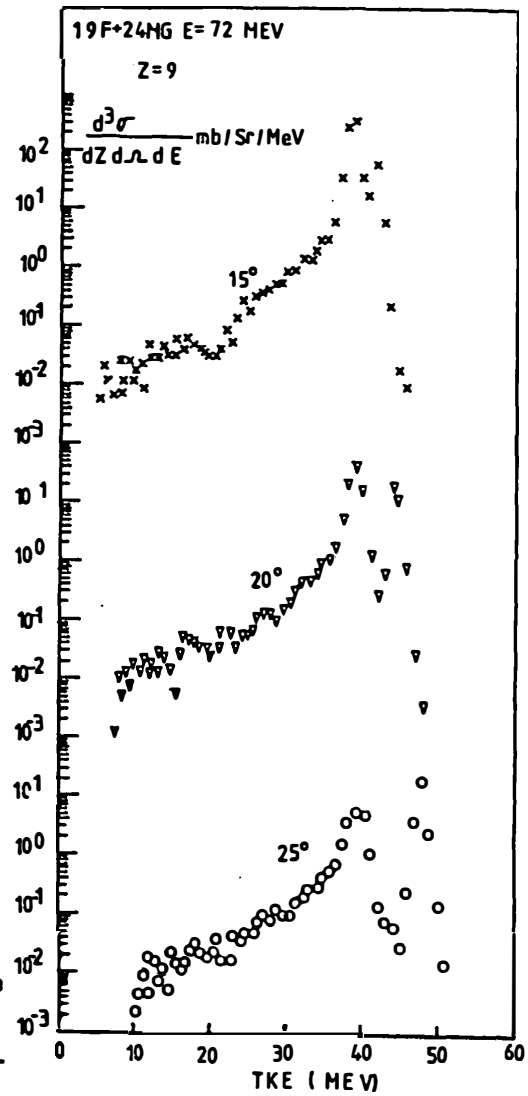

Fig. 2

obtained. Afterwards the total kynetic energy in the CM system was calculated for each point of the energy spectra, taking into account the corrections for the energy loss in the detection window and in the target. In this way were obtained the triple differential cross sections $d^3/dZ\,d\theta\,dE$. In fig.2 and fig.3 are illustrated these cross sections for z=9 and Z=8 elements. As can be seen, besides elastic and cuasielastic components, there are present also large distributions in energy characteristic for deep inelastic collisions as were observed in heavier nuclear systems[2,3]. A marked increase in deep inelastic component can be noticed in fig.4 in which are represented the differential cross sections measured at 20° and 30° for Z=8 and 87.9 MeV incident energy of ^{19}F. From the obtained data a monotonous decrease in the yield of the produced elements in going for Z=9 either to lower Z values or to higher ones. This assertion can be roughly followed also on fig.1 in which the widths of Z element hyperbolas are proportional to the yield of the produced elements. On the contrary the yield of elements produced in $^{16}O + ^{24}Mg$ reaction shows a marked odd-even Z dependence as it is illustred in fig.5 in which are reproduced the data at 25°. From our obtained data this even-odd staggering of the cross section for adjacent

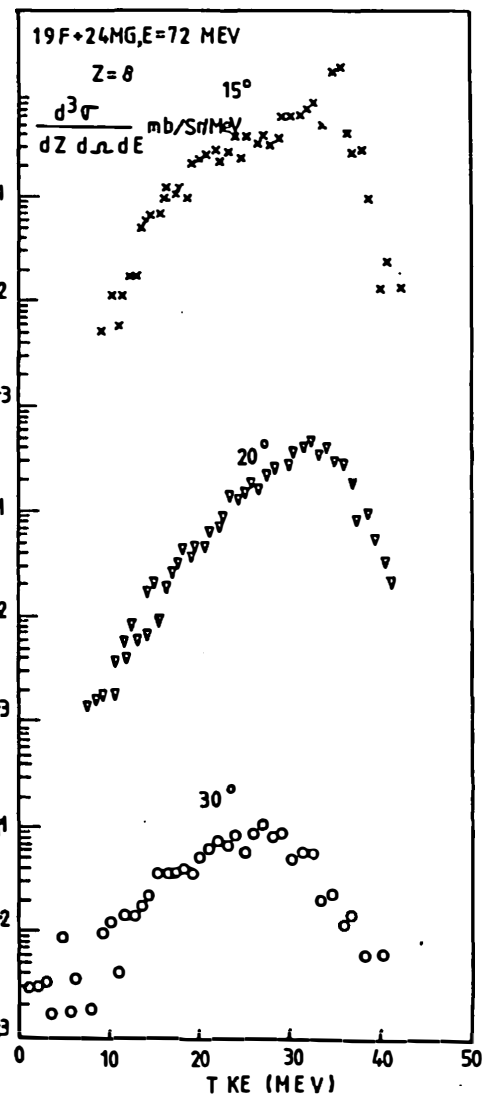

Fig. 3

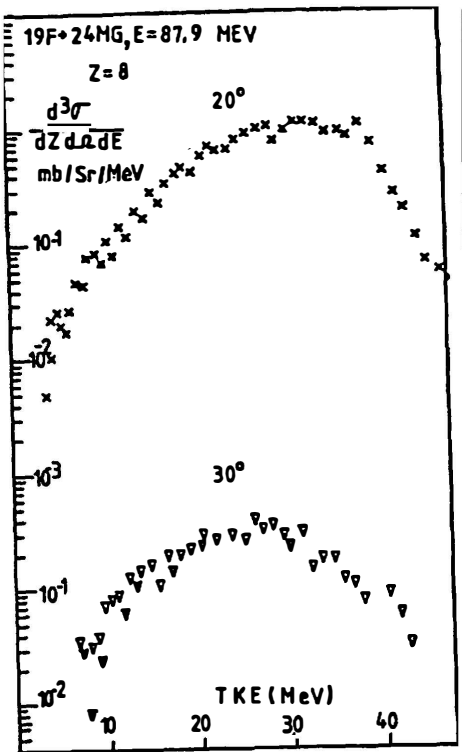

Fig. 4

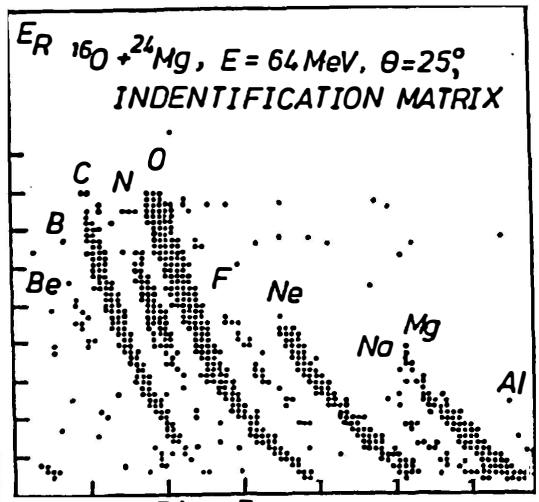

Fig. 5

elements goes up to a factor of 100. A preliminary attempt to explain this difference will be given on the basis of Q_{gg} systematics prescribed for deep inelastic collisions and for binary 1-matched reactions[2,4]. Following these prescriptions the cross section for production of an element is proportional to $\exp \frac{Q_{gg} - Q_c}{T}$ in which T is an effective temperature and Q_c is the change in the Coulomb interaction energy due to the transfer of charge. Results of estimations based on this formalism showing a good qualitative agreement with experimental data, will be presented. It is of interest to follow this even-odd staggering at higher incident energy. An experiment with 100 MeV oxygen is in preparation.

1. M. Petrașcu et al, Nucl. Instr. Meth. B (1984) in print.
2. V.V. Volkov, Deep Inelastic Nuclear Transfer Reactions (Energoizdat, 1982), in russian.
3. I. Brâncuș et al, Zeitschr. für Phys. (1984) to be published.
4. J. Wilczynski et al, Nucl. Phys. A373 (1982) 109.