INTERMEDIATE MASS FRAGMENT PRODUCTION IN THE INTERACTION OF 1 GeV PROTONS WITH Au, Ag AND Ni TARGETS

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The main aim of this experiment is to stuly the intermediate mass fragment IMF ($z_f \geq 4$) production in deep inelastic reactions of 1 *Gev* protons with nuclei. As the result the charge yields of fragments, the energy spectra, the velocity of nucleus emitting fragments and the estimation of fragment multiplicity have been obtained.

The fragments are registrated by two identical time-of-flight (TOF) spectrometers mounted at 30^0 and 126^0 to the beam direction. The basic element of the spectrometer is the double axial field ionization chamber providing reliable charge and mass identification of detected fragments. It is based on such parameters as the value of maximum ionization losses ("Bragg" peak), *E*-value, the range and energy of the particles and their combinations [1]. Fig.1 shows range-energy scatter plot of events for Ag target and demonstrates the charge and mass resolution of the spectrometer. To estimate the multiplicity of fragment production two parallel plate avalanche counters with the large solid angle (~0.1 *sr*) were used. These counters registrated fragments (with $z_f \geq 2$) in coincidence with at least one of TOF-spectrometers.

The parameter of slope of the energy spectrum in moving frame ("temperature"), the value of Coulomb barrier, the velocity of emitting source $\beta_{||}$ and double differential cross sections $\frac{d^2\sigma}{dE\,d\Omega}$ of IMF production have been determined for Au, Ag and Ni targets from simultaneous approximation of the energy spectra of the fragments at forward and backward angles by modified Maxwellian distribution.

The fragment charge distributions $\sigma(z_f)$ obtained by the integration of $\frac{d^2\sigma}{dE\,d\Omega}$ are presented in fig.2*a*. It was established that the fragment charge distributions for Ag and Ni targets are a rather well fitted by the power law $\sigma(z_f) \sim z_f^{-\tau}$ ($\tau = 2.7 \pm 0.2$ for the both targets). However for the Au target, the charge yields are not described by the power law and the cross section production for $z_f > 10$ remains almost constant.

The results of energy spectrum approximation agree with the assumption that the only source of fragments is enough to describe the most part of the experimental data.

The values of longitudinal component of the source velocity versus the charge of fragments are presented in fig.2*b*. One can see that this value is practically independent of the charge for Au although for Ag and Ni targets $\beta_{||}$ increases with z_f until $z_f = 8$.

The eveluation of fragment multiplicity from the coincidence measurements indicates that a number of coincidence events increases from Au to Ni and doesn't exceed few per cent of inclusive cross section (0.4%, 1.6% and 2.4% for Au, Ag and Ni target respectively).

Thus the results of this experiment are compatible with the assumption that the IMF are mainly produced by binary decay in 1 *GeV* proton-nucleus collisions.

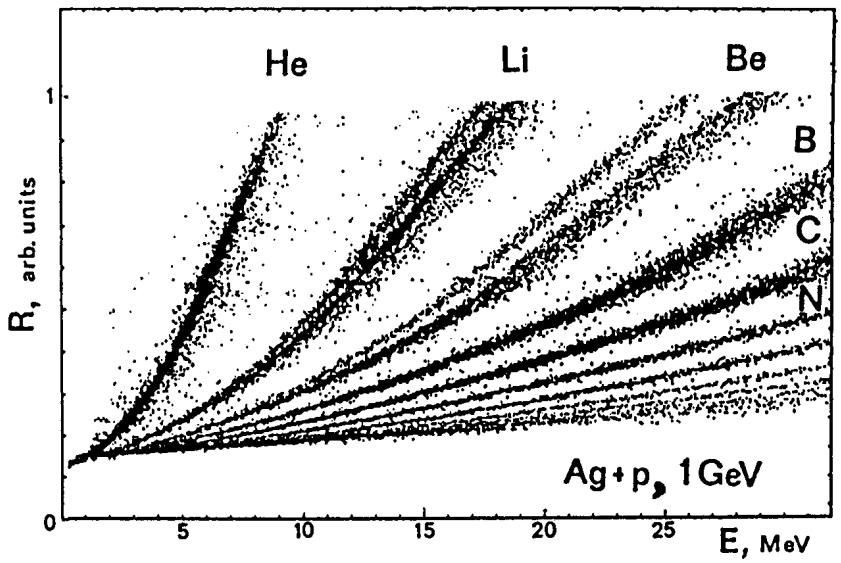

Fig.1. Range versus energy scatter plot of events for Ag target

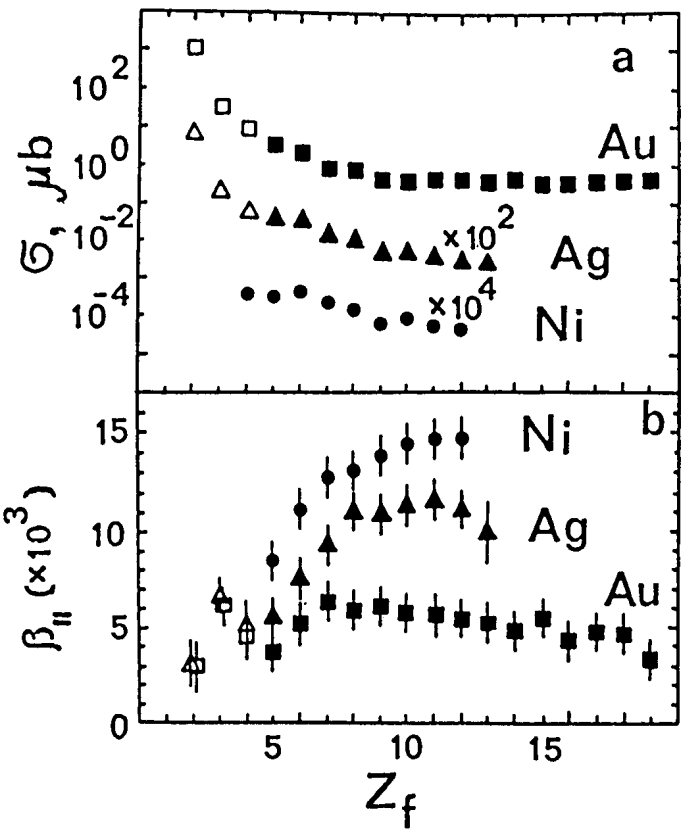

Fig.2. Total cross sections (*a*) and mean values of velocity $\beta_{||} = v_{||}/c$ (*b*) as function of fragment charge for Au, Ag and Ni targets. Open symbols are from Ref [2], closed symbols are from this work

References

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2. Volnin E.N., Amalsky G.M., Vorobyov A.A., Smirnov N.P., Seliverstov D.N. //Phys.Letters. 1975. B55. 409.