EXPERIMENTAL SET-UP USED TO STUDY INTERACTIONS OF RELATIVISTIC NUCLEAR FRAGMENTS AT THE DUBNA SYNCHROPHASOTRON

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A method[1] and a detector that permit one to analyse the anomalon's phenomenon in nuclear interactions[2] with a high statistical accuracy are described. An experimental set-up was exposed to ^{12}C, ^{16}O, ^{22}Ne and ^{24}Mg beams at the Dubna synchrophasotron at an energy of up to 4.5 GeV/c.A. A layout of the experimental set-up is shown in Fig.1, where PC1-8 are proportional chambers; S1-5 scintillation counters and C1-40 Cerenkov counters. A principal part of the apparatus is the target-detector.

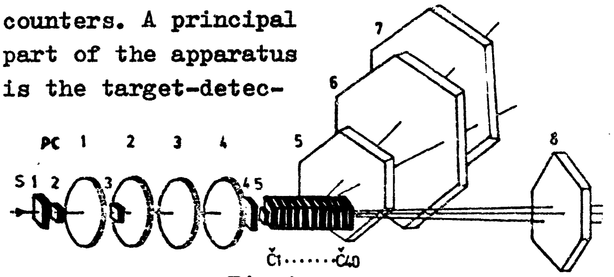

Fig.1.

The detector represents a stack of 40 Cerenkov counters. Each plexiglass radiator 0.52 cm thick is connected to a PM ФЭУ-84. The pulse height of a Cerenkov signal is proportional to the ion charge squared. There is a total internal reflection of Cerenkov light in the radiators if the angular deflection of an ion with a momentum of 4.2 GeV/c.A relative to the beam axis is no more than 2.5°[3]. The Cerenkov stack permits one to determine the coordinates the point of fragment production and their interaction by measuring a charge change in the counters in series. The display of a typical event in Cerenkov stack is shown in Fig.2. Proportional chambers PC1-4 are used to measure the coordinates of the tracks of projectile ions. Each module contains 3 planes of sense wires rotated to 60° with respect to each other. The sensitive regions of the chambers are: PC1-4 - 128 mm, PC5,8 - 384 mm, PC6 - 640 mm and PC7 - 896 mm. The signal wire spacing is 2mm. An aluminium foil 14µm thick is used for HV cathodes. Fig.3 shows the efficiency of the beam chambers PC1-4 for relativistic ions with charges from Z=1 to 12 vs high voltage setting. The accuracy in measuring the entry point of projectile ions is 0.4 mm. The telescope of 5 scintillation counters, placed in front of target, provides a trigger. The average resolution of a Cerenkov counter is 0.25 e for Z=10. This resolution ensure sufficient fragment separation. Fig.4 shows the Z^2 distribution for ^{24}Mg - (Z_1^2) and its fragments with a>3.5 cm free path for the second - (Z_2^2) and third generations - (Z_3^2).

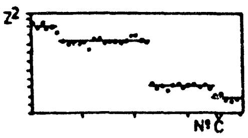

Fig.2.

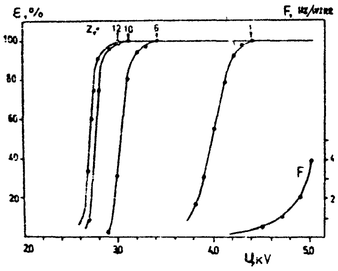

Fig.3.

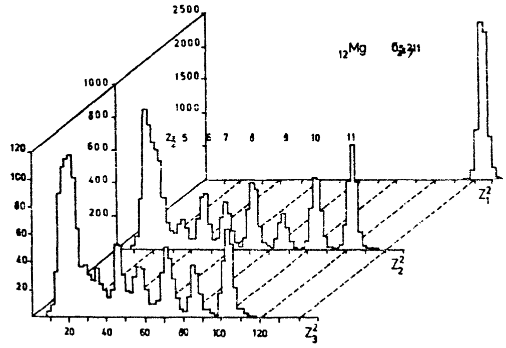

Fig.4.

A remarkable feature of the Cerenkov spectrometer is its almost complete insensitivity to slow and strong ionizing secondary particles and low sensitivity to relativistic particles deflected considerably (more than 2.5°) from the beam axis. The set-up permits one to separate fragments sufficiently, to suppress accompaning particles, to measure the fragmentation branching and the mean free path of nuclei and their fragments. For a single interaction the accuracy in determining the vertex is about 3 mm. The accuracy in measuring the mean free path of nuclei is 2.0% for ^{24}Mg.

1. Golutvin I.A. et al., P1-83-85, Dubna, 1983.
2. Friedlander E.M. et al. PRL, 45, 1084, 1980.
3. Volkov V.I. et al. B1-83-854, Dubna, 1983.