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A possibility is shown of investigating elastic scattering of high energy protons in the region of low momentum transfers ($1.5\cdot10^{-3}$ GeV^2/c^2 $\leq$ $-t$ $\leq$ $\leq$ 1.5 10^{-1} GeV^2/c^2) with semiconductor detectors of nuclear particles. Earlier with this aim the photoemulsion method was used /1/ the disadvantage of which is a low rate of obtaining statistics. Semiconductor detectors are free of this drawback, they have good energy resolution ($\approx$ 1%), are portable and are not sensitive to magnetic fields. The fact that a sensitive layer in a semiconductor detector can start directly from the surface allows to detect protons of a very low energy up to some scores of keV /2/. This means that one can study elastic scattering in the angle region where the Coulomb scattering is many times greater than the nuclear one.

Below are given the results of the test experiment performed on the proton synchrotron of the Joint Institute for Nuclear Research.

Semiconductor detectors were placed into a vacuum channel at an angle of 87.7° to the proton beam. They were at a distance of 3 m from the target which was set on the way of the internal 10 GeV proton beam. The target was made of a hydrogeneous polymer film of the type $(CH_2)_n$, 0.7 μm thick. Semiconductor detectors as well as preamplifiers located near them were safely shielded from stray electric noise and its effect was not observed during the experiment. The pulses of a semiconductor detector after being amplified entered an amplitude analyzer.

Fig. 1a shows the results of measurements carried out with a surface-barrier detector 3x4x0.09 mm. The measurement time was 10 min. One can see an obvious peak corresponding to 2.2 MeV recoil protons. It is at the background level resulting from target carbon. The halfwidth was 220 keV (10%). It was due, mainly, to Coulomb scattering of recoil protons in the target and the geometry of the experiment. The instrumental halfwidth according to measurements on monochromatic α-particles was 50 keV. For the sake of comparison Fig. 1b shows range distributions in 4-fold diluted gelatin emulsion. The particles emerged from a similar target in identical conditions. The peak corresponding to recoil protons from elastic scattering has a halfwidth $\Delta E/E = 18\%$, i.e. somewhat wider than the distribution obtained with a semiconductor detector.

In measuring with thicker detectors it was established that if the thickness of the detector sensitive layer was not larger than some parts of a mm, the background from the target predominated over the background which was not due to the target. It follows from this fact than protons of up to 10 MeV energy whose ranges keep within a silicon layer 0.7 mm thick can be idenfield with a single detector. In the case of thicker detectors a necessity arises to introduce an additional counter to select the particles of the effect by a coincidence method.

In conclusion we note that the above method is applicable for investigating in the region of low momentum transfers any reactions of the type $a+b \to c+d$, for instance, scattering on nuclei, scattering with production of excited nuclear states, etc.

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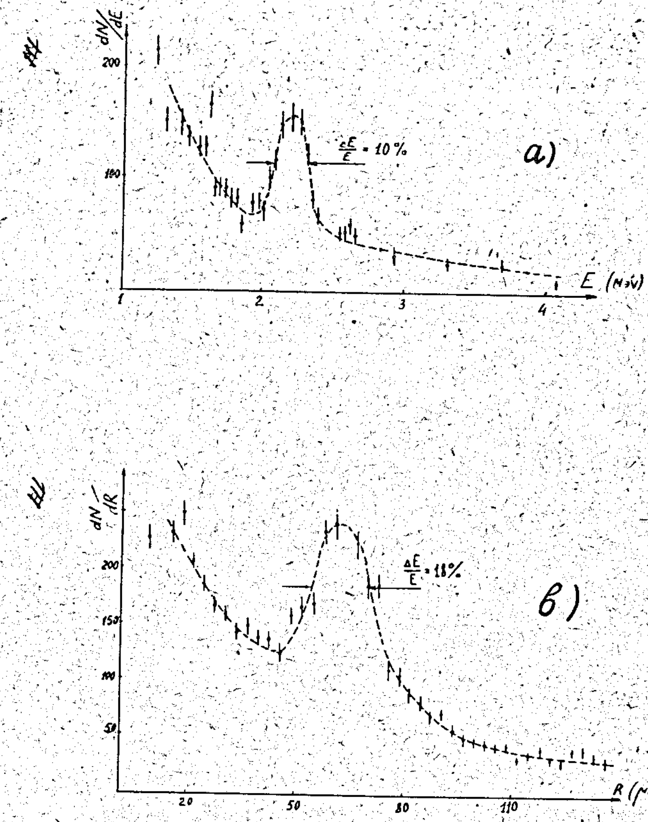

Fig. 1. Spectra of particles emerging at an angle of 87.7° from the target $(CH_2)_n$ bombarded with a 10 GeV proton beam;

a) energy distribution measured with a semiconductor detector

b) range distribution in 4-fold diluted gelatin photoemulsion.