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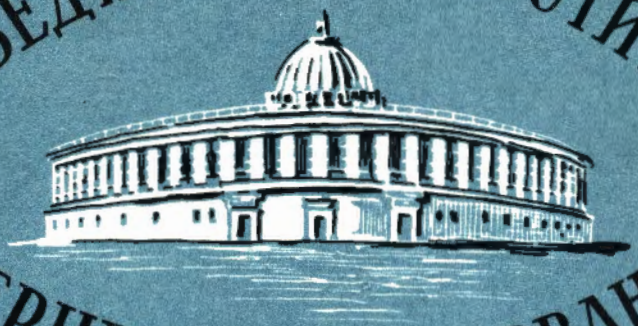
ЛАБОРАТОРИЯ ВЫСОКИХ ЭНЕРГИЙ

ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ



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THE TOTAL CROSS SECTION FOR INTERACTION OF NEUTRONS WITH PROTONS AT THE ENERGY OF 8.3 BeV.

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БИБЛИОТЕКА

The total cross section for neutron-proton interaction has been measured at the Joint Institute synchrophasotron under the conditions of good geometry ($\theta/2 = 0.288°$). The neutral beam used in the experiments was generated at the berillium target 10 cm thick which was placed inside the vacuum chamber of the accelerator. Then the beam was extracted at an angle of 0° to the direction of the proton beam motion in the synchrophasotron. The collimation of the beam was made by a steel collimator 250 cm long. The diameter of the hole in this collimator was 5 cm. The collimator was placed at a distance of 18.5 m from the internal target. The angular divergence of the collimated beam did not exceed 0.07°. The initial beam of neutral particles consisted mainly of neutrons, as well as of γ-quanta produced as a result of the decays of neutral pions, and of a small admixture of K_2^0 mesons. To purify the beam from γ-quanta two lead filters 6.2 cm thick were placed before the collimator. The purification of the beam from the charged particles produced as a result of neutron and γ-quantum interaction with the wall of the accelerator vacuum chamber and with the matter of the lead filters, was made by means of the magnetic field 18000 oersted in strength along the distance of 130 cm. The geometry of the experiment and the magnitude of the magnetic field were chosen so that the charged particles with the momenta maximum possible were deflected at the angles exceeding that subtended by the neutron detector. In Fig. 1 is plotted a schematic drawing of the detector. To increase the recording efficiency of high energy neutrons the lead glass Cerenkov counter was used in the neutron detector. The neutron detector consists of an anticoincidence scintillation counter, of an aluminium convertor 10 cm thick, of three coincidence scintillation counters and of a lead glass Cerenkov counter the dimensions of which were equivalent to approximately 20 r.l. or to 2 mean free paths for nuclear interaction. The calculated efficiency of the detector was of the order of 1% at the satisfactory energy resolution. Only those neutrons were recorded from which the energy release in the Cerenkov counter exceeded a certain threshold energy. The adjustment of the energy thresholds of the neutron detector was accomplished by changing the energy of the accelerated protons in the synchrophasotron. The pulses from the Cerenkov counter were analysed by the amplitudes with the aid of a 12-channel pulse height analyser.

As a monitor we used a telescope of three scintillation counters and of an aluminium convertor which were placed behind the lead collimator 100 cm long at a distance of 17.0 metres from the internal target. The axis of the monitor channels was displaced at 3° with respect to the direction of the accelerated proton motion.

The targets of polyethelene and carbon 48,53 g/cm^2, 23,66 g/cm^2 and 41,56 g/cm^2, 20,32 g/cm^2 respectively were used in the measurements. The measurements have shown that the total cross section for

neutron-proton interaction is equal to σ_{tot} = 41,2 ± 2,6 mb, the effective neutron energy being $8{,}3^{+1{,}2}_{-1{,}3}$ BeV.

The obtained value of the total cross section for neutron-proton interaction is large than that measured at the effective neutron energy of 4.5 BeV and equal to 33.6 ± 1.6 mb[1]. This implies that in this energy interval there is a tendency to a rise in the total cross section for n-p-interaction (see Fig. 2).

At the present time the measurements are being made of the total cross section for the interaction of neutrons with protons and with heavier nuclei.

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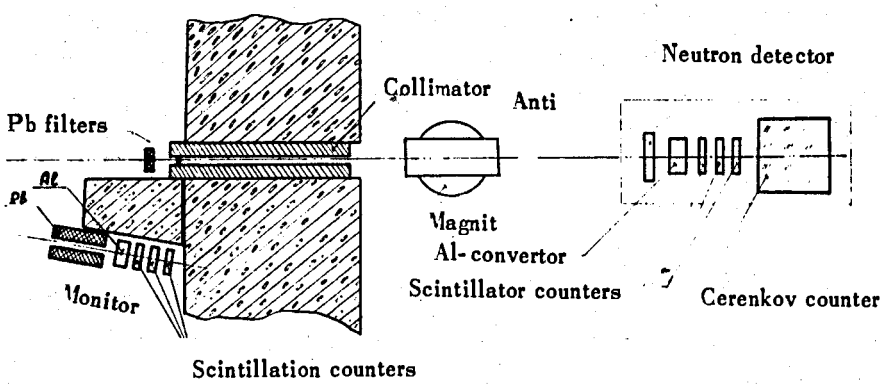

Fig. 1. A schematic drawing of a neutron detector and the geometry of the experiment.

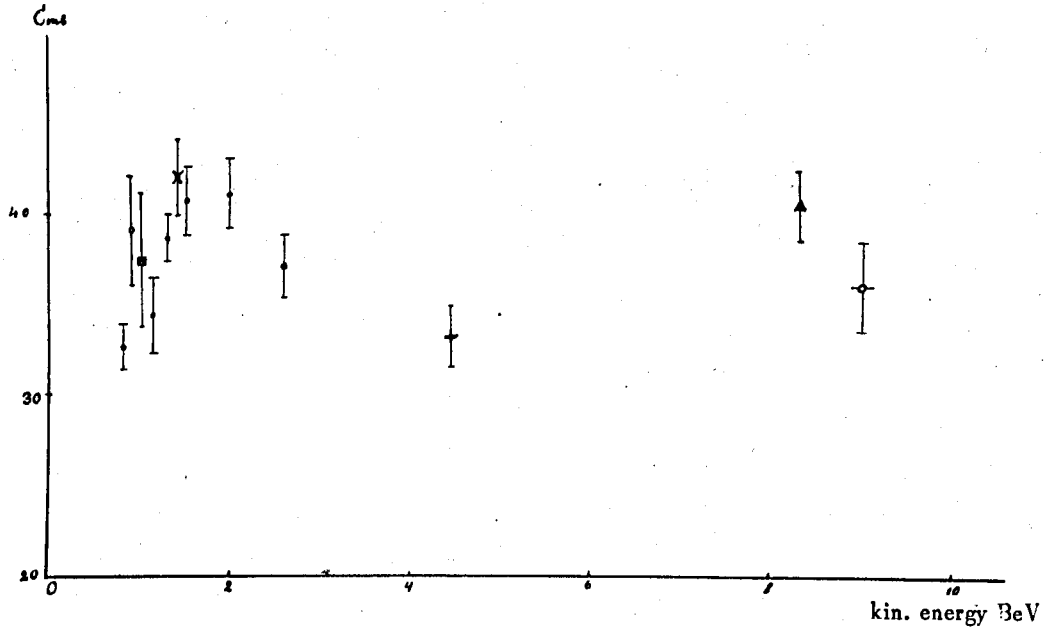

Fig. 2. The total cross section for neutron interaction with protons
[1], [2], [3], [4], [5], [6] * [present work]

* The correction for neutron screening by a proton in a deuteron was, very likely, not incorporated into the above-mentioned magnitude of the cross section.

References

1. Bull. Am. Phys. Soc. Ser. II, 8, 253 (1959).
2. T.Coor, D.A.Hill, W.F.Hornyak, L.W.Smith, G.Snow. Phys.Rev. 98, 1369 (1955).
3. F.F.Chen, C.P.Leavitt, A.M.Shapiro. Phys.Rev. 103, 1489 (1956).
4. M.E.Low, G.W.Hutchinson, D.H.White. Nucl. Phys. 9, 600 (1958/1959)
5. A.P.Batson, B.B.Gulwick, J.A.Riddiford. Proc.Roy.Soc. 251, 233 (1959).
6. V.Perez-Mendez, J.H.Atkinson, W.N.Hess, R.W.Wallace. Bull.Amer. Phys.Soc. 4, 253 (1959).
7. A.Ashmore, G.Cocconi, A.N.Diddens, A.M.Wethirell. Phys.Rev.Lett. 5, 576 (1960).

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