STUDY OF REACTION $pp \to pp\pi^0$ IN ENERGY REGION 600 — 900 MeV

V. P. Andreev, A. V. Kravtsov, M. M. Makarov, V. I. Medvedev,
V. I. Poromov, V. V. Sarantsev, G. L. Sokolov,
A. B. Sokornov, S. G. Sherman

A detailed study of the $pp \to pp\pi^0$ reaction has been performed for incident proton energies 600, 650, 700, 740, 780, 820 and 860 MeV. The energyy spectra and angular distributions are analyzed and compared with one pion exchange model calculations.

The experiment was performed at the LNPI synchrocyclotron using a 35-cm hydrogen bubble chamber placed in a 14.8 kGs magnetic field. The absolute cross sections were measured with an accuracy of 3 — 4% — today this is the most accurate measurement in the energy region under consideration [1]. The experimental data now available on the reaction $pp \to pp\pi^0$ are shown in fig. 1

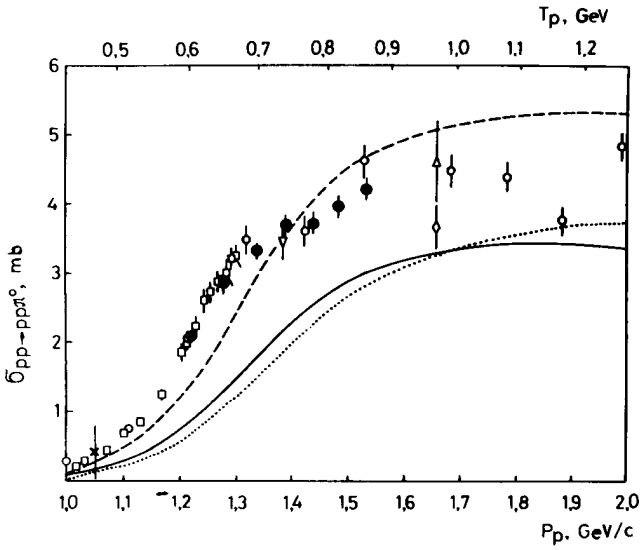

Fig. 1. Cross section of $pp \to pp\,\pi^0$ reaction. Solid line — OPE calculations with P_{33} wave only [3]. Dashed line — calculations with formfactor, which fits total cross section of $pp \to pp\,\pi^0$ reaction. Dotted line — Deck model calculations [4]. Dark points — present work

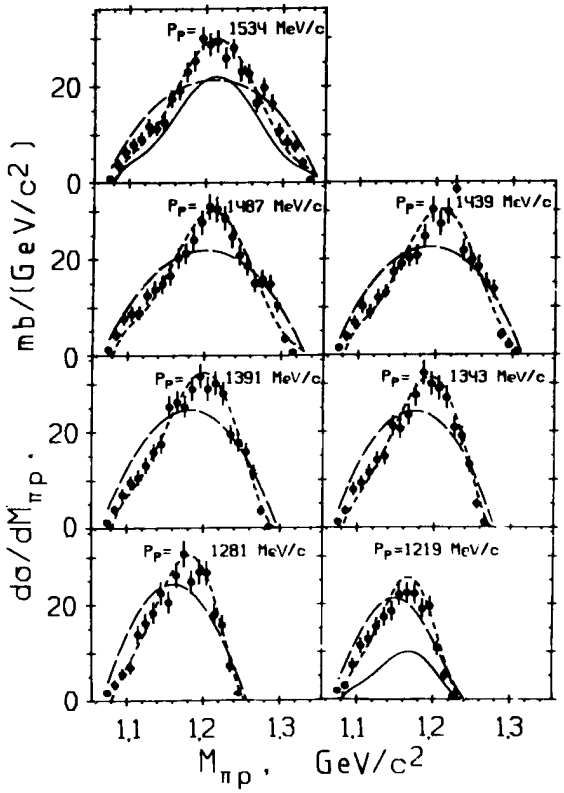

Fig. 2. Effective mass spectra of π^0p-system

together with the predictions of the OPE model, which describes the $NN \to NN\pi$ process with the help of the sum of the pole diagrams [2, 3]. The difference between the data and the predictions is evident. On the other hand, the same calculations for the total cross section of the $pp \to pn\pi^+$ reaction are in rather good agreement with the experiment [3]. If the formfactor of the model is changed in order to fit the experimental data on the $pp \to pp\pi^0$ process (dashed line), the model predictions for the $pp \to pn\pi^+$ reaction will increase sharply, contradicting the experimental data. Thus we cannot describe the behaviour of both cross sections in such a simple way. The dotted line in fig. 1 shows the results of the Deck model calculations [4], when all the partial waves from the phase shift analysis are taken into account in the πN — scattering vertex. It is evident that the addition of other waves does not change the situation significantly.

Fig. 2 shows the effective mass distributions. At large energies the peak position corresponds to the $\Delta(3,3)$ isobar mass, at lower energies the peak shifts to the left asymmetrically. Such behaviour is quite understandable within OPE if one takes into account that the main contribution to the N scattering vertex in pole diagrams comes from the P_{33} wave. OPE calculations are in good qualitative agreement with the experimental spectra.

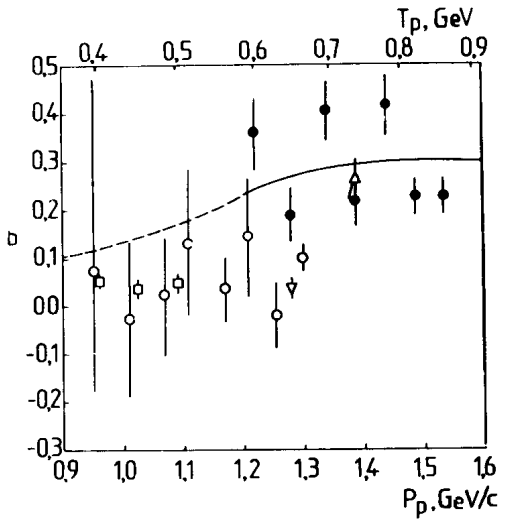

Fig. 3. Parameter 'b' from pion angular distributions fit in c. m. s. ○ — present work. Curve presents OPE calculations

It is important to determine the contribution of the isoscalar channel (I = 0) to inelastic NN-interactions. If this contribution is negligible, angular distributions of π^+-mesons from the $np \to nn\pi^+$ ($pp\pi^-$) reaction should be identical to that of π^0-mesons. It is clear that before making conclusions one should know the contribution of the isovector channel, that is, which terms of the expansion contribute to the angular distribution of the neutral pions. The results of the expansion of c. m. s. angular distributions of pions in Cos Θ_{π^0} are shown in fig. 3 together with the data of other experiments. Though the errors are rather large, it is evident that the pion distributions are quite non-isotropic — the coefficient at $\mathrm{Cos}^2\Theta_{\pi^0}$ being $b = 0.2 - 0.3$ even at low energies.

REFERENCES

1. *Andreev V. P. et al.* Z. Phys. 1988. A329. 371.
   Andreev V. P. et al. Preprint LNPI — 1453. Leningrad. 1988.
2. *Ferrary E., Selleri F.* Nuovo Cim. 1963. 27. 1450;
   Nuovo Cim. 1961. 21. 1028.
3. *Suslenko V. K., Gaisak I. I.* Yad. Fiz. 1986. 43. 392.
4. *Konig A., Kroll P.* Nucl. Phys. 1981. A356. 345.;
   Jauch W. et al. Phys. Lett. 1984, B143. 509