VECTOR ANALYZING POWER iT_{11} IN $\pi^+ d \to pp$ REACTION IN ENERGY REGION 350-450 MeV

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The reaction $\pi^+ d \to pp(1)$ and its inverse $pp \to d\pi^+(2)$ are main channels of the pion absorption and production processes at intermediate energies. Detailed knowledge of these processes has a fundamental importance for understanding nuclear interaction at medium energies. In is well known that we need to measure eleven independent parameters of the reaction mentioned above to reconstruct the amplitude of this process. Among these parameters there are the differential cross-section ($d\sigma/d\omega(\Theta)$), the asymmetry of secondary particles (A_{ik}), the deuteron polarization in the reaction (2) or vector and tensor components of the analyzing power (iT_{11} and τ_{ik}) in (1). The differential cross-sections of the reactions $\pi^+ d \to pp$ and $pp \to d\pi^+$ were carefully measured up to the energy higher than $\sqrt{S} = 3\,GeV$ ($T_p = 3.0\,GeV$, $T_\pi = 1.33GeV$) [1,2]. The measurements of the protons asymmetry in the reaction (2) are restricted by the proton energies $T_p = 2.3\,GeV$ [3] and the analyzing power in (1) is known up to the energy $\sqrt{S} = 2.3\,GeV$ ($T_\pi = 325\,MeV$) [4]. This energy limitation is mainly connected with the lack of intensity pion beams with higher energies and difficulties of definition of the deuteron polarization

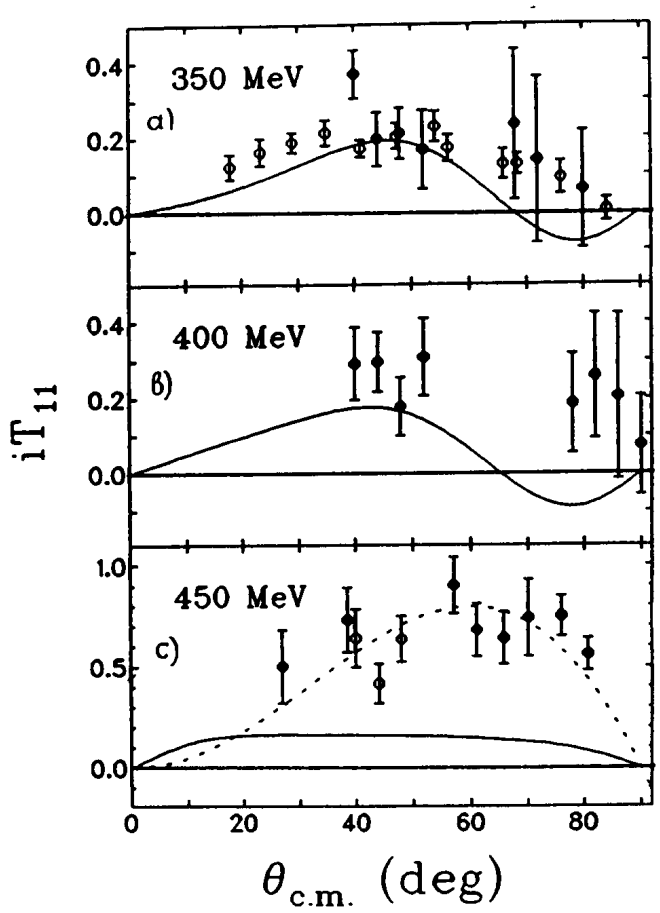

Fig.1. Angular distribution of vector analyzing power iT_{11} for $\pi^+d - pp$ reaction at T_π = 350, 400 and 450 *MeV*. In fig 1*a* our results for T_π = 350 *MeV* (full circles) are shown together with results from Ref.4 at 325 *MeV* (open circles). For T_π = 450 *MeV* (fig.1c) open and full circles denote results from two different runs. Solid curve is a prediction from partial wave analysis of Ref.7. Dashed curve is to guide the eye.

state in (2). On the other hand a measurement of deuteron analyzing powers in $\pi^+d \to pp$ reaction may be a special value due to the fact that they are sensitive to the interference of the small amplitudes with the larger ones which dominate coherent observable like the differential cross-section. The analysis of all the data on processes (1) and (2) which were collected up to 1984 [5] was carried out by A.Kravtsov et al. [6]. Simultaneously some predictions on the behaviour of the observables in $\pi^+d \to pp$ and $pp \to \pi^+d$ reactions were obtained at energies up to $\sqrt{S}$ = 2.42 *GeV* (T_π = 474 *MeV*) [7]. The latter results on the asymmetry of $pp \to \pi^+d$ reaction [3] demonstrate some structures at $\sqrt{S}$= 2.4; 2.7 *GeV* in a contradiction with expected in Ref.7. The possible explanation of this structure was discussed in Ref.3,8,9.

The measurement of vector analyzing power iT_{11} in the $\pi^+d \to pp$ reaction in the pion energy region 350—450 *MeV* (2.3< $\sqrt{S}$ < 2.4 *GeV*) was carried out on the LNPI synchrocyclotron pion beam using the deuteron polarized target and the scintillation counter hodoscopes. The measurement of the relative intensity of the protons from $\pi^+d \to pp$ reaction on unpolarized (σ^0) and polarized targets with different direction of the polarizations (σ^+,σ^-) allows us to obtain the data on iT_{11}.

Relative intensities of protons from the $\pi^+d \to pp$ reaction were measured using the scintillation counter hodoscopes. The energy loss and time-of-flight information was used to separate protons from quasi-elastic scattered pions. The special measurements with dummy and emply targets were carried out to get independent data on the background. All the data were normalized using the information from the two monitors up and downstream the target. The target polarization P_Z was measured using the NMR method.

The results obtained at 350, 400 and 450 *MeV* are presented in fig.1. Fig.2 presents the energy dependence of iT_{11} value near the maxima of angular dictributions at $\Theta = 50^0$ c.m. The earlier results at pion energy of 325 *MeV* [4] along with our new data at 350 MeV are presented in fig.1a. The good agreement of these two sets of data allows us to expect that the level of the systematic errors is low enough. The same

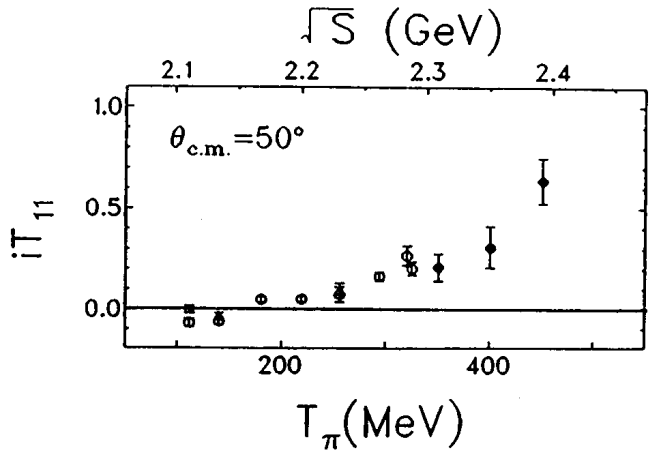

Fig.2. The energy dependence of vector analyzing power $i\,T_{11}$ for $\pi^+ d - pp$ reaction at $\Theta_{cm} = 50^0$. Open circles denote results from measurements at PSI[4], full circles are results of this measurement

statement can be made from the fact that iT_{11} value at the angle near $\Theta = 90^0$ is close to zero according to the symmetry of final state of the reaction. The data obtained at 450 *MeV* ($\sqrt{S} = 2.4$ *GeV*) show the rise of the iT_{11} value up to the level close to its theoretical limit ($\sqrt{3}/2$). It probably supports the existence of the irregularity which was demonstrated at this energy in Ref.3. The measurements at this energy were repeated twice and good agreement between the two sets of data was obtained. The explanation of such iT_{11} behaviour is still not clear. One of the possibilities is to take into account a D_{13} state in a πN-amplitude which has a resonance pole at 1440-60i *MeV* or $^1G_4$ resonance in NN-scattering [9]. They are both situated at the energy $\sqrt{S}$=2.4 *GeV*. We have also to mention that we had found a serious disagreement between the data and amplitude analysis predictions /7/ at the energies 400 and 450 *MeV* which points at the necessity to provide a new version of this analysis including all the to-day data.

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