TWO-PION PRODUCTION AT MOMO*

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The reaction $pd \to {}^3\mathrm{He}\,\pi^+\pi^-$ was measured at 1150 MeV/c proton beam momentum using MOMO instalation at COSY.

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The MOMO experiment focusses on near threshold meson production via the reactions $pd \to {}^3\mathrm{He}\,\pi^+\pi^-$ and $pd \to {}^3\mathrm{He}\,K^+K^-$. It takes advantage of the high quality of the cooled external COSY beam and the existing spectrometer BIG KARL. The setup consists of a high granularity scintillating fibers meson detector near the target with a $\pm$ 45 deg. opening angle, and the spectrometer, which is used for ^{3}He-identification. The large solid angle and high resolution of this detection method will yield precision data on the low energy (T<50MeV) meson-meson interaction and probe into questions like meson-nucleon resonances and KK-molecule.

The MOMO vertex dector consists of 672 scintillating fibers (round, 2.5mm diameter) arranged in three planes tilted 60 deg. versus each other. Each plane is subdivided into two identical modules. The fibers are read

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out by 16-fold photomultipliers followed by individually adjustable level adapters for each channel, which match the signals for the utilized PCOS III data aquisition system. All six modules are installed on location and the detector is fully operational. The efficiency was measured to be better than 99% for minimal ionising particles.

The MOMO scattering chamber houses the 4mm LD_2 target as well as a remotely steerable ladder for beam viewers and solid targets. The 5 mm thin Al front end of the chamber faces the vertex detector on the outside and keeps straggeling of the mesons at a small level.

The BIG KARL spectrometer is also fully operational. The focal plane detectors work reliable and their performance matches the design values.

The spectrometer was calibrated via the two-body reaction $p + d \rightarrow t + \pi^+$. In addition, this reaction was used to check the acceptance of the spectrometer. Fig. 1 depicts focal plane spectra of the $p + d \rightarrow t + \pi^+$ reaction at three different magnetic field settings. The curved shape of the tritium lines results from simple two body kinematics and reflects the utilized optics of BIG KARL, which images the vertical angle to a vertical focal plane position. The dependence of the acceptance on the focal plane position is evident. However, all three settings yielded within statistical errors the same absolute differential cross section of $19 \pm 1\mu$ barn/sr. This adds confidence to the acceptance calculations utilized in our data analysis.

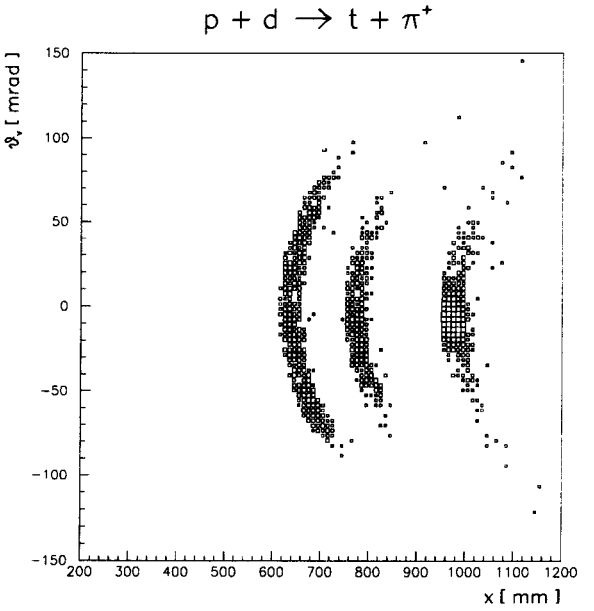

Fig. 1. Focal plane tritium spectra of the reaction $pd \rightarrow t\pi^+$.

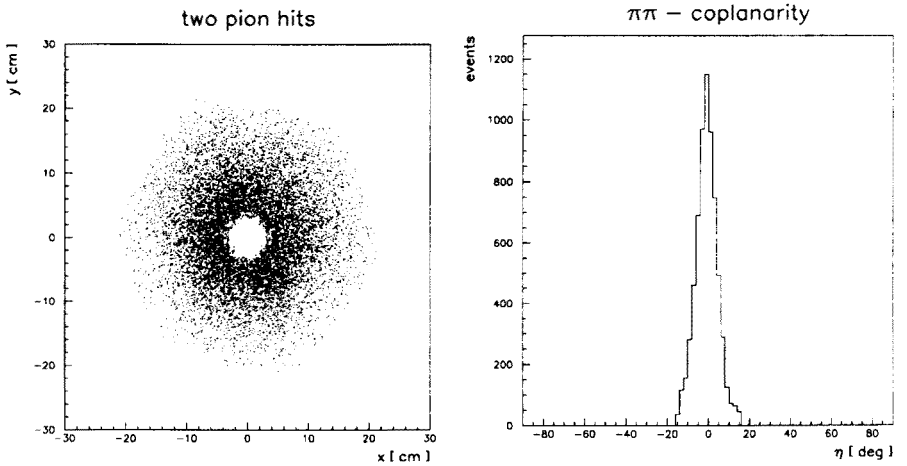

Fig. 2. a) Two-pion hits on the vertex wall, b) Coplanarity of the $\pi^+\pi^-$-events.

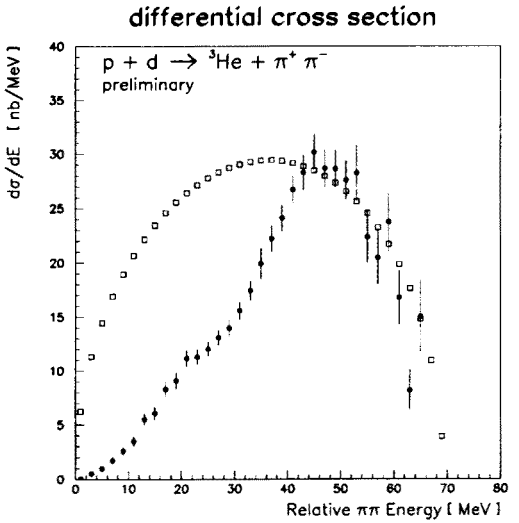

Fig. 3. Relative energy spectrum of two-pion events from the reaction $pd \rightarrow {}^3\mathrm{He}\,\pi^+\pi^-$.

In recent COSY beam times the reaction $pd \rightarrow {}^3\mathrm{He}\,\pi^+\pi^-$ was measured 1150 MeV/c proton beam momentum. Beam intensities ranged up to some 10^9 protons per beam burst. The reaction was measured at several different but overlapping BIG KARL settings. The ^{3}He particles could be unambigiously identified by time of flight and energy loss measurements.

Fig. 2a depicts the observed two-pion hits on the scintillating fibers vertex detector, Fig. 2b demonstrates the coplanarity of the observed ^{3}He — coincident double hits in the vertex wall. Good events must be coplanar in respect to the total meson momentum axis, which is defined by the beam and the ^{3}He momenta. In total some 10000 $\pi^+\pi^-$-events were observed.

Fig. 3 shows results of a preliminary analysis of the data. It depicts the measured differential cross section in dependence of the relative kinetic energy of the two pion events. Statistical error bars are shown. A strong deviation from phase space (open squares) at low relative energies is evident. Explanations for this unexpected effect are presently highly speculative, however, acceptance or detector problems can be excluded at a high confidence level. Upcoming measurements at different beam energies will be necessary to understand the origin of this effect, *e.g.*whether its related to the production mechanism or a two pion interaction.