# BEAM-TIME REQUEST
# for COSY Proposal #75

## 'Study of $\omega$ and $\phi$-meson production in the reactions $pd \to dVp_{sp}$ at ANKE'

# 1 Abstract

A beam time of one week is requested to study the reaction $pn \to d\omega$ by investigating the reaction $pd \to d\omega p_{Spec}$ according to the proposal #75 [1]. During the first beam-time all detectors have been comissioned and their performance has been evaluated. Unfortunately, due to the break-down of a turbo-pump of the cluster target, we could not collect a sufficient amount of data for the $\omega$-production. Especially we were not able to take data below the $\omega$-threshold for comparison. Nevertheless from the first data it can already be stated that, that the total cross-section is about 5 times smaller than estimated in the original proposal and in the order of $10\,\mu$b or less.

# 2 The Detection Systems

For the reaction $pd \to d\omega p_{Spec}$ the deuterons are detected in the ANKE forward detection system whereas the spectator detector in the target region is used to detect the spectator protons (Figure 1).

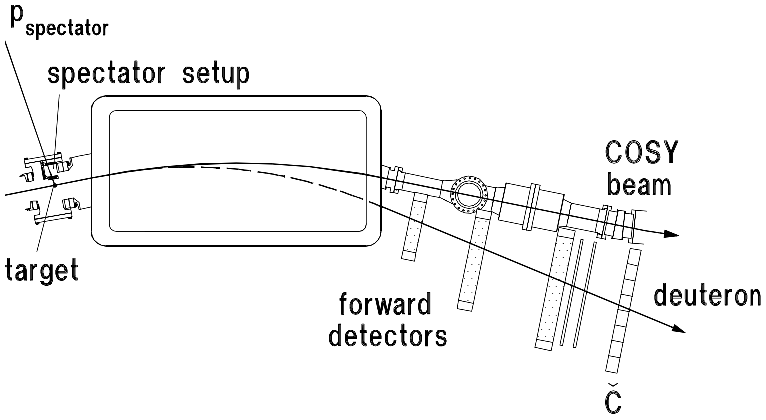


Figure 1: A sketch of the detector setup at ANKE.

In forward direction 3 multiwire proportional chambers will define the track and together with the magnetic field the momentum of the deuterons, whereas the scintillator hodoscope and the Cerenkov counters are used for the deuteron identification.

## 2.1 The Forward Detector

By the use of the scintillator hodoscope and the Cerenkov counters of the ANKE forward-detection system we can identify the deuterons. MWPCs will provide the deuteron track information. Two of finally three chambers have been used in the first beam-time.

## 2.2 The Spectator Detector

The spectator detector consists of 3 planes of silicon detectors (Figure 2), a 60 $\mu$m surface barrier detector, a $32 * 1$ mm Si-strip detector with a thickness of 300 $\mu$m and a 5 mm thick $200 * 0.2$ mm lithium-drifted silicon-strip detector. The complete setup has been installed inside the COSY vacuum close to the target. It covers a proton-energy range from 3 to 30 MeV.

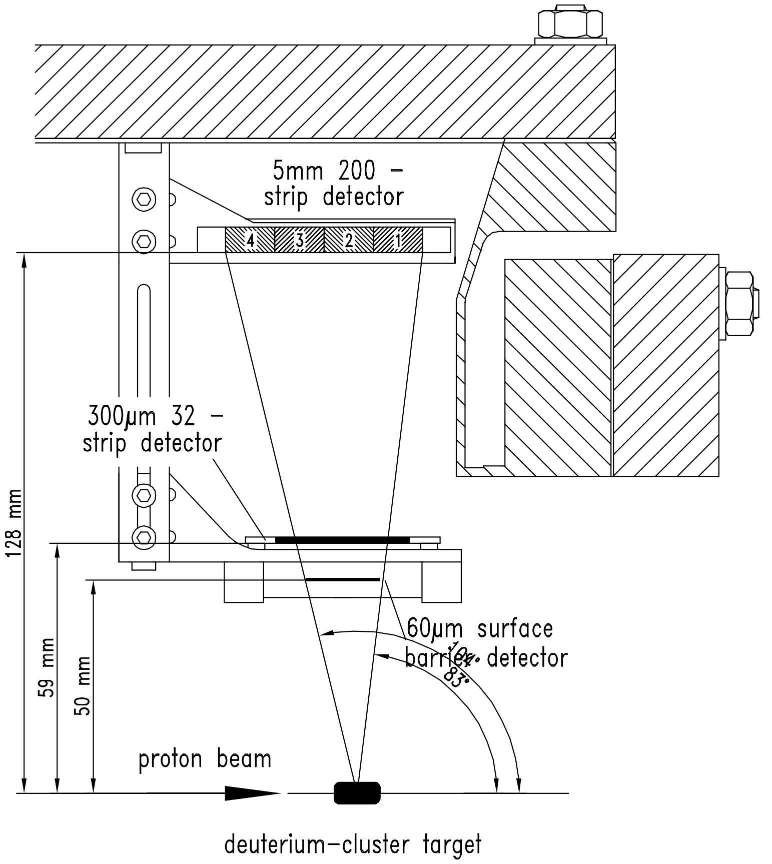


Figure 2: The spectator detection system with 3 layers of silicon detectors.

# 3 Preliminary results of the first beam-time

## 3.1 Proton Spectators

The reaction $pd \rightarrow d\omega p_{Spec}$ has been studied at a COSY beam momentum of $p = 2.772\,\mathrm{GeV/c}$. In the first analysis which is presented here, spectator protons have been identified and selected in an energy range from $T_{Spec} = 3.0 - 5.5\,\mathrm{MeV}$ and under backward angles from 94°-106°.

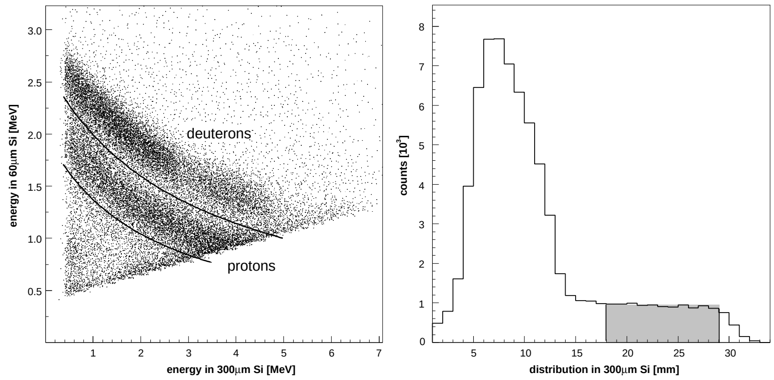


Figure 3: Particle identification with the $60\,\mu$m thick and $300\,\mu$m thick silicon detectors. Protons in the backward direction (strip 18-28) have been selected, corresponding to angles from 94° to 106°.

The proton-deuteron separation below 6 MeV with the use of a new $60\,\mu$m thick detector has been achieved during this beam-time. We could improve the set-up by using special pre-amplifiers and can now identify protons down to $T_{Spec} = 2.5\,\mathrm{MeV}$.
The momentum spectrum of the forward going particles in coincidence with these spectators is shown in figure 4. The missing mass spectrum, assuming the forward going particle was a proton, clearly shows a peak arround the neutron mass coming from $pn \rightarrow pn$ quasi-elastic.

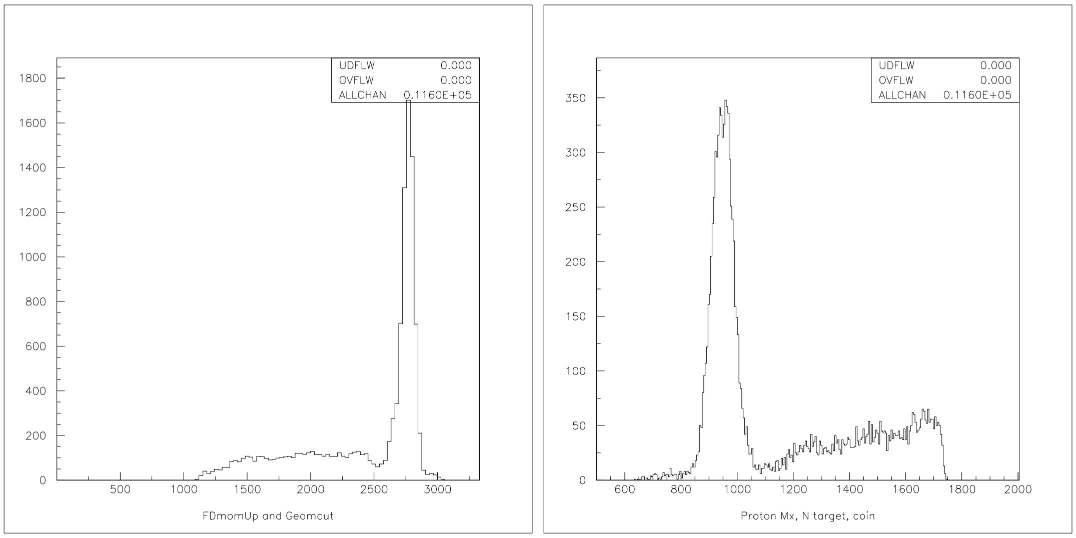


Figure 4: Momentum and missing-mass (proton) spectrum of the forward going particles.

## 3.2 Proton Suppression by Cherenkov Detectors

The major task of the current data analysis is to detect the deuterons from the reaction $pn \to d\omega$ in a huge background of protons from $pd \to pX$. For this purpose Cherenkov detectors are used. Only fast protons should give a signal in these detectors. Figure 5 shows the detection efficiency for protons depending on their momentum.

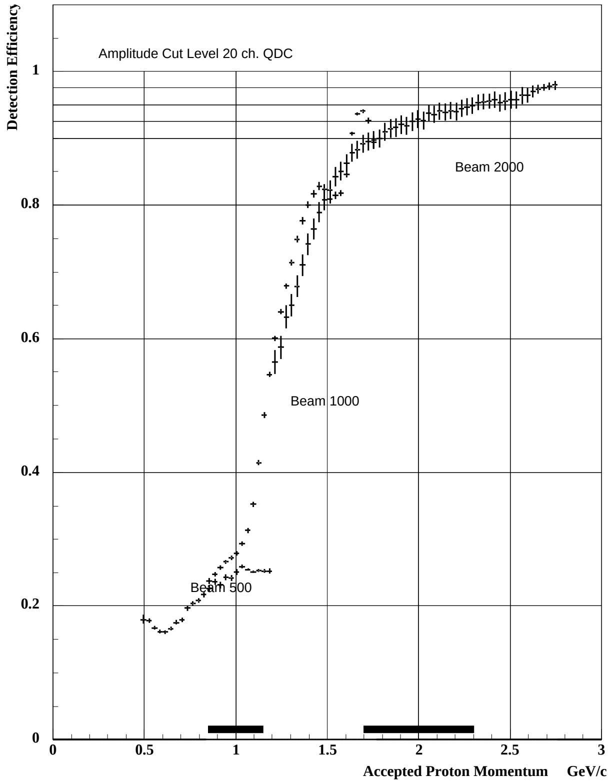


Figure 5: Cherenkov efficiency for protons. For momenta above 1.7 GeV it is larger than 90%.

Figure 6 now shows the missing-mass distribution under the assumption that the forward going particle was a deuteron, before and after applying the Cherenkov cuts.

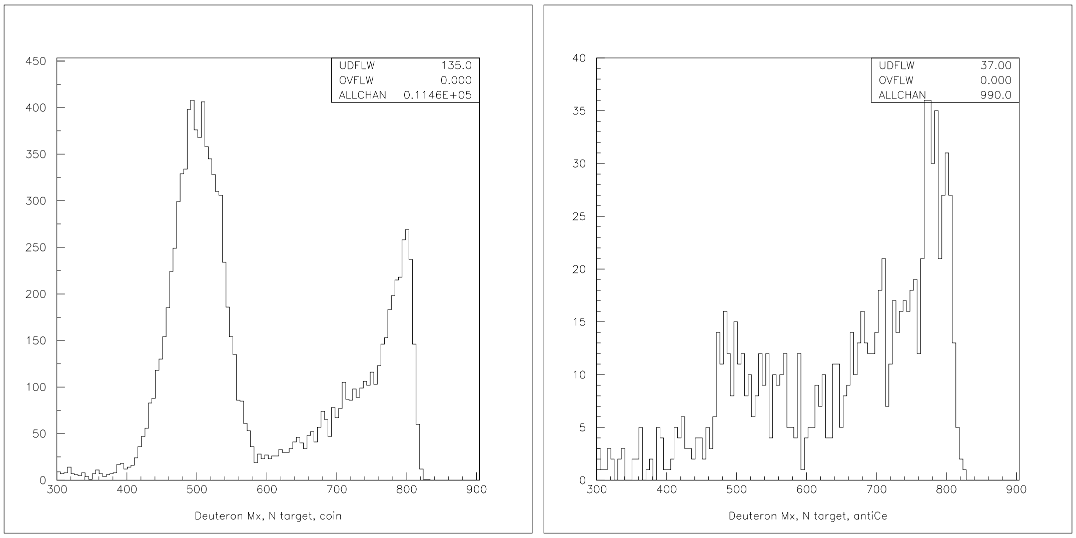


Figure 6: Missing mass distribution (deuteron) without and with Cherenkov-supression.

Furthermore restricting the momentum range for the $\omega$-production to $1.7 - 2.3\,\mathrm{GeV/c}$ and selecting an horizontal angular range from $1^\circ \leq \theta \leq 6^\circ$, the missing mass distribution for the remaining events is shown in figure 7. For the $\omega$, a missing mass resolution of about 20 MeV is expected. With the poor statistics in these plots, no conclusion can be made.

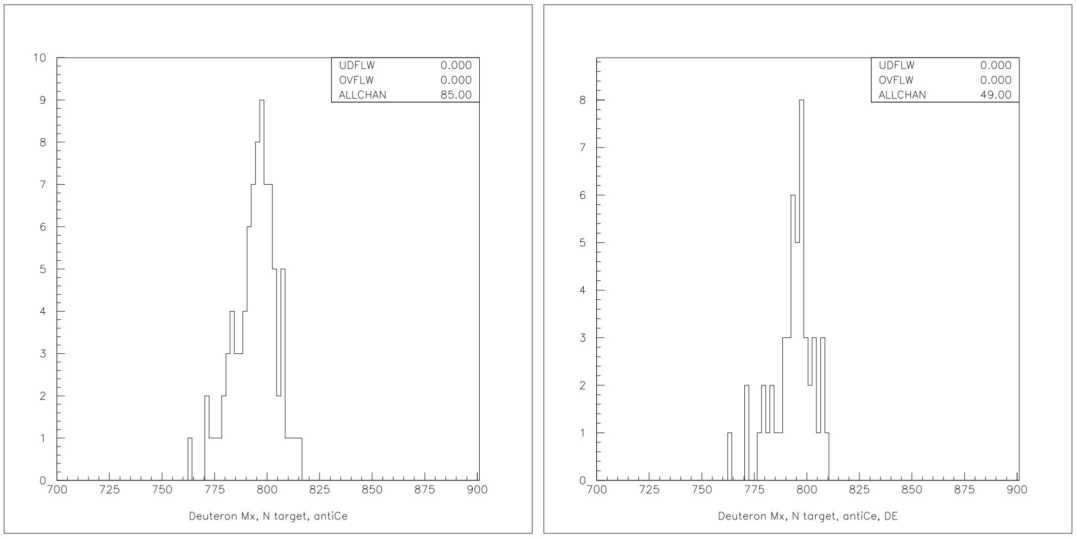


Figure 7: Missing mass spectrum (deuteron) without and with additional $\Delta E$ cuts on the amplitude in the forward sctintillators.

# 4 Requested time for measurements

Even from the small statistics presented in figure 7, it can be concluded that the total cross-section for the reaction $pd \to d\omega p_{sp}$ at $2.7\,\mathrm{GeV/c}$ is not larger than $10\,\mu\mathrm{b}$. The results of 15h of data taking are presented in figure 7. The request is, to improve statistics by a factor of 10 and to compare the results with sub-threshold data, which could not be taken during the last beam-time. Therefor we ask for one additional week of beam-time.

# References

[1] The ANKE WEB page, http://ikpd15.ikp.kfa-juelich.de:8085/doc/Proposals.html