$\omega \rightarrow \pi^+\pi^-\pi^0$ decays in p-p collisions

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Introduction

The WASA-at-COSY collaboration has recently performed experiments dedicated to studies of ω meson decays. One of the decay channels that will be under detailed investigations is the most probable decay of the ω meson into $\pi^+\pi^-\pi^0$ with 89% branching ratio.

The decay mechanism was considered within the Vector Meson Dominance model as proceeding via the $\rho\pi$ intermediate state [1]. More recent predictions are based on a counting scheme for flavor-SU(3) systems of Goldstone bosons and light vector mesons [2]. The importance of the $\pi\pi$ final state interaction is also considered [3]. However, the expected deviations from Vector Meson Dominance model are small.

The goal of this experiment is the investigation of the ω decay mechanism to three pions. This information may be gained from a comparison of the density distribution in the Dalitz plot with theoretical predictions. To reach this goal a high statistics experimental Dalitz plot distribution is necessary. Measurements of the Dalitz plot for the $\omega \rightarrow \pi^+\pi^-\pi^0$ decay have been done before in experiments on the determination of the spin and parity of the ω meson [4]. However, the statistics of existing measurements is limited to about 4600 $\omega \rightarrow 3\pi$ events. The WASA-at-COSY experiment has produced a higher amount of fully reconstructed $\omega \rightarrow 3\pi$ events using proton-proton and proton-deuteron collisions.

WASA-at-COSY

The experiments have been performed with the WASA detector setup at COSY [5]. COSY (COoler SYnchrotron) is a synchrotron and storage ring which can provide a beam of (un)polarized protons or deuterons with a momentum range between 600-3700 MeV/c.

WASA (Wide Angle Shower Apparatus) is a nearly 4π detector optimised for studying the production and decay of light mesons. A unique pellet generator provides frozen pellets of hydrogen and deuterium as a fixed target. The central part of WASA can detect both charged and neutral particles while the forward detector is designed to detect scattered projectiles and charged recoil particles like protons, deuterons and He nuclei.

The current analysis

WASA-at-COSY collected data of ω production with a proton beam on a proton target (p-p) collisions ($p + p \rightarrow p + p + \omega$) at T_p=2.063 GeV. The excess energy for this reaction is 60 MeV. For the $\omega \rightarrow \pi^+\pi^-\pi^0$ reaction channel analysis, the final state particles to be detected are protons, $\pi^\pm$ and γ(from π^0 decay).

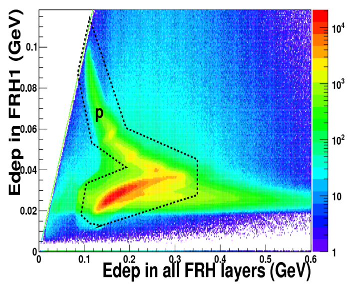

FIG. 1: Proton identification using the ΔE/E method

The forward going protons are identified in the forward part of WASA using the ΔE/E technique, as shown in FIG 1. Here the energy deposited of particle in five successive thic lay-

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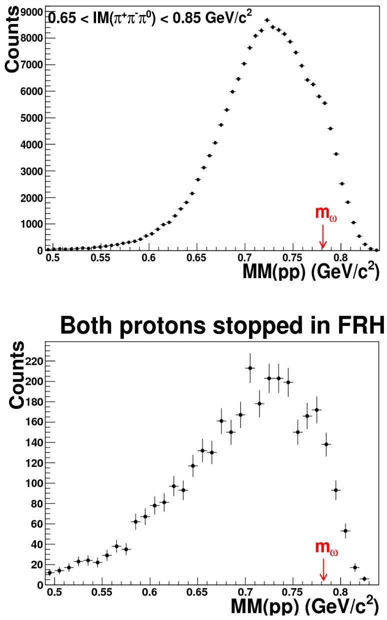

FIG. 2: The missing mass of two protons

ers of plastic scintillator (range hodoscope) has been used as E. From FIG 1 it is clear that most of a protons are punching through range hodoscope.

The decay products of the ω are detected in the central part of WASA. For charged pions, the charge and momentum are reconstructed using information from the central mini drift chamber placed in the solenoid magnetic field. The π^0 is reconstructed using the energy deposit and angle in the central calorimeter of the two photons.

In order to see a signal in the data, the missing mass technique MM(X) is used, in which the invariant mass of (initial reactant - X) is plotted. FIG 2 top, MM(pp) (here X=pp) shows a small shoulder structure around the ω mass which indicates a small ω signal buried under direct multipion background. When events with both protons stopped in the forward detector are selected, omega can be identified more clearly as shown in bottom part of FIG 2. This indicates that with further improvement of the detector resolution in the anaysis a clear signal of the ω can be obtained.

Further analysis is being carried out to investigate ways to substract the multipion background in order to improve the signal to background ratio and to apply kinematical fitting to optimise overall detector resolution.

Acknowledgments

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References

[1] M. Gell-Mann, D. Sharp, W. G. Wagner, Phys. Rev. Lett. 8 (1962) 261.

[2] S. Leupold, M.F.M. Lutz, *Eur. Phys. J. A*, **39**, 205, (2009).

[3] F. Niecknig, B. Kubis, S. P. Schneider, *Eur.Phys.J.*, **C72**, 2014, (2012).

[4] M. L. Stevenson et al., *Phys. Rev.*, **125**, 687, (1962)

[5] H. H. Adam et al., arXiv:nucl-ex/0411038