Towards the $\omega\pi$ Transition Form Factor

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Introduction

One of the major physics motivation of the WASA-at-COSY experiment is to determine transition form factors of light mesons. The $\omega\pi$ transition form factor is observed through the conversion decay $\omega \rightarrow \pi^0\gamma^\star \rightarrow \pi^0 e^+e^-$. The squared four-momentum transferred by virtual photon $\gamma^\star$ corresponds to the squared invariant mass distribution of lepton and antilepton pairs. The comparision of the lepton-antilepton mass distribution with the QED perdiction, based on the assumption that mesons are point-like particles, gives information about the structure arising at the transition . While these form factors [1] are important properties of hadrons, the information on transition form factors is also required for the interpretation of the g-2 and $\pi^0 \rightarrow e^+e^-$ experiments. One of the prominent decay channels, $\omega \rightarrow \pi^0\gamma$, is the reference channel in the extraction of the form factor as it is the real photon case. In this paper, we will report about the ongoing analysis towards the $\omega\pi$ transition form factor where the first step is the observation of the $\omega \rightarrow \pi^0\gamma$ decay.

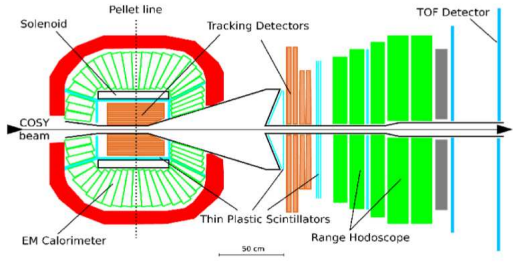

FIG. 1: Experimental setup

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WASA-at-COSY Experiment

It is possible to study the decay of different light mesons from both the reactions proton-proton and proton-deuteron with WASA-at-COSY experimental setup [2]. High luminosities are required to study rare decays of mesons and have been achieved due to the high intensity proton beam from the COoler SYnchrotron (COSY) at Forschungszentrum Juelich and the high density pellet target of the WASA experiment. The WASA detector covers a large solid angle acceptance which is an important criterion for the study of rare decays of light mesons. Recoil particles are detected with the forward detector which covers 3-18 degrees in the polar angle, as shown in Fig.1. Neutral and charged decay products of the mesons are identified with the central part of the detector which covers 20-169 degree. The central part of the detector consists of an electromagnetic calorimeter, a plastic scintillator barrel and a mini drift chamber. The forward part consists of layers of segmented hodoscopes and tracking detectors.

Analysis

In a one-week pilot experiment ω mesons were produced in the $pp \rightarrow pp\omega$ reaction at a beam energy of Tp=2.063 GeV. First, the identification of recoil protons has been done using the $\triangle$E-E method, as shown in Fig2. It shows the sum of the deposited energies in the forward part versus the deposited energy in the first layer. The tracks falling in the region marked by the red line in the figure are recoil protons from the proton-proton reaction. The meson is being tagged by the missing mass technique with the help of the beam parameters and recoil particle reconstruction. Different charged decay particles $(\pi^\pm, e^\pm)$ of the meson are detected through the energy information from the electromagnetic calorimeter and momentum information from the plastic

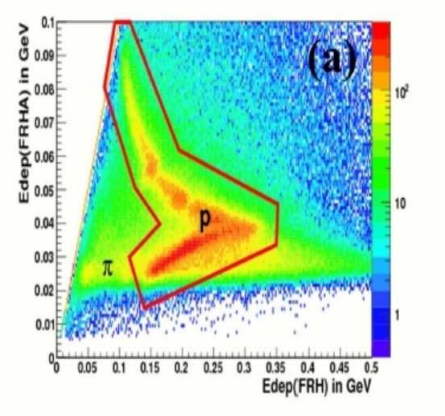

FIG. 2: Identification of recoil particles

scintillator barrel and the mini drift chamber of the central detector. All decay products of the meson are detected. Kinematic conditions can be implemented in the data analysis due to identification of all final state particles. Different background contributions are studied with the help of Monte Carlo simulations. Finally, kinematic fitting helps in the suppression of the background and will introduce an improved dilepton mass resolution. We will show the status of our analysis by demonstrating the analysis tools for the identification of the decay channel and the resulting missing mass spectrum for the $\omega \to \pi^0\gamma$ decay.

Outlook

The ongoing analysis of the ω meson decay from proton-proton reactions aims at the precise determination of the $\omega\pi$ transition form factor.

Acknowledgments

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References

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