Decay of Light Mesons with the WASA detector at COSY

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Introduction

The physics motivation of WASA is to determine the transition form factor, measurment of branching ratios and to determine Dalitz plot parameter and to test symmetries and symmetry breaking through the study of rare decay channels of light mesons. In this paper, we will discuss the decay channels of the pseudoschalar meson η and the vector meson ω to determine the transition form factor. The precise determination of the transition form factor of η and ω is possible through their dalitz decays $\eta \rightarrow \ e^+e^-\gamma$ and $\omega \rightarrow \pi^0 \ e^+e^-$. Here, the comparison of lepton-antilepton invariant mass distributions with the QED prediction, based on the assumption that the particle has a point-like structure, gives insight into the inner structure of the meson. The form factor information aids the interpretation of the g-2 and $\pi^0 \rightarrow \ e^+e^-$ experiments. The ω and η dalitz decay provides information about the form factor in the time like region. The most puzzling issue is that transition form factors of pseudoscalar mesons agree with the prediction of standard vector meson dominance whereas the transition form factor of the ω meson deviates significantly [1].

Experimental Setup and Analysis Techniques

WASA [2] [3] is a detector of almost 4π acceptance to identify all final state particles. The high intensity proton beam from the COoler SYnchrotron(COSY) combined with the high density pellet target provide the opportunity to study the same physics channels in two different reactions pp and pd with high luminosity which is essential to study a rare decay channel. The detector setup consists of two parts, the central detector and forward detector. Recoil particles, protons in pp reactions and 3He in pd reactions are tagged by the forward part of the detector. Decay particles of mesons (γ,e,π) are detected by the central part of the detector which consists of an electromagnetic calorimeter, a plastic scintillator barrel and a mini-drift chamber. The transition form factor and Dalitz plot of η and ω are analyzed independently from both production reactions (pp and pd). The pd production reaction has less pion background compared to the pp production reaction. On the other hand, the cross section of meson production from pp reactions is bigger than from pd reactions. Therefore, the pd production reaction has been used first to finalize the analysis conditions whereas the pp reaction is required for the higher statistics of data at the price of substantial multi-pion background. Due to the identification of all final state particles, the full kinematics is implemented to reduce the background. Kinematic fitting has been used to improve the mass resolution and increase the signal to noise ratio.

Status of Analysis

The transition form factor of the η meson in the time like region is being determined using the $\eta \rightarrow \gamma \ e^+e^-$ Dalitz decay in the pd reaction. The analysis from the production reaction pp is underway. In pd $\rightarrow 3He\eta$, $10^7\eta$ meson were taged at beam kinetic energy 1.0 GeV and in pp $\rightarrow$ppη, $5 \times 10^8\eta$ meson were produced at beam kinetic energy 1.4 GeV. The analysis of the $\omega\pi$ transition form factor is going on using the decay $\omega \rightarrow \pi^0 \ e^+e^-$ after taking data in pilot experiments with pp and pd. The analysis of the $\omega \rightarrow \pi^0\gamma$ decay has been started as a reference channel. After the analysis,$1.6 \times 10^4\omega$ decays through channel $\omega \rightarrow \pi^0\gamma$ in pd reaction(FIG.2) and 5600

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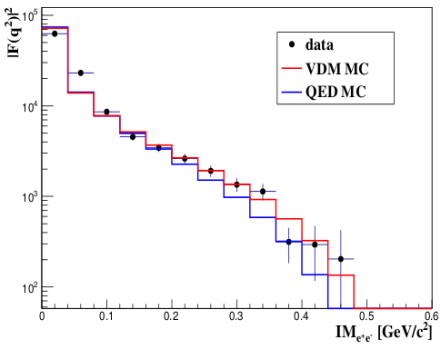

FIG. 1: Preliminary Invariant mass spectra of e^+e^- pair, error bars on data points are statistical errors only: Himani Bhatta(Indian Institute of Technology Bombay)

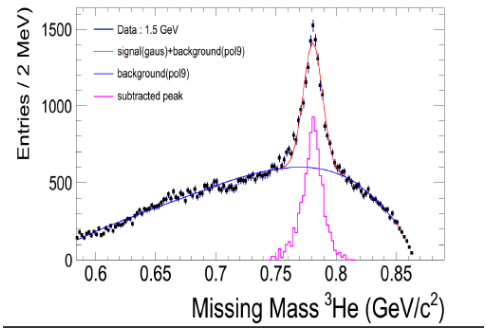

FIG. 2: Reconstructed ω in pd data after $\pi^0\gamma$ selection: Farha Khan(Juelich)

ω in pp reaction throught $\omega \to \pi^+\pi^-\pi^0$ channel have been obtained. Preliminary results will be presented in this report.

Outlook

The study of meson decays are important in many aspect for eg. form factor, box anomaly, the precise measurement of branching ratios and possibly new physics beyond stndard model. The ongoing analysis of the η and ω meson decays from pp and pd reactions aims at the understanding of these aspects.

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References

[1] NA60 experimant: PLB 677 (2009) 260, Nucl.Phys.A855 (2011)189

[2] *CELSIUS/WASA*, C.Bargholtz et al. Nucl. Instrum. Meth. A594, 339(2008), 0803.2657.

[3] Proposal for the wide angle shower apparatus (wasa) at COSY-Juelich H.H.Adam et al.(WASA-at-COSY Collaboration) arXiv:nucl-ex/0411038