Study of the $K^+ K^- \pi^+ \pi^-$ System Centrally Produced in the Reactions $\pi^+ p \to \pi^+ (K^+ K^- \pi^+ \pi^-) p$ and $p p \to p (K^+ K^- \pi^+ \pi^-) p$ at 85 GeV/c

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Abstract. The reactions $\pi^+ p \to \pi^+ (K^+ K^- \pi^+ \pi^-) p$ and $p p \to p (K^+ K^- \pi^+ \pi^-) p$ where the $(K^+ K^- \pi^+ \pi^-)$ system is centrally produced have been studied at 85 GeV/c. 48% of the final state proceeds through single or double vector meson resonant production i.e., $K^*0(890) (37\%)$, $\phi (4\%)$, $\rho^0 (7\%)$. Evidence is found for associated $K^*0(890) K^*0(890)$ production (6.4 ± 1.1%) with a cross section ten times higher than that found for associated $\phi \phi$ production in the same experiment.

Introduction

Experiment WA76 at CERN was designed to study centrally produced exclusive final states, and searches for signs of new mesonic states. As the centre of mass energy increases Double Pomeron Exchange (DPE) is one of the production mechanisms which is expected to become relatively more important and, if the Pomeron is composed of gluons, DPE can be expected to be a source of gluonium states [1]. Several experiments have been performed in order to explore this possibility [2]. In addition, the study of associated vector meson production has been proposed as a method of searching for $qq\bar{q}\bar{q}$ multiquark states [3].

Data from this experiment have already been presented showing evidence for exclusive production of vector – vector $\phi \phi$ in the $K^+ K^- K^+ K^-$ final state [4]. In this paper we present the results of the analysis of the $K^+ K^- \pi^+ \pi^-$ final state and show evidence for other associated vector-vector production.

2. Data Selection

The data come from the WA76 experiment performed at CERN using the $\Omega$ spectrometer (Fig. 1) in the H1 beam which contains approximately equal numbers of $\pi^+$ and protons at 85 GeV/c. Details of the trigger conditions and the data processing have been given in a previous publication [5].

The reactions

\[ \pi^+ p \to \pi^+_f (K^+ K^- \pi^+ \pi^-) p_s \]  

and

\[ pp \to p_f (K^+ K^- \pi^+ \pi^-) p_s \]  

where the subscripts $f$ and $s$ refer to the fastest and slowest positive particles in the laboratory system,
have been isolated from the sample of the events with six outgoing tracks in the final state. The slow proton, which triggered a 14 - slab scintillation counter, was identified by means of the pulse – height momentum correlation as shown in Fig. 2. The fast particle was assumed to be of the same nature as the incident beam. The two kaons were identified by using the information from the two Cherenkov counters C1 and C2, i.e. requiring one positive and one negative particle to be identified as a $K$ or $K/p$. The two remaining tracks were required, if reaching the Cherenkov system, to have a mass assignment compatible with the pion.

Momentum balancing events were selected by requiring $|\text{missing } P_x| < 3.00 \text{ GeV/c}$, $|\text{missing } P_y| < 0.10 \text{ GeV/c}$ and $|\text{missing } P_z| < 0.08 \text{ GeV/c}$.

The Cherenkov information antisects all the competitive channels except for the $p\bar{p}\pi^+\pi^-$ final...