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MEASUREMENT OF THE REACTION $dd \to \alpha K^+K^-$ WITH ANKE/COSY

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Abstract

High resolution studies of $a_0/f_0(980)$ decays into channels involving open strangeness are currently being performed at COSY-Jülich. Here we report about a measurement of the $dd \to \alpha K^+K^-$ reaction with the magnetic ANKE spectrometer. This reaction can be used as a "filter" for isospin-zero intermediate states, *i.e.* to selectively produce the $f_0(980)$ resonance.

1 Introduction

Quantum-chromodynamics (QCD) is the theory of strong interactions. The properties of QCD at low energies or small momentum transfers ("strong QCD") are yet poorly known and are among the few uncharted territories of the Standard Model.

A better understanding of strong QCD can be achieved from the investigation of its symmetries and their breaking as well as the spectroscopy of strongly bound quark states (hadrons).

Precise knowledge of the $a_0(980)$ and $f_0(980)$ coupling constants to kaons would allow one to determine the $K\overline{K}$ content of the a_0/f_0. However, the values for $g_{a_0K\overline{K}}$ and $g_{f_0K\overline{K}}$ are still poorly known. The isospin-violating (IV) a_0/f_0 mixing amplitude is in leading order proportional to the product of $g_{a_0K\overline{K}}$ and $g_{f_0K\overline{K}}$ [1,2]. Since the a_0 and the f_0 are rather narrow overlapping

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resonances, a_0-f_0 mixing should give the dominant contribution to the IV effect via the reaction chain $dd \to \alpha f_0(I{=}0) \to \alpha a_0^0(I{=}1) \to \alpha(\pi^0\eta)$ [2, 3]. Any observation of $\pi^0\eta$ production in the $dd \to \alpha X$ reaction would be a direct indication of IV.

An experiment on the IV reaction $dd \to \alpha(\pi^0\eta)$ is under preparation for WASA-at-COSY. As a first step, we aim at the determination of the isospin-conserving $dd \to \alpha f_0$ cross section via a measurement of the $dd \to \alpha f_0 \to \alpha K^+K^-$ process.

2 Event identification

In order to identify the rare $dd \to \alpha K^+K^-$ events, two charged particles, K^+ and α, have been detected in coincidence at ANKE during an experiment in April 2006.

Positively charged Kaons can be identified in the side detection system(SD) [4, 5] of ANKE by a time-of-flight (TOF) measurement (see Fig. 1), by energy-loss cuts, and by measuring the delayed decay $K^+ \to \mu^+X$. The latter criterion allows for a very clean K^+ identification, however at reduced detection efficiency. The $dd \to \alpha K^+K^-$ events presented here have been obtained with that criterion, for the final analysis we are aiming at a softer K^+ selection and, thus, increased statistics.

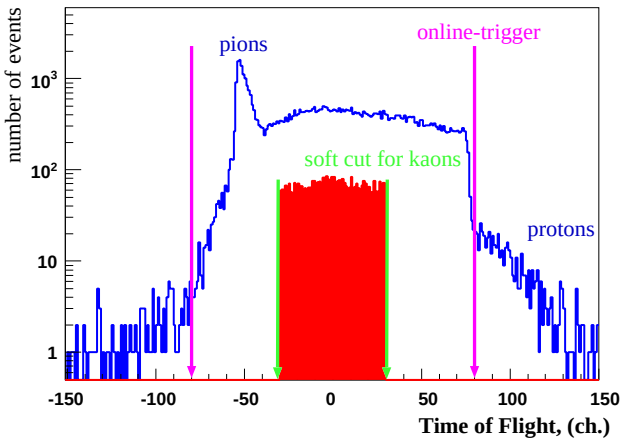

Figure 1: The TOF distribution of positively charged particles. The shaded area shows the TOF cut of kaons after background suppression via track selection and vertical angle cuts.

The TOF start counters, consisting of one layer of 23 scintillation counters, have been mounted next to the large exit window of the vacuum chamber

inside the D2 magnet of ANKE. Kaons from f_0 decay have been stopped in range telescopes that comprise the TOF stop counters. Two multi-wire proportional chambers (MWPCs) positioned between the TOF start and stop counters allow one to deduce the ejectile momenta and to suppress background from secondary scattering [6, 7].

Fast particles produced in coincidence with the K^+ candidates as well as elastically scattered deuterons have been detected in the ANKE forward-detection system (FD) [8] which contains two layers of scintillation counters for TOF and δE measurements. In addition there are three MWPCs, each with two sensitive planes, which have been exploited for momentum reconstruction and background suppression [4, 7]. Using a cut on time difference between the fast forward-going particles and K^+, two bands of protons and deuterons are distinguished and some hints on α's can been seen in Fig. 2.

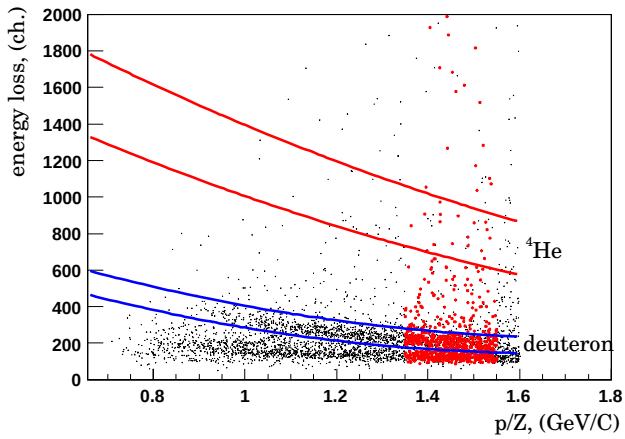

Figure 2: Energy loss in the first layer of the hodoscope *vs.* the rigidity of particles in FD. According to the phase space of the reaction $dd \to \alpha K^+K^-$ the rigidity of α should be between 1.3 and 1.6 GeV/C.

In the missing-mass distribution of the $dd \to \alpha K^+X$ events, some K^- candidates can be seen in the red area of Fig. 3.

3 Result and Outlook

An attempt to measure the $dd \to \alpha K^+K^-$ reaction has been made at the ANKE spectrometer. About 10 $dd \to \alpha K^+K^-$ candidates have been identified in a preliminary analysis. The cross section of the $dd \to \alpha f_0 \to \alpha K^+K^-$ process will be deduced from an ongoing analysis from which an increased

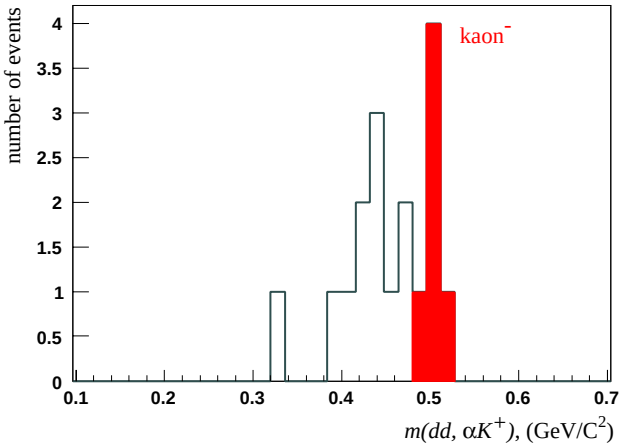

Figure 3: Missing-mass $m(dd, \alpha K^+)$ distribution of the $dd \to \alpha K^+X$ events. The shaded area indicates the K^- candidates.

number of events is expected. A new proposal for the final experiment $dd \to \alpha(\pi^0\eta)$ with WASA-at-COSY is under preparation.

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CASCADE RESONANCE PROPERTIES FROM CHARM BARYON DECAYS AT *BABAR*

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Abstract

We present studies of hyperon and hyperon resonance production in charm baryon decays at *BABAR*. Two-body decay spin formalisms are extended to three-body final states and are used to study $\Xi(1530)^0$ production in Λ_c^+ decay. Similarly, the properties of the $\Xi(1690)^0$ are extracted from a detailed isobar model analysis of the $\Lambda_c^+ \to \Lambda K_S K^+$ Dalitz plot.

1 Introduction

Although considerable advances have been made in baryon spectroscopy over the past decade, there has been very little improvement in our knowledge of cascade resonances since 1988 [2]. The $\Xi(1690)$ has been observed in the $\Lambda\overline{K}$, $\Sigma\overline{K}$ and $\Xi\pi$ final states with various degrees of certainty. Its quantum numbers have not yet been measured. The $\Xi(1530)$ has primarily been seen via its decay to $\Xi\pi$, however its spin-parity remains uncertain.

2 The $\Xi(1530)^0$ from $\Lambda_c^+ \to \Xi^-\pi^+K^+$ Decay

The $\Xi(1530)^0$ resonance is observed in the $\Xi^-\pi^+$ system produced in the decay $\Lambda_c^+ \to (\Xi^-\pi^+)K^+$. The data sample analyzed corresponds to a total integrated luminosity of $\sim$230 fb^{-1} [3, 4].

The Dalitz plot for $\Lambda_c^+ \to \Xi^-\pi^+K^+$ is dominated by the contribution from $\Lambda_c^+ \to \Xi(1530)^0K^+$. The efficiency-corrected projection of the $\Xi^-\pi^+$ invariant mass for the Λ_c^+ signal region in shown in Fig. 1(a). The Dalitz plot (Fig. 1(d)) shows evidence for only one resonant structure. A clear band can be seen at the nominal mass squared of the $\Xi(1530)^0 \to \Xi^-\pi^+$.