

Measurement of $\bar{K}N$ scattering below the $\bar{K}N$ mass threshold

Friday, 23 June 2023 16:45 (25 minutes)

We measured $\pi\Sigma$ invariant mass spectra below and above the $\bar{K}N$ mass threshold in the $K-d \rightarrow N\pi\Sigma$ in order to study the $\bar{K}N$ interaction and the $\Lambda(1405)$ resonance. For this purpose, a negatively-charged kaon (K^-) beam of 1 GeV/c was irradiated on a deuterium target at the K1.8BR beam line in the J-PARC Hadron Experimental Facility. In the experiment, a nucleon (N: neutron or proton) knocked out from a deuteron (d) by an incident K^- was detected at a very forward angle, and four different final states of $\pi^+\Sigma^-$, $\pi^-\Sigma^+$, $\pi^0\Sigma^0$, and $\pi^-\Sigma^0$ were identified by measuring the charged particles emitted around the target.

This reaction can be described by the two step process: (i) $K^-N_1 \rightarrow \bar{K}N$ and (ii) $\bar{K}N \rightarrow \pi\Sigma$, where “ N_1 ” and “ N_2 ” are nucleons bound in the deuteron. Since the nucleon emitted at the forward angle carries away most of the collision energy in (i), the center-of-mass energy in (ii) can be lower, even below the $\bar{K}N$ mass threshold. Around the $\bar{K}N$ mass region, one expects that the S-wave $\bar{K}N \rightarrow \pi\Sigma$ scattering is dominant. In order to separate the $I=0$ and 1 amplitudes in (ii), we demonstrate that an isospin relation of the cross sections between the four final $\pi\Sigma$ states is satisfied as $\sigma(\pi^0\Sigma^0) = [\sigma(\pi^+\Sigma^-) + \sigma(\pi^-\Sigma^+) - \sigma(\pi^-\Sigma^0)]/2$.

By reproducing the $\pi\Sigma$ spectra of the $I=0$ channel, we deduced the S-wave scattering amplitude of $\bar{K}N \rightarrow \bar{K}N$ as well as $\bar{K}N \rightarrow \pi\Sigma$ in $I=0$ in the framework of the $\bar{K}N$ - $\pi\Sigma$ coupled channel. We find a resonance pole at $1417.7^{+6.0}_{-7.4}(\text{fitting error}) + 1.1_{-1.0}(\text{systematic error}) - i[26.9^{+6.0}_{-7.9}(\text{fitting error})^{+1.7}_{-2.0}(\text{systematic error})]$ MeV.

Collaboration

J-PARC E31

Primary author: NOUMI, Hiroyuki (Osaka University)

Presenter: NOUMI, Hiroyuki (Osaka University)

Session Classification: Parallel session C4