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Measurement of KbarN scattering below the KbarN mass threshold

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We measured \pi\Sigma invariant mass spectra below and above the KbarN mass threshold in the K-d -> N\pi\Sigma in order to study the KbarN 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 identefied by measuring the charged particles emitted around the target.

This reaction can be described by the two step process: (i) K-"N_1"->KbarN and (ii) Kbar"N_2"->\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 KbarN mass threshold. Around the KbarN mass region, one expects that the S-wave Kbar"N_2"->\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 \pi^0\Sigma^0 = [\pi^+\Sigma^- + \pi^-\Sigma+ - \pi^-\Sigma^0]/2.
By reproducing the \pi\Sigma spectra of the I=0 channel, we deduced the S-wave scattering amplitude of KbarN->KbarN as well as KbarN->\pi\Sigma in I=0 in the framework of the KbarN-\pi\Sigma coupled channel. We find a resonance pole at 1417.7^+6.0_-7.4(fitting error)^+1.1_-1.0(systematic error) -i[26.9^+6.0_-7.9(fitting error)^+1.7_-2.0(systematic error)] MeV.

Collaboration

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