Measurement of analyzing power for $pp \to pp\pi^0$ reaction at the beam energy 390 MeV.

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Pion-production near the threshold gives us important information about the low-energy strong-interaction physics. Several experimental studies of $NN \to NN\pi$ reaction near the pion-production threshold have been performed. The total cross section of $pp \to pp\pi^0$ reaction was measured at IUCF[1] very precisely. It has been pointed out that large contribution of the s-wave pion-production amplitude Ss, in which final protons are in the S state, is necessary to reproduce these data. The importance of short-range effect between nucleons and off-shell property of πN interaction was indicated[2, 3, 4]. The theoretical investigations based on the chiral perturbation theory were also performed[5] and give that the sign of s-wave pion-production amplitude is opposite to the sign predicted in Ref.[2, 3, 4]. The systematic comprehension for s-wave pion-production mechanisms is not established yet.

The integrated polarization observables of $\vec{p}\vec{p} \to pp\pi^0$ reaction were measured at IUCF using the polarized beam and polarized target between the beam energy 325 and 400 MeV[7]. These observables were integrated by the emitted angle and the pion energy. The integrated analyzing power Ay is expressed by the product of p-wave amplitude Pp and s-wave amplitude Ps in which final protons are in the P-state. The calculation of RCNP model, in which relevant pion production channels can be calculated based on the meson exchange picture and the higher partial waves were taken into account, predicts significantly smaller value of Ay than the experimental one, typically by a factor of 4[6]. This result suggested that large Ps amplitude is necessary to explain these data and one may conclude that origin of s-wave pion-production amplitude corresponding to Ss and Ps is not yet clear.

In this work, angular dependence of analyzing power is discussed. The global structure of $Ay(\theta_\pi)$ is given by associated Legendre function $P_{11}(\cos\theta_\pi)$ and $P_{21}(\cos\theta_\pi)$ which are in proportion to $PsPp$ and $SsSd$ amplitude, respectively. Here θ_π is the emitted angle of pion in the C.M. system. The function P_{21} has the cross point at $\theta_\pi = 90^\circ$. On the other hand, the function P_{11} shows symmetric structure. Therefore we can deduce the relative strength of these partial wave amplitudes from experimental data of angular dependence of Ay.

The experiment was performed using the 390 MeV polarized proton beam from Ring Cyclotron at RCNP, Osaka, University. The Liquid hydrogen target was used and the target system was developed by the Kyushu University group[8]. Two out-going particles are detected by array of scintillator which cover the emitted angle of $15^\circ \sim 35^\circ$ and four kinematical variables (scattered angles:θ_1, θ_2,energies:E_1,E_2) are measured; The number of measured variables is enough to determine the kinematics of three-body final state on the basis of ϕ_1,ϕ_2=0. The energy of protons is measured by E-counter plastic scintillator which can stop