Photoproduction of Neutral Kaons off Hydrogen

A. Sakaguchi[a], S. Ajimura[a], T. Hayakawa[a], T. Itabashi[a], T. Kishimoto[a], K. Matsuoka[a], S. Minami[a], P.K. Saha[a], Y. Shimizu[a], K. Sugita[a], K. Terai[a], M. Fujiwara[b], T. Hotta[b], K. Kino[b], H. Kohri[b], T. Matsumura[b], T. Nakano[b], M. Sumihama[b], J.K. Ahn[c], R.G.T. Zegers[d], N. Muramatsu[e], T. Fukuda[f], W. Imoto[f], T. Ohtaki[f], K. Hicks[g], T. Watanabe[h] and M. Miyabe[i]

[a] *Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan*
[b] *Research Center for Nuclear Physics, Osaka University, Ibaraki, Osaka 567-0047, Japan*
[c] *Department of Physics, Pusan National University, Busan 609-735, Korea* [d] *National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824-1321, USA*
[e] *Advanced Science Research Center, Japan Atomic Energy Research Institute, Tokai, Ibaragi 319-1195, Japan*
[f] *Research Center for Physics and Mathematics, Osaka Electro-Communication University, Neyagawa, Osaka 572-8530, Japan*
[g] *Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701, USA*
[h] *Department of Physics, Tohoku University, Sendai 980-8578, Japan*
[i] *Department of Physics, Kyoto University, Kyoto 606-8502, Japan*

Recently, experimental studies on the kaon photoproduction reactions had great progress due to constructions of several new facilities that provided high-energy photon beams of a few GeV in energy. SAPHIR (Bonn), CLAS (JLAB), LEPS (SPring-8), GRAAL (ESRF) collaborations reported new results on the Λ and the Σ^0 photoproduction reactions off hydrogen, the $p(\gamma,K^+)\Lambda$ and the $p(\gamma,K^+)\Sigma^0$ reactions. The experimental results inspired theorists to develop state of the art calculations for the reactions. Although the new theoretical works had great progress in the treatments of various elements of model calculations, still there ware several parameters unable to be fixed by the theory itself, but to be fixed experimentally.

At SPring-8/LEPS, we already published results of the first precise measurement of the beam polarization asymmetry for the K^+ photoproduction reactions [1], which could constrain the ambiguity of the parameters in the theoretical calculations. As an extension of the study on the kaon photoproduction reaction, we also studied the neutral kaon photoproduction reaction, the $p(\gamma,K^0)\Sigma^+$ reaction, for which experimental data were scarce. The reaction is a complementary reaction of the $p(\gamma,K^+)\Sigma^0$ reaction due to the iso-spin symmetry of the strong interaction, so the study is quite important to understand the reaction mechanism of all kaon photoproduction reaction channels. We put emphasis especially on the beam polarization asymmetry measurement.

We confirmed the feasibility of the neutral kaon detection with the LEPS spectrometer. The neutral kaon was measured by the $K_S \to \pi^+\pi^-$ decay mode, and the decay charged particles were measured by the LEPS magnetic spectrometer. We introduced new trigger detectors to observe high-momentum charged pions from the K_S decays. The measurement of the high-momentum pions had not been possible because the original LEPS experimental trigger based on an aerogel Čerenkov detector killed all high-momentum pions. The identification of the K_S decay was made clearly by a calculation of the invariant mass of the $\pi^+\pi^-$ system and the K_S flight distance before decay (see Fig.1). Data taking was finished and data analyses are in progress.

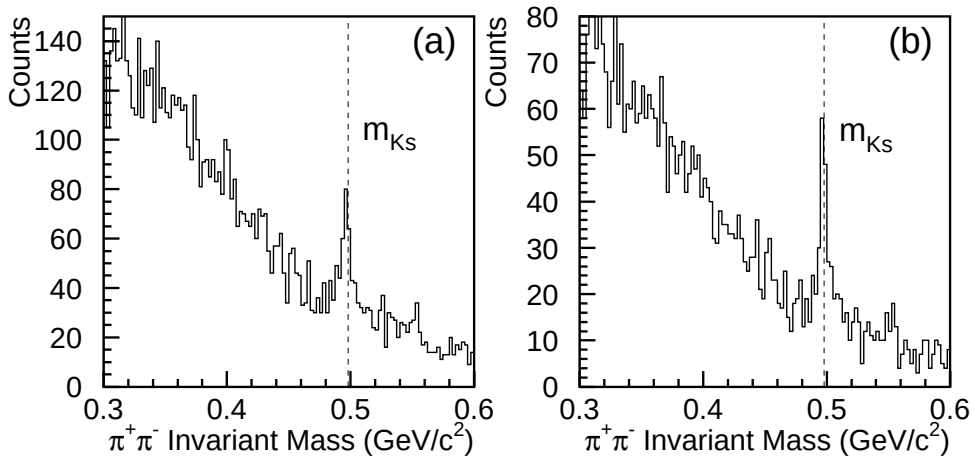

Figure 1: Invariant mass spectra of $\pi^+\pi^-$ pairs plotted (a) for all events and (b) for events in which K_S flew downstream.

References

[1] R.G.T. Zegers et al., the LEPS Collaboration, Phys. Rev. Lett. **91** (2003) 092001.