

# Photoproduction of Neutral Kaons off Hydrogen

A. Sakaguchi<sup>1</sup>, J.K. Ahn<sup>2</sup>, S. Ajimura<sup>1</sup>, M. Fujiwara<sup>3</sup>, T. Fukuda<sup>4</sup>, T. Hayakawa<sup>1</sup>, K. Hicks<sup>5</sup>, T. Hotta<sup>3</sup>, W. Imoto<sup>4</sup>, T. Itabashi<sup>1</sup>, K. Kino<sup>3</sup>, T. Kishimoto<sup>1</sup>, H. Kohri<sup>3</sup>, T. Matsumura<sup>6</sup>, K. Matsuoka<sup>1</sup>, S. Minami<sup>1,4</sup>, M. Miyabe<sup>7</sup>, N. Muramatsu<sup>3</sup>, T. Nakano<sup>3</sup>, T. Ohtaki<sup>4</sup>, P.K. Saha<sup>8</sup>, Y. Shimizu<sup>1</sup>, K. Sugita<sup>1</sup>, M. Sumihama<sup>9</sup>, K. Terai<sup>1</sup>, T. Watanabe<sup>9</sup> and R.G.T. Zegers<sup>10</sup>

<sup>1</sup>*Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan*

<sup>2</sup>*Department of Physics, Pusan National University, Busan 609-735, Korea* <sup>3</sup>*Research Center for Nuclear Physics, Osaka University, Ibaraki, Osaka 567-0047, Japan*

<sup>4</sup>*Research Center for Physics and Mathematics, Osaka Electro-Communication University, Neyagawa, Osaka 572-8530, Japan*

<sup>5</sup>*Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701, USA*

<sup>6</sup>*Department of Physics, Kyoto University, Kyoto 606-8502, Japan*

<sup>7</sup>*Japan Atomic Energy Research Institute, Tokai, Ibaragi 319-1195, Japan*

<sup>8</sup>*Department of Physics, Tohoku University, Sendai 980-8578, Japan*

<sup>9</sup>*Department of Physics, Tohoku University, Sendai 980-8578, Japan*  
<sup>10</sup>*National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824-1321, USA*

Recently, experimental studies on the kaon photoproduction reactions had great progress due to contributions from several facilities that provided high-energy photon beams of a few GeV in energy. SAPHIR (Bonn), CLAS (JLAB), LEPS (SPring-8) and GRAAL (ESRF) collaborations reported new results on the  $\Lambda$  and the  $\Sigma^0$  photoproduction reactions off hydrogen, the  $p(\gamma, K^+) \Lambda$  and the  $p(\gamma, K^+) \Sigma^0$  reactions.

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 isospin symmetry of the strong interaction, so the study is quite important to understand the reaction mechanism of the kaon photoproduction reactions systematically. We put emphasis especially on the beam polarization asymmetry measurement.

We confirmed the feasibility of the neutral kaon detection and identification of the  $p(\gamma, K^0) \Sigma^+$  reaction with the LEPS spectrometer. The neutral kaon was measured by the  $K_S \rightarrow \pi^+ \pi^-$  decay mode, and the decay charged particles were measured by the LEPS magnetic spectrometer. The identification of the  $K_S$  decay was made clearly by a calculation of the invariant mass of the  $\pi^+ \pi^-$  system as shown in Fig.1(a). To identify the  $p(\gamma, K^0) \Sigma^+$  reaction, a missing mass was calculated by assuming the  $p(\gamma, K^0) X$  kinematics. Fig.1(b) shows the missing mass distribution after an event subtraction of side bands of the invariant mass spectrum. Further analyses are in progress.

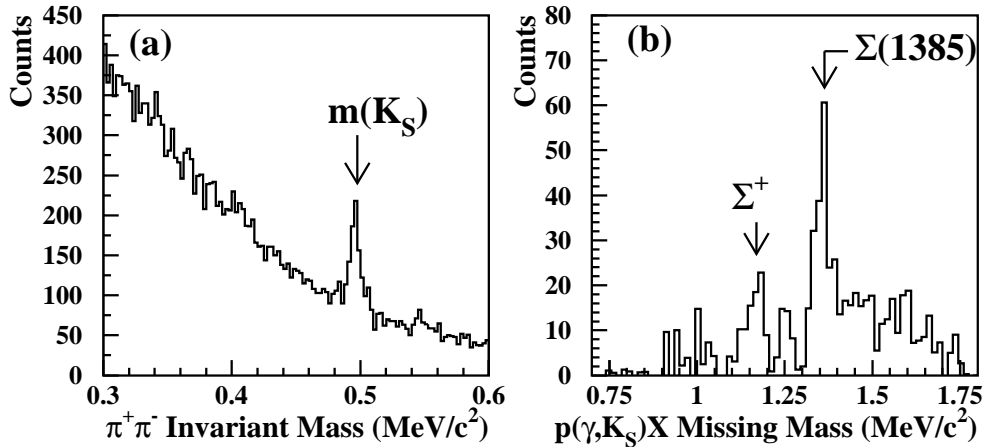


Figure 1: (a) Invariant mass spectrum of  $\pi^+ \pi^-$  pairs plotted. (b) Missing mass spectrum by assuming the  $p(\gamma, K^0) X$  kinematics.

## References

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