Present Status from
the Experimental Study of
Neutral Kaon Photoproduction
around Threshold Region
at Tohoku-LNS

Masashi Kaneta
for the NKS2 collaboration
Department of Physics, Tohoku University
Introduction
Physics Motivation

• Investigation of strangeness production mechanism
  – Threshold region of production
    • No resonance decay
      – Good for comparison with models
      – Give theoreticians base data to address
        » coupling constant
        » resonance contribution
      – Small cross-section, i.e. high statistics data is required
  – Neutral channel in strangeness photo-production
    • Past experiments studied by $K^+$ production until 2002
    • Not enough data of differential cross-section of
      $\gamma+n \rightarrow K^0 + \Lambda(\Sigma^0)$
The Experiment

• The experiment of neutral kaon spectrometer at LNS-Tohoku
  - The first generation (NKS)
    • Used TAGX spectrometer of INS and successfully done in 2004
      - C target results: nucl-ex/067022 submitted to PLB
      - Liquid D$_2$ target results: will be submitted soon
    • Some weak points were found
      - No coverage on forward region
      - No Stereo wire in Chambers
  - The second generation of the experiment, NKS2
    • Constructed in 2004-2006 from scratch
    • Commissioning run
      - Mar., Jun., and Sep 2006 by Carbon target
    • The data taking with LD2 target
      - First data: Nov/2-Nov/11
      - more data taken in Nov/28-Dec/11
      - will be taken in Jan/15-29, Feb/13-26

results from this data set will be shown today
The NKS2 Collaboration

- **Department of Physics, Tohoku University**

- **Laboratory of Nuclear Science, Tohoku University**

- **Department of Electrical and Electric Engineering, Akita University**
  - A. Sasaki

- **Department of Electrical Engineering, Ichinoseki National College of Technology**
  - O. Konno
Tagged Photon Beam at LNS-Tohoku

- 200 MeV electron beam from LINAC
- 1.2 GeV Stretcher-Booster Ring
- Neutral Kaon Spectrometer 2
- Sweep magnet
- Photon tagging system

Masashi Kaneta, Tohoku Univ.
Tagged Photon Beam at LNS-Tohoku

- **Photon beam**
  - Electron beam on carbon wire
  - Tagged by electron which has energy loss
  - $E_\gamma = 0.8-1.1$ GeV
    - from 1.2 GeV electron beam
  - 6 MeV coverage per tagging counter
Photo of NKS2

Masashi Kaneta, Tohoku Univ.
Recent Results

from Nov/2-11 run
(3.2×10^{11} events)
Particle Identify (PID)

Opening angle cut
\[-0.9 < \cos \phi < 0.8\]
is required to reduce $e^+ e^-$

Red : proton region
Blue : pion region

Note:
There is a ghost between pion and proton due to shift of TOF, that is, the calibration is not perfect yet....
• Decay vertex is reconstructed from trajectories of positive and charged particle pair

This distribution is projected on beam axis direction

Opening angle cut

-0.9 < \cos \phi < 0.8

is required
Invariant Mass ($\pi^+\pi^-$)

- **cut A**: $K^0_S$ candidate
- **cut B**: $\Lambda$ candidate

We can see Lambda peak after applying cut B to all entries. The signal-to-noise (S/N) ratio increased after the cut. There are 3.2×10^{11} tagged photon events.

Masashi Kaneta, Tohoku Univ.
Invariant Mass ($\pi^- p$)

Number of counts

Zoom in

Invariant mass of $\pi^- p$ [GeV/$c^2$]

Number of counts

Invariant mass of $\pi^- p$ [GeV/$c^2$]
Summary
Summary

• The first data taking with liquid D$_2$ target in new spectrometer NKS2
  - all detectors become to be ready
  - no problem in liquid deuteron target system
  - $\sim$100 $K^0_S$ and $\sim$300 $\Lambda$ from run of Nov/2-11

• We have and will have more data
  - Nov/28-Dec/11 run have about 3 times data more than Nov/2-11
  - Two sets of the beam time in Jan and Feb.
    - two weeks in each
  - Total statistics will be ten times in this fiscal year
  - Some progresses will be shown in the next JPS meeting

• What is the next?
  - $K^0_S$ and $\Lambda$ coincidence measurement
    - three tracks requirement on/off-line
    - new vertex chamber to increase acceptance in vertical direction