# HIGH ENERGY PHOTON BEAM BY PHOTON TAGGING SYSTEM

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Abstract

A photon tagging system which determines the energy of each photon in the bremsstrahlung process was constructed, and was tested using an extracted electron beam from the 1.3 GeV electron synchrotron at the Institute for Nuclear Study, University of Tokyo.

## 1. Photon Tagging System

The principle of photon tagging is to determine an energy of each photon in the bremsstrahlung process by analyzing the momentum of the recoil electron. The energy of the tagged photon is given by a difference between the energies of the incident and recoil electrons because the energy transfer to the nucleous in a photon radiator is negligibly small.

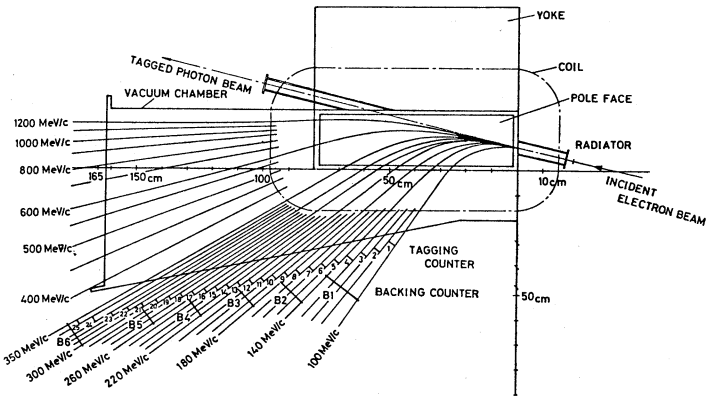
The system was consisted of a C-type dipole magnet and a hodoscope made of 25 plastic scintillation counters with 6 backing counters. The momentum range of recoil electrons measured by the system is from 100 MeV/c to 350 MeV/c. The tagged photon beam available to the experiment has, therefore, an energy range of 250 MeV with the maximum energy of E-100 MeV, where E is the incident electron energy.

The distribution of the magnetic field in the median plane was measured at the central field strength of 11.7 kG by a rotating coil fluxmeter, which had been calibrated with an NMR system. From this field map, the trajectories of the recoil electrons were calculated as is shown in Fig. 1. Although the designed energy bin spanned by a tagging counter was 10 MeV, calculated energy resolution taking account of the effects of beam size and angular divergence of the incident electrons, energy spread of the incident electrons, and multiple scattering on the incident and recoil electrons in the radiator was 14 MeV at around 500 MeV.

The energies of the tagged photons were measured by a total absorption lead glass Cherenkov counter, which had been calibrated by the monoenergetic electron beam.

The intensity of the tagged photon beam was limited due to the counting speed of the tagging counter and the resolving time of the coincidence between the signal from the tagging counters and the signals from the experimental detectors. Typical intensity of the tagged photon beam in the experiment to measure momentum spectrum of negative pions was $10^5$/sec.

FIGURE 1.




The tagged photon beam was used in the experiments to measure the total pair production cross sections in Hydrogen, Aluminium, Carbon, and Copper and to measure the momentum spectra of pions and protons from Hydrogen to study double pion photo-production in the energy range between 710 MeV and 950 MeV[2,3,4].

## 2. Possible Improvements on the System

An improvement on the energy resolution of the tagged photon beam is required to study photo-nuclear reactions precisely. The requirement can be fulfilled by using a magnet with small aberration like a 180° bend-type one with small size of counters or MWPC.

Also an improvement on the intensity of the beam is required to reduce machine time to get good statistics of the data. One way is to get better time resolution by using TDC. Ten times of intensity is obtainable. The other way is to increase duty factor by making flat top in the shape of the magnetic field strength of the synchrotron magnet.

## References

1) This report is based on the following paper: S. Arai et al. ; Japan. J. appl. Phys. 14(1975)95.

2) S. Homma et al. ; INS-J-148(1975).

3) H. Fujii et al. ; Nucl. Phys. B114(1976)477.

4) I. Arai et al. ; J. Phys. Soc. Japan 43(1977)363.