Laser-Electron Photon (BL33LEP)

1. Beamline and Laser-Electron Photon Beam

The BL33LEP beamline [1] has a 7.8-m long straight section between two bending magnets. Polarized laser photons are injected from a laser hutch toward the straight section where Backward-Compton scattering (BCS) of the laser photons from the 8 GeV electron beam takes place. The BCS photon beam is transferred to the experimental hutch, 60 m downstream of the straight section.

If the laser lights are 100 % polarized, a backward-Compton-scattered photon is highly polarized at the maximum energy. The polarization drops as the photon energy decreases. However, the energy of the laser photons is easily changed so that the polarization remains reasonably high in the energy region of interest (Fig. 1). The intensity, position, and polarization of the laser lights are monitored at the end of the beamline.

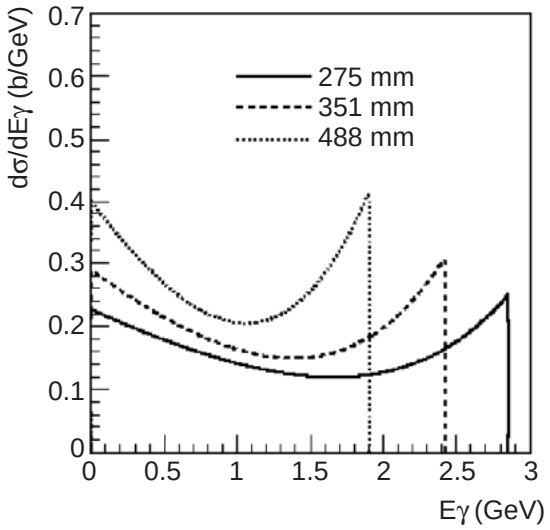

Fig. 1. Differential cross-section of the Compton scattering at three typical waveltngths of Ar laser.

The incident photon energy is determined by measuring the energy of a recoil electron with a tagging counter. The tagging counter is located at the exit of the bending magnet after the straight section. It consists of multi-layers of a 0.1 mm pitch silicon strip detector (SSD) and plastic scintillator hodoscopes. Electrons in the energy region of 4.5 - 6.5 GeV are detected by the counter. The corresponding photon energy is 1.5 - 3.5 GeV. The position resolution of the system is much better than the required resolution. The energy resolution (RMS) of 15 MeV for the photon beam is limited by the energy spread of the electron beam and the uncertainty of a photon-electron interaction point.

The operation of the BCS beam at SPring-8 started in July, 1999. Ar laser at 351-nm wave length is used to produce 2.4-GeV BCS photon beam. The intensity of the beam is about 2.5×10^6 photons/sec for 5-W laser output. Figure 2 shows the energy spectrum of the BCS beam measured with a PWO crystal calorimeter.

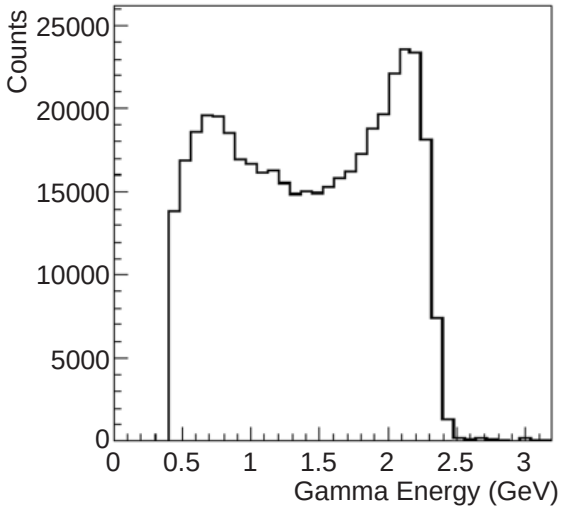

Fig. 2. Energy spectrum of the BCS beam measured with a PWO calorimeter.

2. Detector and Performance

The LEPS detector consists of a plastic scintillator to detect charged products after a target, an aerogel cerenkov counter with a refractive index of 1.008, charged-particle tracking counters, a dipole magnet, and a time-of-flight TOF wall. The design of the detector is optimized for a phi photo-production in forward angles. The opening of the dipole magnet is 135-cm wide and 55-cm in height. The length of the pole is 60 cm, and the field strength at the center is 1 T. The vertex detector consists of 2 planes (x- and y-) of single-sided SSDs (SVTX) and 5 planes (x,x',y,y',u) multi-wire drift chamber (DC1), which are located upstream of the magnet. The stereo ambiguity (pairing ambiguity) for two-track events are solved with DC1. Two sets of MWDCs (DC2 and DC3) are located downstream of the magnet. The active area size of DC2 and DC3 is 200cm(W)×80cm(H). Each set has 5 planes; x,x',u,u', and v. The identification of momentum analyzed particles is performed by measuring the time of flight from the target to the TOF wall. The start signal for the TOF measurement is provided by an RF signal from the 8-GeV ring, where electrons are bunched at every 2 nsec (508MHz) with a width (σ) of 12 psec. Since the speeds of both the electron beam and the laser-electron photon are same, the arrival time of the laser-electron photon at the target is synchronized with the RF signal. A stop signal is

provided by the TOF wall consisting of 40 2m-long plastic scintillation bar with a cross section of 4cm (t)×12 cm (w). The resolution of the TOF counter is about 100 psec. Figure 3 shows a preliminary mass distribution of charged particles reconstructed from momentum and TOF information.

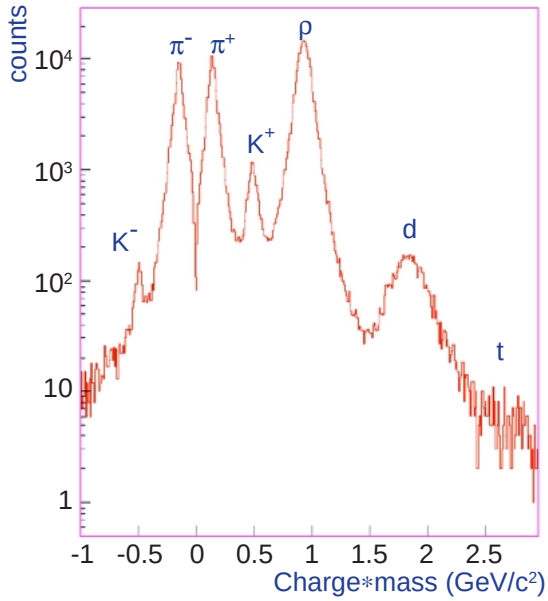

Fig. 3. Reconstructed mass distribution of charged particles.

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References

[1] T. Nakano, SPring-8 Annual Report 1998 (1998) 95, and references therein.

Light Source	
Laser BCS Photon	
Maximum Energy	2.4 GeV
Tagged Energy Range	1.5 - 2.4 GeV
Intensity	2.5×10^6 sec^{-1}

Facilities in the Experimental Hutch
1T Dipole Magnet
SSD and DC tracking counters
TOF counter
Aerogel cerenkov counter