BL33LEP
Laser-Electron Photon

1. Introduction

BL33LEP (LEPS) is designed to study quark–nuclear physics. It uses a polarized photon beam produced by laser-induced backward Compton scattering from 8 GeV electrons. Photon energies from 1.5 GeV to 3 GeV are tagged by detecting recoiled electrons. A beam with such extremely short wavelengths (~1 fm) can be used to investigate the substructure of hadrons, which consist of quarks. In the standard experimental setup, forward-going charged particles produced by photo-reactions are detected with a high-resolution magnetic spectrometer. On the other hand, pair-created electrons/positrons are also momentum-analyzed by the spectrometer magnet. Thus, electrons or positrons around the 1 GeV energy region can be used. These are suitable to test and calibrate many types of detectors. BL33LEP has also been used for such test experiments as international joint usage.

In FY2019, the physics run was not performed, but some detector test experiments were carried out by the LEPS2 group and external users. One of the joint usage experiments is described below.

2. Test of resistive plate chambers

Four resistive plate chambers (RPCs) used in the LEPS2/BGOegg experiments were tested. These RPCs will be installed at J-PARC E16 and Fermilab EMPHATIC experiments. Since these RPCs had been stored without gas flow for 4 years, possible aging effects were studied. A new RPC amplifier with a fast shaping time for the time-over-threshold (TOT) method was also tested. Since TOT information is nearly proportional to the pulse height, ADCs are unnecessary, in principle, if the new amplifier is successfully working.

In the experiment, converted electrons/positrons with a 0.5-mm-thick lead target were used. The BGOegg RPC had dimensions of 25 cm × 120 cm with 8 readout strips with 2.5 cm × 100 cm. To test such a horizontally wide detector, electrons and positrons were vertically separated using a special permanent dipole magnet. Figure 1 shows the experimental setup. Each RPC is sandwiched with two scintillation counters for the trigger.

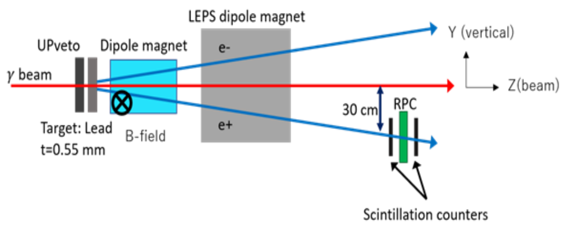

Fig. 1. Schematic view of the experimental setup.

The obtained timing resolutions at the fixed positions of each readout strip were 50–80 ps. The aging effects were almost negligible. In the test of the new amplifier, the ADC value was so low that the slewing correction, which is the correction for the time shift caused by the pulse-height difference, was initially unsuccessful. When an external amplifier was added, a resolution of 65 ps was obtained. This value is similar to that of the old amplifier.

3. Intensity upgrade by a pulsed laser synchronized with the electron bunch

Our research has investigated new ways to increase the beam intensity with low output power because lasers with a high output power cause distortion and faster deterioration of the optical components. The FY2018 test confirmed that the 355-nm pulsed laser synchronized with the electron bunch could be used for practical experimental use. In FY2019, deep UV 266-nm pulsed lasers in the A-mode (203 bunches) operation were tested. The output pattern of the pulsed laser was controlled by a function generator. The RF signal from the SPring-8 storage ring was pre-scaled and used as the external trigger of the function generator. The beam intensity reached 1.2 MHz around 4 W. However, the intensity gradually decreased with the frequency of the pulsed laser. To reduce multi-Compton scattering in the same bunch, in which the photon energy cannot be uniquely determined in the tagging system, it is desirable to raise the frequency as much as possible. To optimize the output pattern in each filling mode, the pulsed laser will continue to be developed.

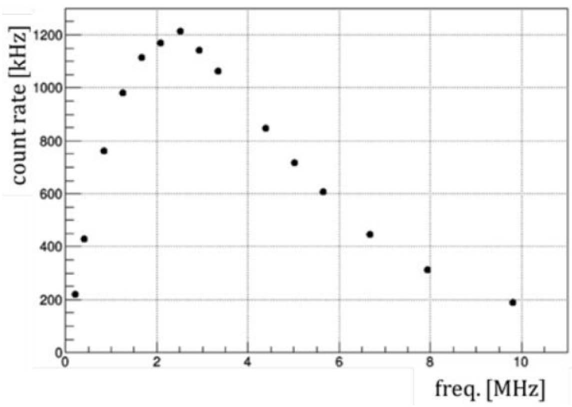

Fig. 2. Beam intensity obtained at each frequency.

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