BL33LEP
Laser–Electron Photon

1. Introduction

BL33LEP is the first beamline that 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. Such a beam has been used to investigate the substructure of hadrons, which consist of quarks, since 2000 and many remarkable results, such as a clue to the existence of a pentaquark, have been obtained. However, after more than 20 years of operation, many devices have aged and some are already out of order. We did not perform any runs in physics experiments at BL33LEP in FY2020. Some detector test experiments and development of pulse laser injection were carried out. At the end of 2020, the BL33LEP contract expired.

2. Test of a prototype RICH detector

A ring image Cherenkov counter (RICH), which identifies the beam K^- in the momentum range of 5–10 Gev/*c*, is a key detector for future experiments at the J-PARC high-momentum beamline. A prototype RICH detector consisting of an aerogel with a reflective index of 1.02 and multipixel photon counters (MPPCs) as photon sensors was developed by a J-PARC hadron group. To evaluate its light yield, timing resolution, and angular resolution, the group performed a test experiment at BL33LEP, using positrons generated by pair production from a lead target. The RICH detector was installed behind the LEPS dipole magnet, and the paths of positrons whose momentum was analyzed were determined by finger scintillators that sandwiched the RICH detector. Cherenkov lights were detected by 128 MPPCs. All signals were collected by a newly developed triggerless DAQ system. As a preliminary result, a timing resolution of about 1.5–2.0 ns was obtained for 1 Cherenkov light. The number of photons detected was 5–6 at a thickness of 10 cm. These results were very promising for further development of the detector.

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

We have been testing a new way to increase beam intensity using a pulse laser synchronized with the electron bunch [1]. In 2020, we searched for the optimal operation condition for each bunch mode (A-, B-, C-, D-, E-, or H-mode). The pulse laser used was LDH-V1611-PoD of Spectronix Inc. The wavelength of its laser light was 355 nm, the pulse width was less than 15 ps, and the maximum output power was 20 W, which depends on the repetition rate. The waveform pattern, repetition frequency, and output power were optimized by increasing beam photon intensity (tagger rate). Although the intensities obtained rather depended on the bunch mode used and were 1.2 to 4.3 MHz, the superiority of the synchronized pulse laser over the CW laser was confirmed and we will introduce this laser to the LEPS2 experiment at BL31LEP in 2021.

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Reference:

[1] Yosoi, M. (2020). *SPring-8/SACLA Annual Report FY2019*, 150–151.