Laser-Electron-Photon Beamline BL33LEP

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A practicability of constructing a high energy photon beamline in the SPring-8 storage ring had been discussed intensively. We concluded it to be promising as in Refs.[1,2]. There was a major advance in FY1997 toward realization of such a facility. We briefly describe the events that occurred in the past few years as below:

1)Research Center for Nuclear Physics at Osaka University(RCNP) formally proposed the project to investigate a quark-nuclear physics by means of laser-electron-photon(LEP). It was approved in December 1995 by the Advisory Committee in JASRI.

2)BL33B2 was assigned to the LEP beamline (BL33LEP) in August 1996 by the SPring-8 Management Steering Committee. JASRI agreed to a continued cooperation on construction of BL33LEP.

3)Specification of the BL33LEP was narrowed down and finalized by the end of August 1997.

4)Manufacturing of the storage ring and the beamline components is going on since September 1997.

5)An application for the license on radiation safety was submitted to the Science and Technology Agency in December 1997.

We preferred the ID straight section for a longer interaction region and less modifications to the vacuum chambers, however, all the available ID straight sections were reserved for the synchrotron light users exclusively. Alternative choice of using bending magnet section was re-examined and concluded that a modification of quadrupole magnet(QM9), which was mentioned in Ref.[1], was unnecessary. This made the LEP beamline realistic and acceptable in the SPring-8.

Since some of the vacuum chambers must be rebuilt and the LEP beam is valuable for machine studies, JASRI accelerator division took a responsibility for construction of all the components in the SR tunnel. RCNP is responsible for the other construction outside of the SR tunnel. RCNP is also responsible for management and operation of this beamline as an international cooperative research facility for users.

Layout of the BL33LEP is shown in Fig.1. Laser light is injected from about 40 m downstream of interaction center, and is focused to 1 mm in diameter. Interaction region is 7.8 m long. Non-interacted light is extracted from the upstream port of the BM1 chamber to monitor the intensity, position and polarization. Ar laser of 5 watts at 351 nm wave length is planned to install in the initial stage. Corresponding Compton back scattered photon beam has a maximum energy of 2.4 GeV and the intensity of 1.2¥107 /s when the electron beam current is at 100 mA. Maximum photon beam intensity is not limited by laser but is set on condition that the electron beam loss should not exceed 10% of synchrotron light use case. Polarization of LEP is almost complete except for a small degradation of laser polarization by optic transport devices. Figs.2-4 shows some SP8LEP characteristics. A tagging counter, which gives photon beam energy, consists of a silicon strip detector with 0.1 mm pitch and a plastic scintillator hodoscope. The tagging counter covers the electron energy from 6.5 to 4.5 GeV with a resolution of 15 MeV. The profile of the LEP beam is monitored by a beam profile monitor consisting of a thin converter and a two dimensional position detector. Beam energy spectrum is monitored by a heavy crystal calorimeter.

Definite plan in the next year is as follows. New vacuum chambers(SS3C,BM2C,CR2,BE2C) in the SR and the front-end components will be installed during a long summer shutdown period, and the laser hutch will be constructed in parallel. After confirming performance of every equipment, first LEP beam is scheduled by the end of 1998. An experiment hutch will be constructed in the SR experimental hall for a first stage of experimental programs in the next few years.

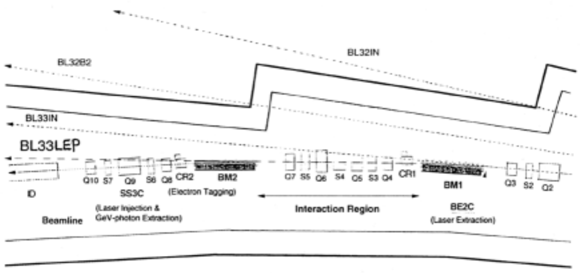
Proposed research programs include glueball search through vector meson photoproductions, Kaon photoproduction, N* properties, meson spectroscopy, hypernuclear physics, deuteron photodisintegration, test of the Gerasimov-Drell-Hearn sum rule. Measurement of the electron beam emittance by a pair of high precision position detectors is planned as a machine study program.

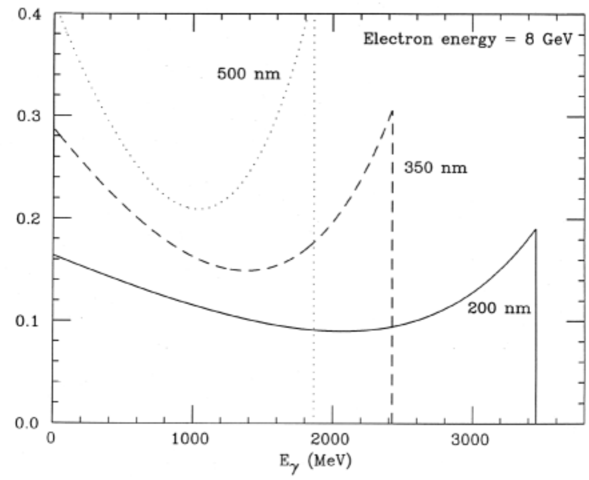
As a long range program we have a plan of producing low energy LEP beam around 10 MeV to study gamma transition of various nucleus. It is very attractive because an energy loss of electron beam by LEP does not lead to immediate beam loss. Therefore LEP beam intensity in this case is only limited by a balance between electron beam energy spread and radiation damping rates, and by a laser light intensity. As laser wave length is around 0.1 mm, high power far infra-red laser is required. R&D of such laser system will start next year.

References

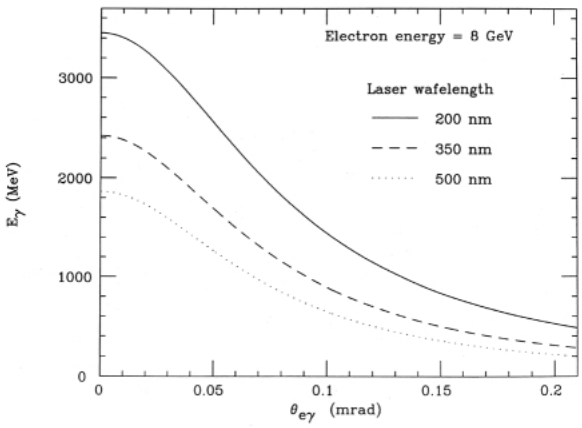
[1]Schin Date et al., SPring-8 Annual Report 1995, p. 172.

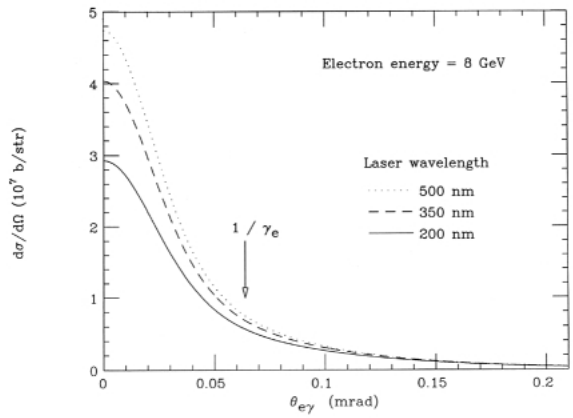
[2]Takashi Nakano, in Proceedings of Nuclear Physics Frontiers with Electro-Weak Probes, Osaka, Japan, 1996, edited by Hiroshi Toki et al.





1. Layout of BL33LEP.
2. Energy spectrum of LEP.





3. Scattered angle vs. LEP energy.
4. Angular differential cross section of LEP