Feasibility of Constructing a Facility of Backward Compton Scattering in the Storage Ring

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A plan of constructing a beamline of high energy gamma ray by means of backward Compton scattering in the SPring 8 storage ring has been discussed for the last two years in collaboration with RCNP (Research Center for Nuclear Physics, Osaka University). The basic concept of the facility is depicted in Fig. 1. The aim of this facility is to provide sufficient number of tagged and polarized photons in an energy range up to 2 to 3 GeV to use for various nuclear experiments.

From the begining of our discussion, it has been noticed that such a facility, like ones in BNL [1] and ESRF [2], is indeed possible to construct in SPring-8 with available laser technology without influencing other conventional beamlines. In Table 1, we list the maximum energies of photons $(E_\gamma)_{max}$ for each wavelength λ_L of the incident laser light. Also listed in this table is the maximum laser power P_{max} applicable when we limit the lifetime of the electron beam longer than 70 hours. The total number of photons corresponding to this limit is $(\dot{N}_\gamma)_{max} = 1.2 \times 10^7$/sec when the electron beam current is assumed as $I_e = 100$mA . Polarization of photons is almost complete at their maximum energies when 100% polarized laser beam is injected.

Table 1. The maximum energy available and the maximum laser power applicable for each wavelength of incident laser.

λ_L(nm)	$(E_\gamma)_{max}$(GeV)	P_{max}(W)
200	3.45	4.6
350	2.42	4.6
500	1.86	4.3

We list below the main results of our study.

1. An ID straight section should be adopted as the interaction region. If the focussing straight section is used instead, modifications of a straight chamber and a quadrupole magnet become necessary in addition to that of bending magnet and crotch vacuum chambers. This is because the trajectories of the incident laser beam and generated gamma ray direct 3.7 mrad outward relative to the designed BM beamline. In particular, a port attached to the straight chamber should be shifted outward by 2cm at the exit point while there is a york of the QM9 magnet 1cm outward. In the case of using an ID straight section, those extra modifications are unnecessary.
2. The energy resolution achievable in our tagging system has been estimated to be 15 MeV by developing an event simulator with tracking of electron trajectories in a magnetic lattice.
3. Insuring sufficient physical aperture for the off axis injection of the electron beam, we may tag energy of photons down to 800 MeV.

Currently, a design for a modified bending magnet chamber having a pathway for scattered electrons and sufficiently strong structure is under the study by RCNP. They also have studied a design of a modified crotch chamber to install the tagging system. The design is consistent with negligible influence on the electron beam through impedance.

Our present task is to estimate the flux of background X-ray from edge fields of bending magnets in the both sides of the interaction region. The result should be seriously taken into account when schemes of the laser injection and the shielding for the tagging system are decided.

References
[1] C.E. Thorn et. al., Nucl. Instr. and Meth. *A285*, 447 (1989).
[2] M. Anghinolfi et. al., Preprint No. ISN9331, ISN, Grenoble, 1993.

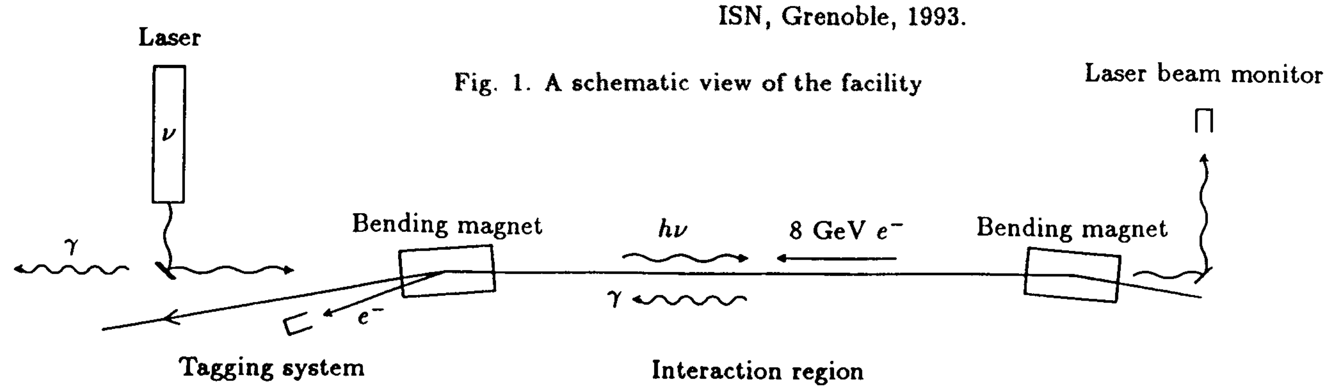

Fig. 1. A schematic view of the facility