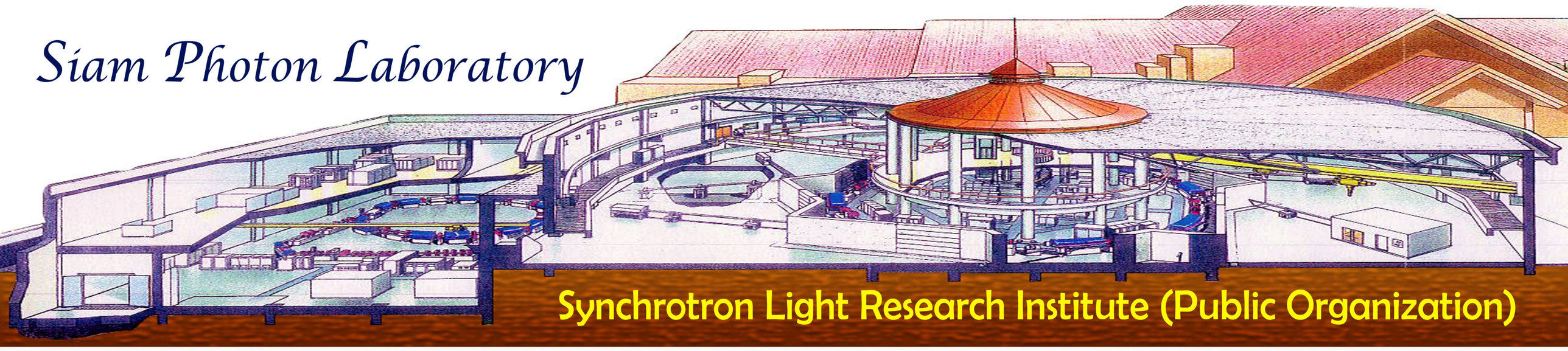
Siam Photon Laboratory



OBSERVATION OF BEAM LOSS SIGNAL AT THE SPS STORAGE RING

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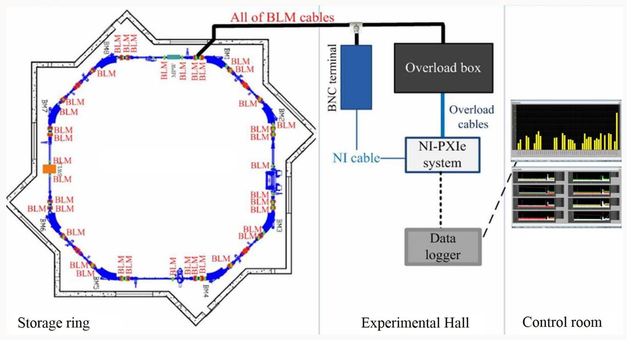
Abstract

Beam Loss Monitoring (BLM) system is an essential tool for observing beam instabilities and hence for machine protection. At the Siam Photon Source (SPS) storage ring, the BLM system is used to check the beam behavior due to optics perturbation, ion trapping, and vacuum leakage. A network of 50 PIN-diode detectors from Bergoz has been installed around the ring at the positions of high particle density. These positions are at the values of large betatron and dispersion functions in the machine lattice. The operational results of tune scanning verses loss rate in the resonance diagram are described. These results will be useful for improving the beam performance in terms of lifetime and beam stability.

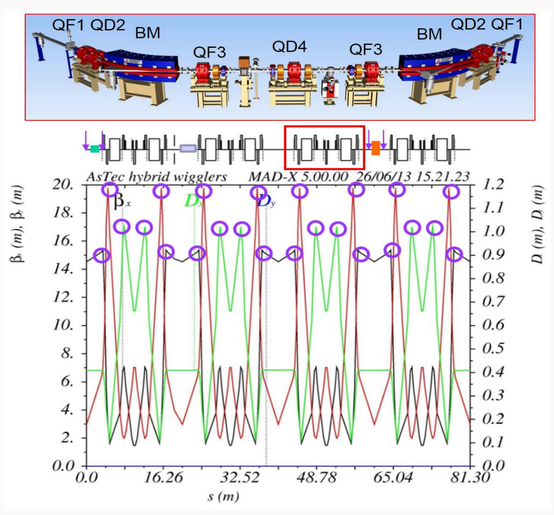
Introduction

Siam Photon Source (SPS) storage ring is a 1.2 GeV electron light source. It contains four Double Bend Achromat (DBA) super periods with four straight sections. Each symmetric period consists of four focusing quadrupole magnets (QF), three defocusing quadrupole magnets (QD), and two bending magnets (BM). Three insertion devices; Undulator (U60), Superconducting Wavelength Shifter (SWLS), and Multipole Wiggler (MPW), have been installed and commissioned at three of the straight sections.



The sketch map of BLM system. The detectors are two PIN-diodes from Bergoz. The real-time loss rate is recorded at each point of the storage ring and updated every second by NI-PXIe system.

Optimal BLM Locations



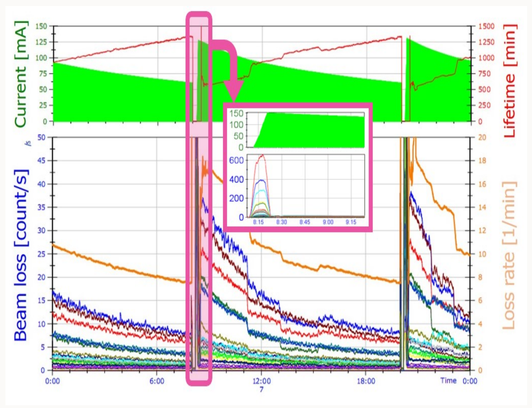
Betatron function and dispersion function along the SPS storage ring.

Good locations for installing the BLM are sensitive to

- ✓ ***Touschek lifetime*** is in the section with the highest value of dispersion function.
- ✓ ***Quantum lifetime*** occurs at the position that exhibits large betatron function where the aperture is small.
- ✓ ***Vacuum lifetime or coulomb scattering*** is likely to happen when electron beam passing through dipole magnet.

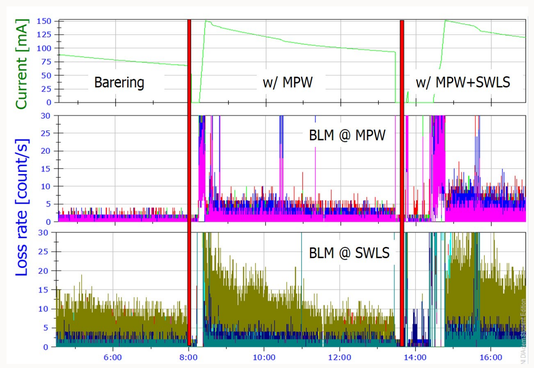
A network of 50 PIN-diode detectors is therefore placed along the SPS storage ring at QF1, QD2, QF3, BM, and insertion devices (IDs).

Observation of Beam Loss



Machine operation status. The beam loss signal during injection process is expanded in the pink box.

Machine operations with IDs

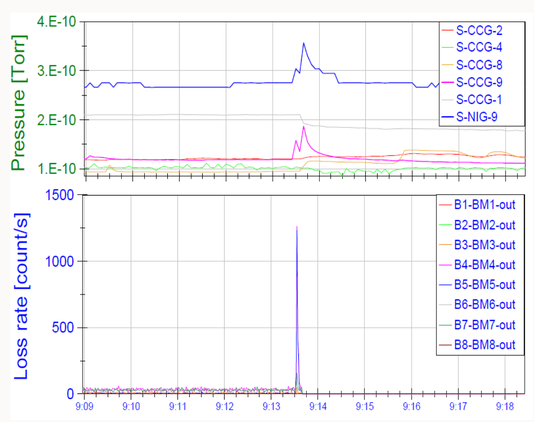


Beam loss for three modes of machine operation (Bare ring w/o IDs, 2.2 T MPW, and 4.0 T SWLS + 2.2 T MPW).

Table shows the parameters of machine operation with 4.0 T SWLS, 2.2 T MPW, and U60 before and after LOCO correction. After LOCO correction, The loss rate is also increased by 40% at the bending magnets due to the coupling value.

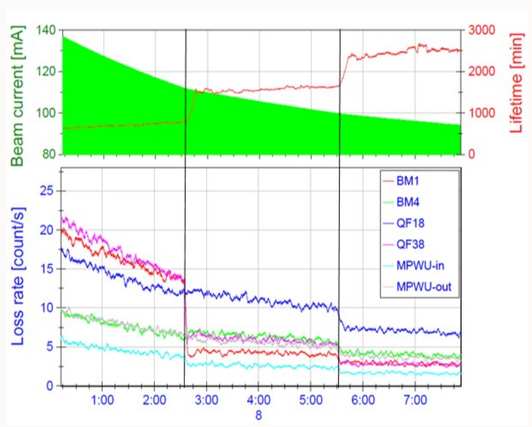
	Lifetime (mA.min)	Tune (ν_x , ν_y)	Coupling (%)
Before cor.	75,000	4.755, 2.823	10.21
After cor.	74,000	4.766, 2.824	6.78

Vacuum pressure



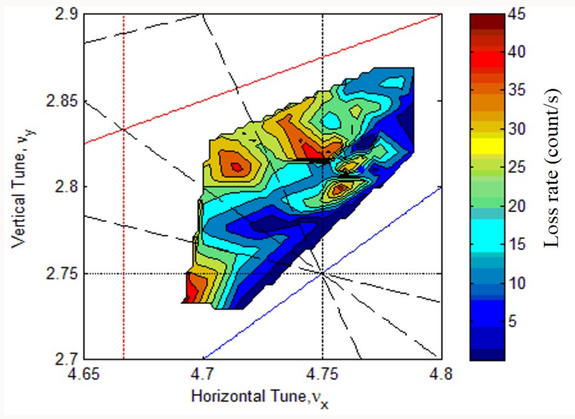
Beam loss and vacuum pressure during the beam dump.

Emittance issue



Beam loss for three different emittances without IDs at the beam energy of 1.2 GeV.

Tune scanning measurement



Beam loss rate versus tune scanning for the SPS storage ring with the emittance of 61 nm-rad.

Summary

Beam loss monitor is an important tool to observe the beam instability and understand behaviors of the electron beam. Results of optics perturbation, ion-trapping, and vacuum leakage can be investigated. In addition, the good operation point in the resonance diagram can be chosen when the loss rate is plotted with the tune scanning. These results provide a possibility to improve the beam stability during machine operation of the SPS storage ring.

Acknowledgement

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References

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