Data Acquisition and Studies of Vibration Motion in TLS Beamlines

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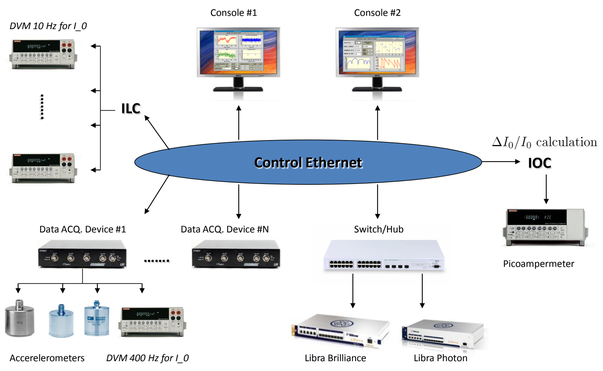
Abstract

TPS (Taiwan Photon Source) is being under construction while TLS (Taiwan Light Source) is still on operation at the same NSRRC site. It was observed that the stability of beamline intensity (Io) of TLS seemed a little deteriorated at daytime, when civil work is busy, compared to the nighttime. The intensity changes at different beamlines, however, were not so consistent with each other and furthermore not so agreeing with the electron beam. Therefore, to correlate how the ground vibration due to civil construction effected on beam behavior, the vibration measurement system is planned to integrated into the existing TLS control system. The system will support waveform acquisition which could be acquired on demand. Meanwhile, realtime 10 Hz rms detector which could be archived continuously is also considered to be built in the future.

Introduction

The TPS is a 3 GeV energy electron ring with 512 meter circumference and planned to be delivered to users' end stations in 2014. During the periods of its constructions, the TLS at the same site will continuous be on operations. The quakes caused by excavators or pile drivers seem to have deteriorated the stability of beamline intensity (ΔIo/Io) from 0.1% up to 10% or more. On the other hand, these stability indicatorsΔIo/Io between different beamlines have been not always concordant. Furthermore, it has been confused us over a long period that the indicators sometimes became worsen while the related subsystem remained normal even before TPS construction. It is suspected that different characteristics of vibration of different girders quite would be one of possible causes. Therefore, to clarify these inconsistent and not-yet-explained phenomena, the data acquisition system of vibration is planned to be built and continual expanded. In this report, the infrastructure of vibration data acquisition system will be presented as well as correlations of electron orbit, photon beam and vibrations of several spots will be shown.

Infrastructure of Data Acquisition for Vibration

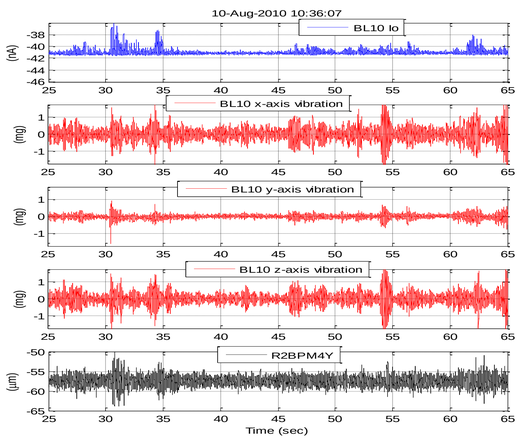


➢Infrastructure of data acquisition.

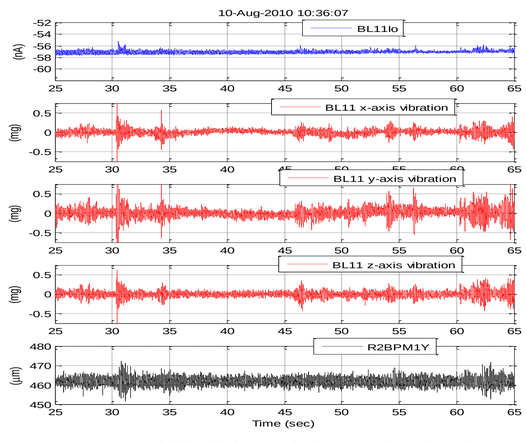
➢TPS construction site

- The DT8837 manufactured by Data Translation Inc. is employed as data acquisition tools for the accelerometers and photon intensity of beamlines distributed around the rings.
- The device supports functionality of bias current enable for ICP input.
- The equipped Ethernet interface is convenient for cabling and UDP trigger packet also provides sufficient synchronization mechanism for the distributed modules. All of the data from electron beam, photon beam, and vibrations could be synchronous acquired by software trigger within 100 msec.
- Fast transient motion could be also observed in adjustable higher time resolution and sampling rate up to 10 kHz.

Status of Normal Operation



➢ Time series of BL 10 Io and three-axis vibration and electron BPM R2BPM4Y.

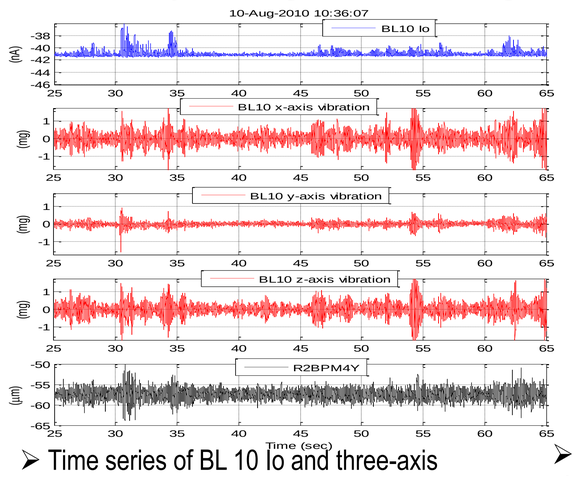


➢ Spectrum of BL 11 Io and three-axis vibration and electron BPM R2BPM1Y.

- The normal status of the beam stability in quiet: the stability of beamline intensity (ΔIo/Io) usually around 0.1%.
- The spectrum amplitude of electron beam stability is also less than 0.5 um below 50 Hz.
- The firmness of BL11 looks better than BL10's where the vibrations of three-axis at BL11 are all less than 0.01 mg and are less 0.1 mg at BL10.
- The spectrums of two electron BPM are very similar while they are not consistent with the spectrum of photon intensity Io of BL10 and BL11.
- Even these two Io behaviours cannot agree with each other. It infers that the vibration characteristics of two beamlines are not so consistent either.

Large Vibration Condition

- The inconsistence of the above section is also presented when large vibration occurs.
- Although the scales of the instabilities of photon intensity and vibration became larger when excavators or pile drivers were operated, but the characteristic of the behavior still quite differed.
- It can be observed that in the time domain, the transient motions (spikes) occurred simultaneously but the spectrum of these signals are not so correlated.



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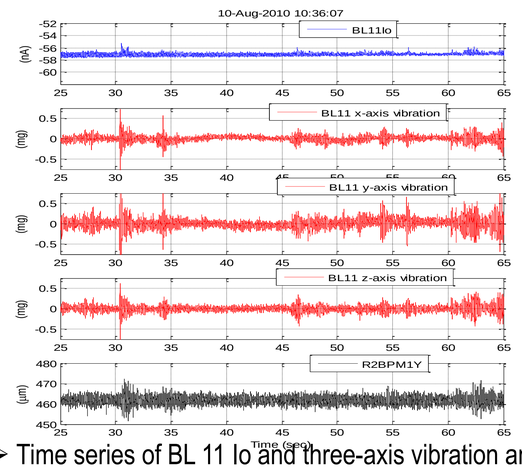
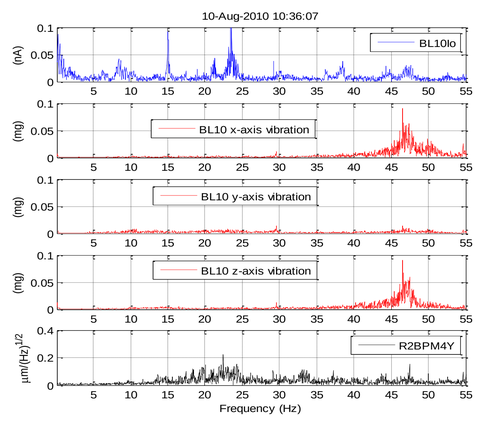


➢ Time series of BL 11 Io and three-axis vibration and electron BPM R2BPM1Y when large vibration occurs.



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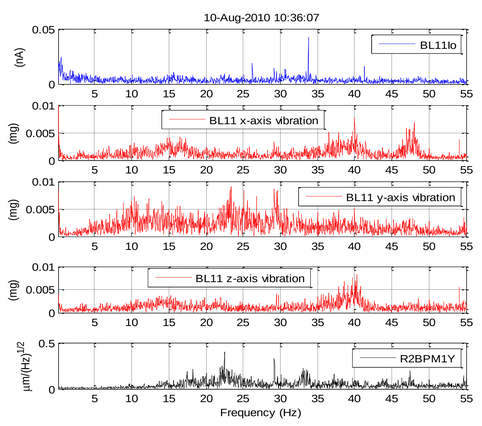
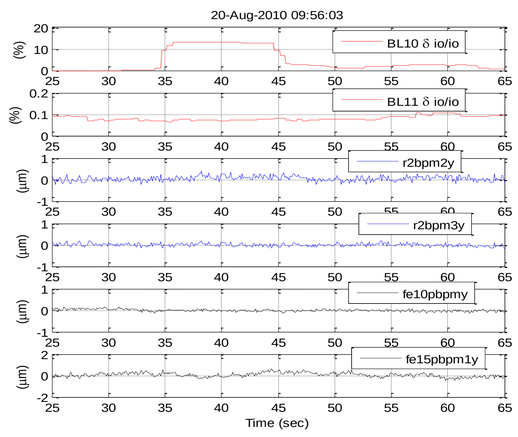


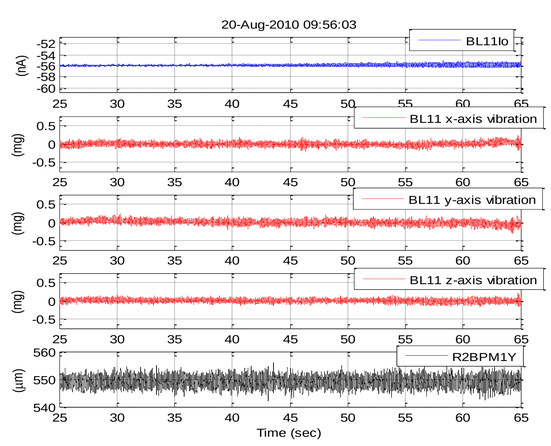
➢ Spectrum of BL 11 Io and three-axis vibration and electron BPM R2BPM1Y when large vibration occurs

• ΔIo/Io Change Study :



➢10Hz data of ΔIo/Io and electron and photon BPM. Only BL10 became worsen.

- The case of which the indicatorsΔIo/Io between beamlines are inconsistent was also studied.
- The stability indicatorsΔIo/Io of one BL10 became worsen in the meanwhile BL11 still remained normal and the electron beam orbit was also steady.
- It could be observed that an individual vibration event nearby the BL10 caused the BL10 quake. The vibration is local not global.
- If not all of the indicators ΔIo/Io become worsen simultaneously, the indicators are meaningless. However, even if the global vibration result in instabilities, the change of photon beam motion is not majorly from electron beam but itself vibration contributed more
- The electron beam are more stable than photon beam when large vibration occurs.



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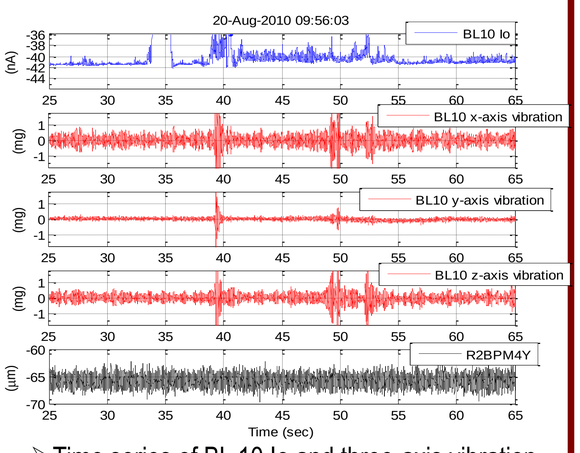

➢Time series of BL 10 Io and three-axis vibration and electron BPM R2BPM1Y. At 40 sec, a large vibration occurs.

Summary

- The installation of the accelerometers and its data acquisition are presented.
- The vibration acquisition system provides information about ground vibration so that it could be correlated with electron and photon beam. It helps to clarify some unclear confusions and contradictions in the TLS operation.
- It could be concluded that the inconsistency ofΔIo/Io between different beamlines was possibly resulted from local ground motion.
- The characteristic of the different girders quite differed. The firmness of storage ring girder is better than beamlines. The electron beam are more immune from vibration than photon beam.

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