



DEVELOPMENT OF BEAM ABNORMAL STATE MONITORING PROCESSOR ON SSRF STORAGE RING



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•Abstract

An abnormal beam state monitoring processor has been developed on SSRF, which is based on the hardware of self-developed digital BPM processor. By applying digital signal processing algorithms in the on-board FPGA, the processor keeps monitoring the beam running state. Once abnormal event is detected, the processor will record the abnormal event type and store the turn-by-turn beam position data before and after the event for later analyzing. The abnormal events including beam loss and beam position jump.

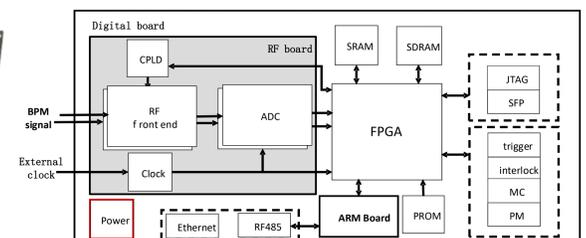
•Introduction

SSRF starts operation since 2009, some unexplained beam loss events occurred on the storage ring during the operation. BPM data analyzing is one of the effective means to find the possible reason. The Postmortem function on Libera captures turn-by-turn data before machine interlock. However, it relies on the input "Post mortem" signal from interlock system. Sometimes partial beam loss and orbit deviation may not trigger the interlock function, then Libera can't buffer the BPM turn-by-turn data for analyzing.

An in-situ DBPM has been developed in SSRF. Based on the platform, a serial of processors been developed successfully for variety applications over the past few years, including stripline BPM, cavity BPM, BAM, booster BPM, storage ring BPM. The DBPM has been deployed in DCLS, SXFEL, SSRF and Sirius linac in a large scale. It consists of an ADC daughter board and a FPGA+ARM mother board.

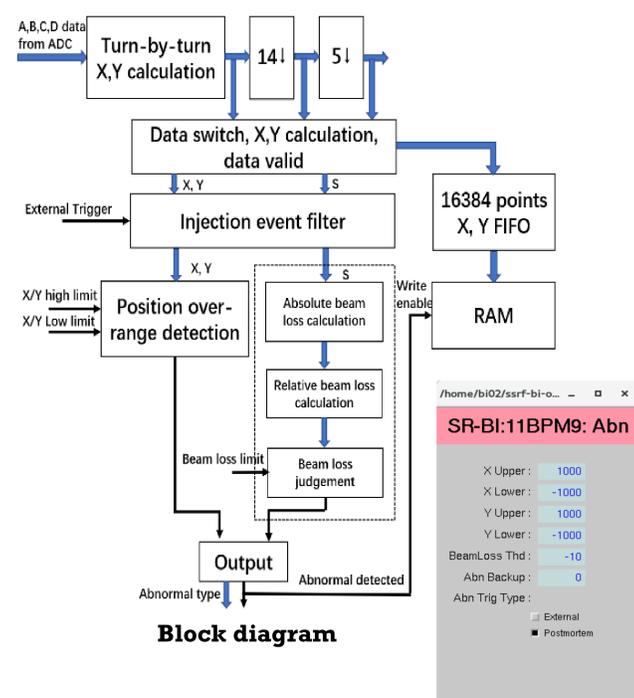


Requirements	Value
ADC	4 channels, 16bits
Central Frequency	499.654MHz
Sampling clock	External/internal
Sampling rate	117.2799MHz
Turn-by-turn rate	693.964kHz
Trigger	External/internal/period
Signal processing	FPGA
Data	ADC/TBT/FA/SA
Attenuator	0-31dB
OS	Arm-Linux
Control	EPICS

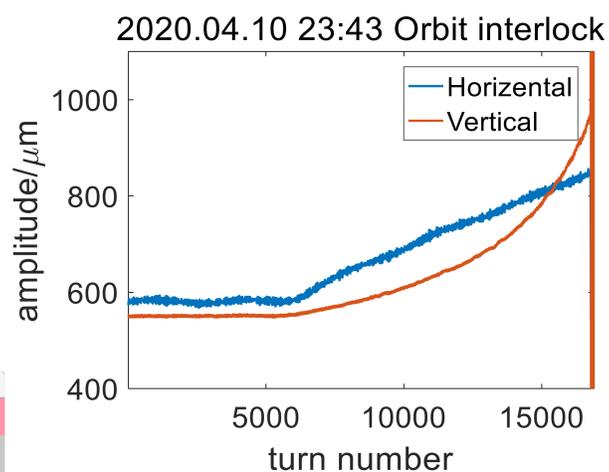


DBPM

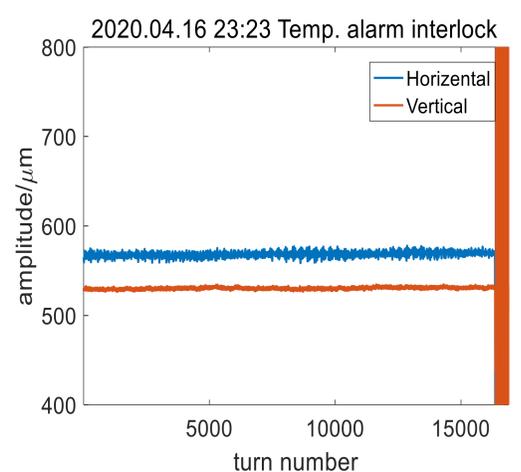
•Design & Operation on SSRF



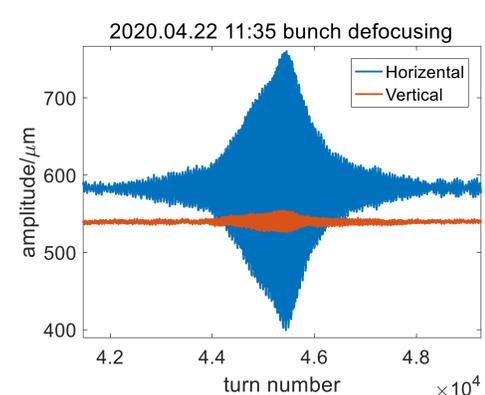
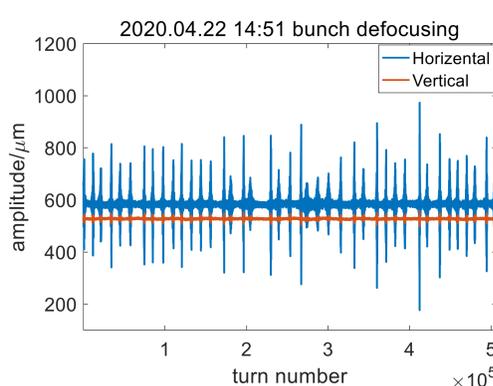
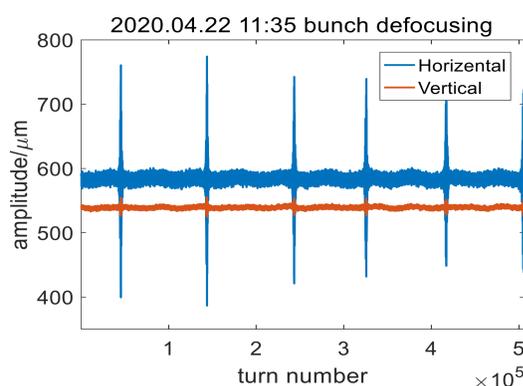
Configure panel



Obvious orbit drift appeared at about 6000 turns, then the beam lost totally after about 10,000 turns. Checking with operation log, an orbit interlock event was recorded at that time. The buffered data reveals the possible reason of the beam loss is the magnet failure.



The orbit seems quite normal before the beam lost. Operation log recorded a temperature alarm interlock at that time. It is likely that the temperature interlock system has failed.



There was no beam lost, but periodic orbit oscillation can be seen. Checking with the operation log, bunch defocusing was recorded at that time. The beam behavior is consistent with the data.