BEAM MONITOR SYSTEM FOR CENTRAL JAPAN SYNCHROTRON RADIATION FACILITY

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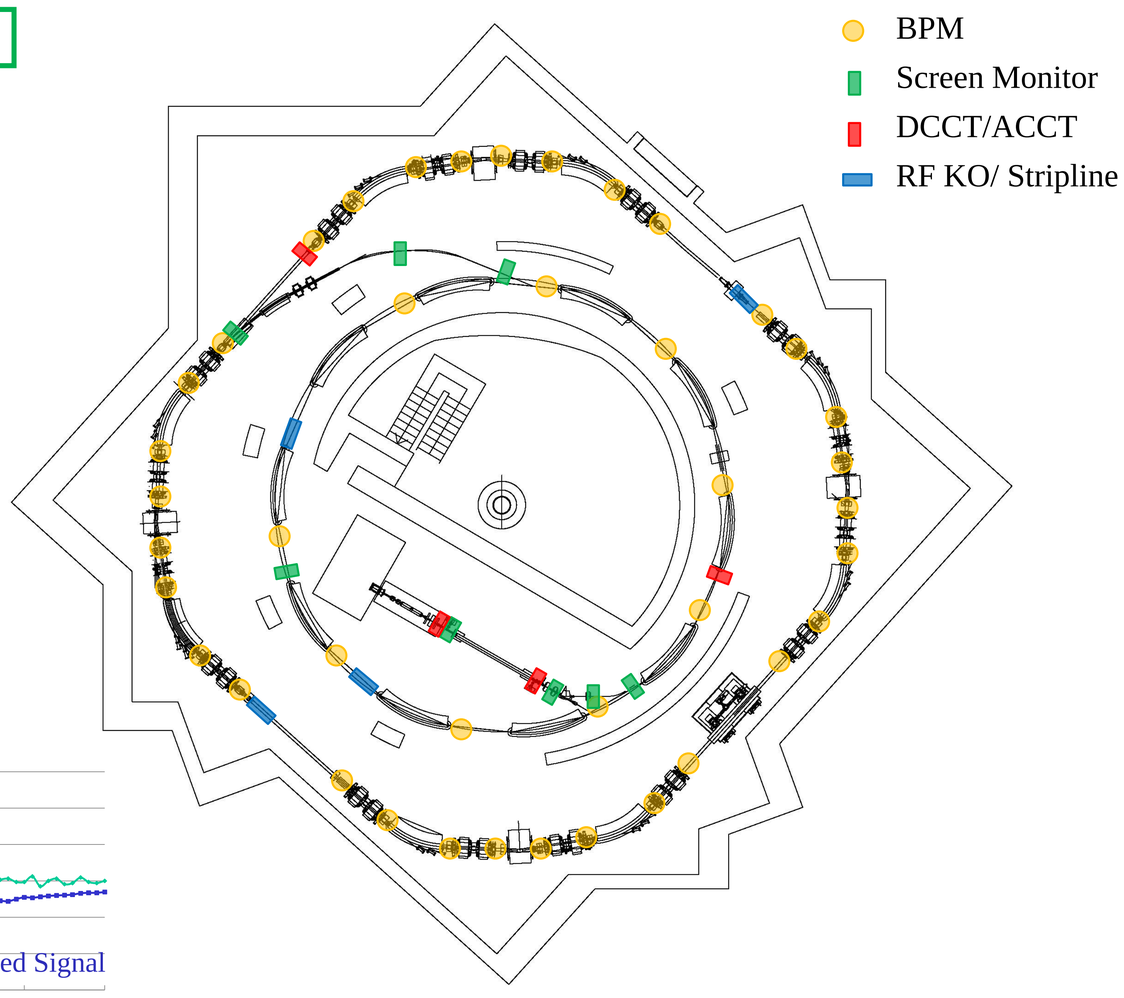
Abstract

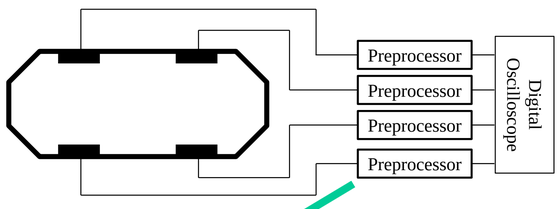
We have designed beam monitor system for light source accelerator complex of Central Japan Synchrotron Radiation Facility. A simple turn-by-turn beam position monitoring system based on a fast digital oscilloscope was developed. Performance of the system was evaluated at the UVSOR-II storage ring. We also designed RF knockout system for measuring betatron tune of electron beam in the booster synchrotron and in the storage ring, based on studies at UVSOR-II.

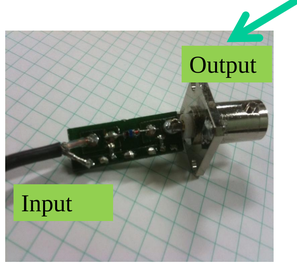
1. Overview of accelerator complex and beam monitoring system

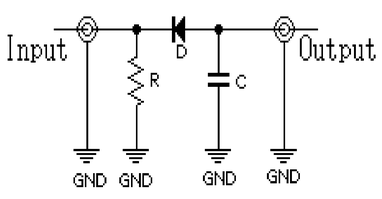
Storage Ring		**Linac**	
Energy	1.2 GeV	Energy	50 MeV
Circumference	72 m	Charge	> 1 nC
Beam Current	> 300 mA	Pulse Length	1 nsec
Natural Emittance	53 nmrad	Repetition	1 Hz
RF Frequency	500 MHz		
RF Voltage	500 kV	**Super Bend**	
		Number	4
Booster Synchrotron		Magnetic Field	5 T
Energy	50 MeV – 1.2GeV	Bending Angle	12 deg.
Circumference	48 m	Critical Energy	4.8 keV
Beam Current	> 5 mA		
Repetition Rate	1 Hz		



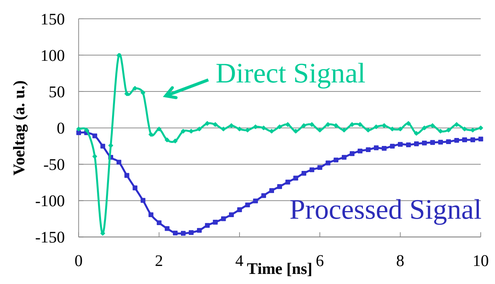
2. Turn by turn beam position monitoring system





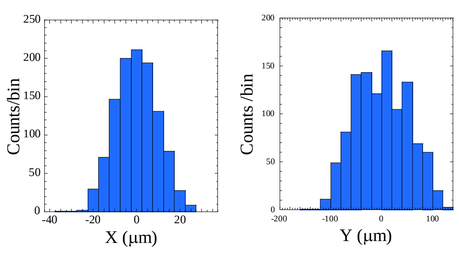


Diode: 1SS99
Condenser: 47pF
Resistatnce: 471Ω

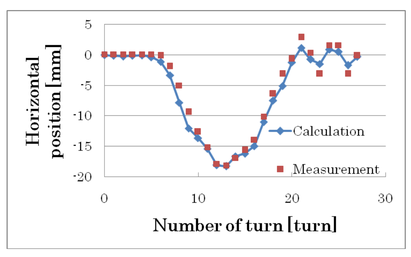


Direct signal from pick up electrode is too fast to measure the peak with the oscilloscope.
A simple preprocessor to make the signal broader and resolve the sampling problem was fabricated.

Performance test of TBT BPM system @ UVSOR-II

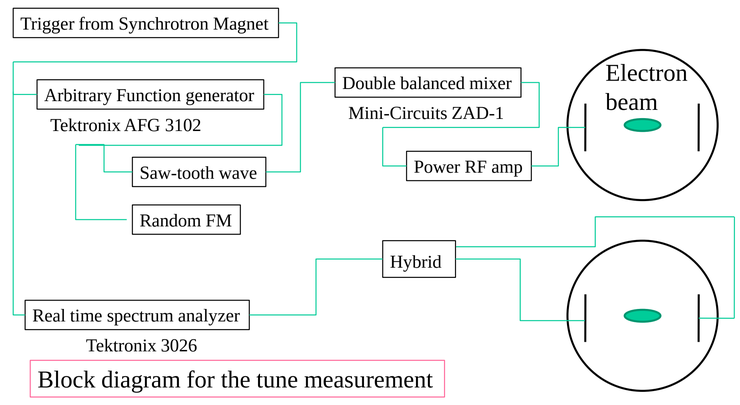


Variation of obtained beam position in repetitive measurements of identical beam positions with the TBT BPM system. RMS values of 10 μm for X and 50 μm for Y are obtained .

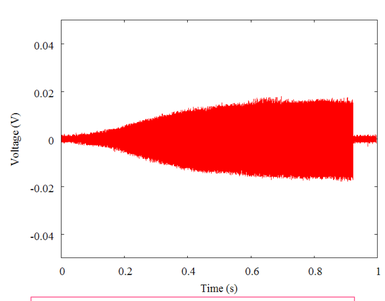


UVSOR-II injection bump orbit measured by TBT. Calculation using Elegant are also They agree very well.

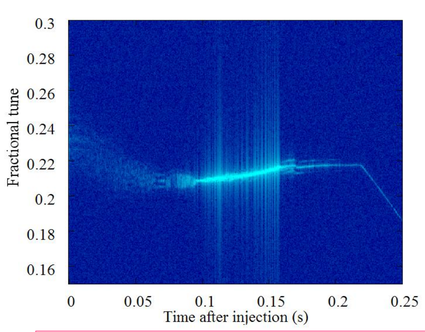
Experiment 2: Measurement of betatron tune @ UVSOR-II booster synchrotron



Block diagram for the tune measurement



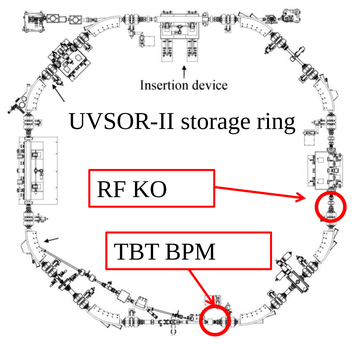
RF signal applied to electrodes.



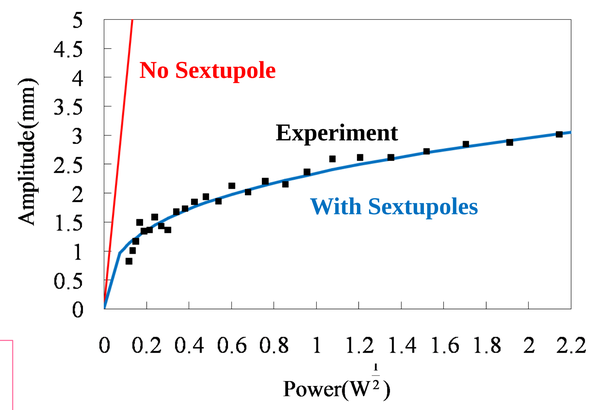
Measured tune at the booster synchrotron.

3. RF knockout system to measure betatron tune

Experiment 1: Amplitude of betatron oscillation excited by RFKO @ UVSOR-II



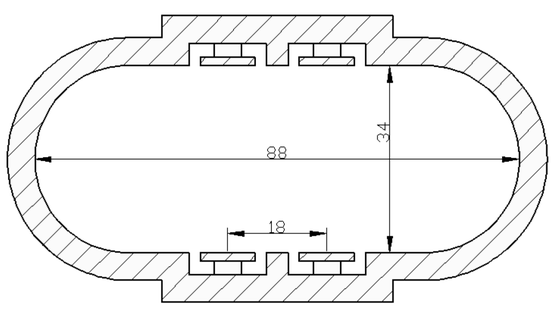
UVSOR-II
E = 750 MeV
C = 53.2 m
Betatron tunes:
Horizontal 3.71
Vertical 3.20



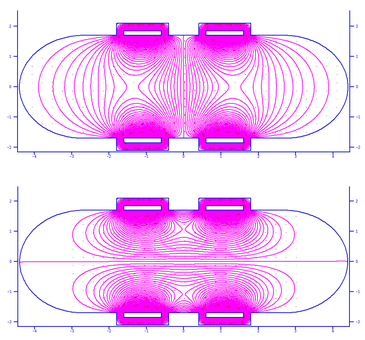
Betatron oscillation amplitude was measured using the turn by turn BPM as a function of applied power to RFKO. Frequency of RFKO was adjusted to betratron frequency. The result is compared with simulation including, excitation, damping and setupoles.

The simulation including the sextupole magnets reproduces the saturation of amplitude.

Design of RFKO for the Central Japan Synchrotron Radiation Facility



Cross section of RFKO chamber.
The characteristic impedance is 50 ohm.



Field calculations using Poisson.
The distance between striplines was chosen to produce the same kick in the horizontal and vertical directions. The power needed for one stripline to excite 0.5 mm amplitude of betatron oscillation is estimated to 16 W.