DEVELOPMENT OF FAST CONTROLS FOR BEAM WIRE SCANNER FOR SuperKEKB

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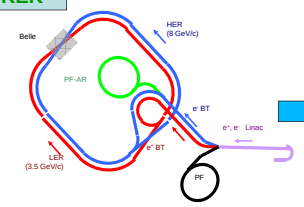
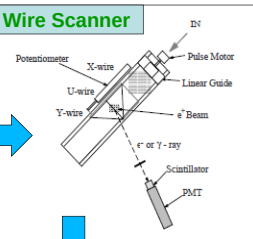
WEPD26

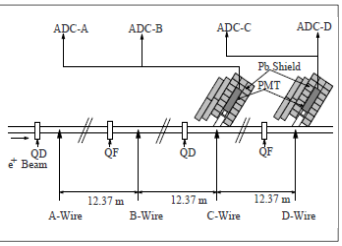
KEK



Wire Scanner

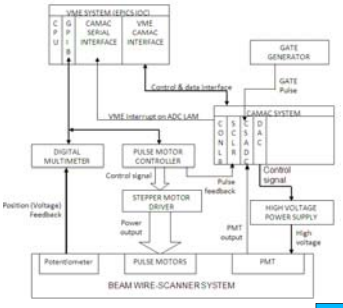


- Used for Non-destructive monitoring of beam profile
- A frame holding 100μm Tungsten wire forming X, Y & U wires perpendicular to beam
- A stepper motor drive to move the frame inside beam line
- A PMT with Plastic Scintillator to detect Bremsstrahlung emitted due to interaction of wire with Beam
- A set of four wire-scanner for measuring beam emmittance & Twiss parameter for optics
- A control and data acquisition system, synchronized with beam pulse timing



Existing system

- VME and CAMAC based hybrid system
- VME PowerCore 6750 CPU with Vx-Works 5.3
- CAMAC based Data acquisition system (e.g. ADC, DAC etc.)
- Using EPICS Base-3.13 version
- **Not synchronised** with LINAC Timing system
- Beam mode identification using special method
- IOC independent data acquisition process
- Uniform wire speed while scanning the beam
- **Not suitable** for acquiring **multiple beam mode data simultaneously**



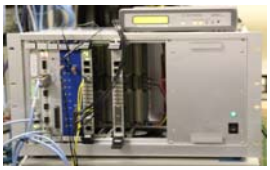
Hardware Architecture

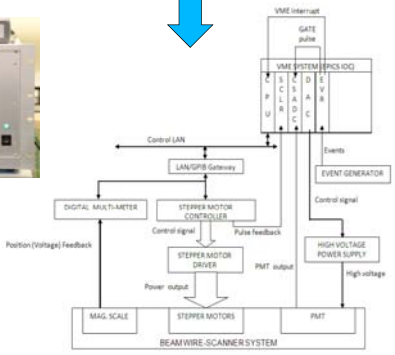
Why new control?

- 8 Gev LINAC, simultaneously, injects of e^- and e^+ beam of different characteristics into
  - KEKB high-energy ring (HER) – 8.0 GeV, 2nC
  - KEKB low-energy ring (LER) – 3.5 GeV, 2nC
  - Photon Factory (PF) – 2.5 GeV, 0.1nC
  - PF/AR – 3.0 GeV, 0.1nC
- A wire-scanner data acquisition system, synchronized with LINAC Timing system, for **simultaneous measurement** of beam profiles of multiple beam modes
- Simultaneous measurement reduces measurement time and hence improves the overall efficiency of the transport line
- Simultaneous measurement helps in PF and PF/AR mode beam studies without degradation of luminosity at KEKB!

New System

- Emerson MVME5500 CPU card, EPICS Base-3.14.12.1 and Vx-works 6.8
- VME based ADC (14bit, 15μsec conversion time), Scaler and DAC
- MRF's event receiver module (VME-EVR-230RF) - synchronizing the data acquisition process with LINAC timing system
- A LAN/GPIB converter to communicate with Pulse motor controller (PMC) and Digital Multimeter (DMM) for control and data acquisition.
- ADC Gate generated by event receiver – simultaneous measurement of multiple beam modes (pulse-to-pulse)
- Multispeed wire movement to minimize time of scan and maximize useful data
- Options to user for selecting beam modes for data acquisition
- Application specific EPICS record, compatible to SAD user interface



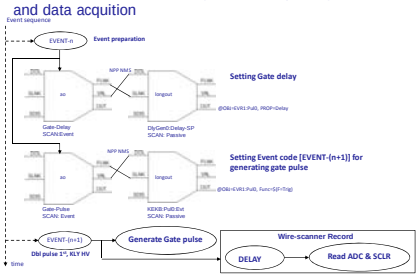


Special features

- **Wire scanner (WS) record**
  - ✓ A waveform record with multiple input links (26, INPA....INPZ) for collecting data
  - ✓ A Ring Buffer, appending an array of data (from input links) on every scan
  - ✓ Provision for delay the processing – to ensure completion of ADC conversion (if LAM is absent!)
  - ✓ Fields for defining number of SCALER, BPM (4 ADC per BPM) and wire-scanner ADC channel
  - ✓ Field for appending BEAM mode (event code) to data on every scan for identification
  - ✓ Option for resetting the buffer
- **Multi-speed scanning**
  - X, Y & U wire interact with beam at three distinct regions of whole span
  - Slow speed scanning at regions of interactions results into better beam profile
  - Higher speed (Fast) at other regions results into optimum scan time

Data Acquisition Strategy

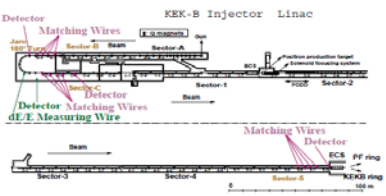
- **Requirement:** configuration of pulse generator (i.e. delay & timing event) for each beam mode to generate ADC Gate synchronized with beam pulse
- **Solution:** Utilize two consecutive timing events for pulse generator configuration and data acquition

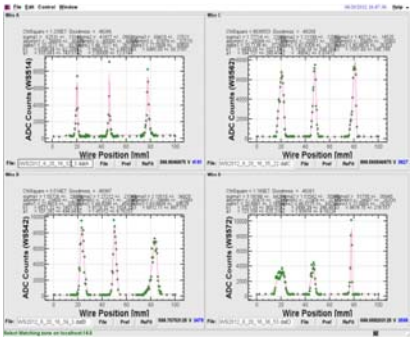


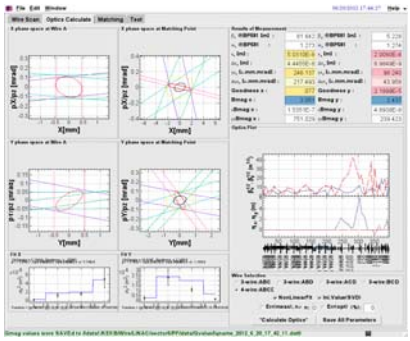
Conclusion

- ✓ New system is installed at Sector 5 of LINAC BT for testing
- ✓ The system is tested with PF and PF Study modes satisfactorily
- ✓ measurement became **fast and precise** after upgradation
- ✓ Data Acquisition system becomes simple and **easy to take pulse-to-pulse beam data**

✓ **The system will contribute significantly for beam tunning during SuperKEKB commissioning and subsequent stages**







Test results