SLAC - End Station A ILC testrun – April '06

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Overview, status, results and future plans

Dubna meeting 30-31 May 2006

End Station A

Technical drawing of the End Station setup
 In the alcove (BPMs 41, 42) (ESA_zlocations1.pdf)
 Further downstream: SPEAR girders with BPMs 3,4,5 (new triplet) and BPMs 9,10,11 (ESA_zlocations2.pdf)

Last run :

T474 : energy spectrometer
T480 : wakefield box

Bunch length studies





Old SLAC BPMs, x and y separat

New model, no Q, x and y in same cavity



A-Line setup, optics configurations



BPM Data Acquisition, Readout



Amplitude and Phase determination

One way.. fitting the waveforms !



However extremely sensitive :initial frequency of waveformstarting point for fit

 \rightarrow Often fails :-(

Practical method : Digital DownConversion (DDC)

Amplitude and Phase determination

The other way... DDC

Conversion to baseband by software multiplication with sin wave in timedomain,

Subject to number of input parameters :

- filter bandwidth
- decay constant of exponential (Q factor)
- resonance frequency
- starting time of signal (t0)



Handling of saturated pulses : needs some work !!

<u>Amplitude and Phase</u> : normalization by Q cavity (monopole signal)

Default calibration : corrector scans





Corrector scans to calibrate the measured positions in BPMs

use 2 correctors in both x and y

BPM4 mover calibration

In ILC would be very 'unpopular' to use corrector scan for BPM calibration... Use BPM4 mover (high precision!) to calibrate BPM4 : both x and y ! Crosscheck existing calibrations

Could be very valuable tool for energy BPMs (all on moving platform...)



BPM4 mover calibration

Results e.g. for runs 319-320-321-323-324 :



Determining BPM resolution



Rough BPM resolution : eg. x10Pos

Get rid of beam jitter : correlate positions in different BPMs



Task is now e.g. to understand features like :

Singular Value Decomposition

$$A \cdot x = b$$

x : vector with correlation coefficientsb : measured position in BPM10x



Same data run (712), using BPMs 9x and 11x

Alignment plots : used BPMs 41 & 11



Fairly possible to stear beam down on all BPMs even though they are not on movers

Least square fitting with systematics

- Trying to determine the orbit : need some discussion (T474 meeting)
 - drawing straight line between BPMs 41 and 11 ?
 - define orbit by BPMs 31,32 and 41,42 ?
 - Fitting globally, a line ?, a parabola (earth's magnetic field)?
- Trying to implement an alternative for SVD:
 - http://www.phys.ufl.edu/~avery/fitting.html

$$\sum^{2} = y - A \quad T V^{-1} \quad y - A$$

$${}^{2} = \sum_{l} y_{l} - A_{l} - B_{l} v^{T} V_{l}^{-1} y_{l} - A_{l} - B_{l} v$$

Systematic effects (offsets) you try to get out by collecting multiple fits

Online position display in LabVIEW

- Apply and tune DDC algorithm in LabVIEW, and hope it's fast enough ;-)
- Integrate calibration information
- Ship as subvi to DAQ computer for July test run



Data processing

Large amount of runs taken :
stability runs, calibration runs
different beam optics configurations
external and internal clocking

Copied to UCL

NEED :

Determine optimised parameters (filtBW, gamma, freq,...) for DDC algorithm on BPMs 3,4,5

Go over all calibrations manually and redo (check stability, think of automation)

Reprocess runs

Next few weeks

Agree upon default data quality, selection criteria, orbit definition (meeting) :

- encoded in libRooEsa
- **Start systematic studies : run conditions in runlist : resolution stability versus :**
 - Temperature (ambient, thermocouple,...)
 - Beam energy
 - Bunch charge and shape
 - Internal vs. external clocking
 - Effect of beam optics configuration
- Check calibration stability, seek out factors that influence calibration...

Endgoal for data analysis should be a <u>report</u> describing in detail the collective studies done during this testrun and <u>come up with a plan</u> for the July running !!

Long term stability runs : 8-hrs shift : calib – stability – calib - stability...

Actively study effect of temperature

FONT plans to install a mess up the beam --> study effect on BPM resolution..

Discussion, phoneconf. preparation

- What needs to be done in for the next years of testrunning
 - Refurbishement of magnets (at SLAC)
 - Setup for measurements for magnets : readout, control (power supply)
 - Think of how accurately magnets need to be measured ?
 - Do we need to monitor continuously ? + which probes/method ? + how accurate ?
 - What is available (SLAC, Dubna ?) (possible to transport ?)
 - Magnet installation
 - Magnet specifications from old SLAC magnet --> Dubna simulation
 - What is sergei's code doing, using TOSCA simulation of magnets ? Calculation of effect of imperfections on beam optics ??
 - What kind of effects can TOSCA simulate ? + how accurate ?
- How do we split the tasks, who is doing what ?
- What equipment is needed, what is available ??
 - Should come up with a list !!! + assign people to that list
 - If stuff needs to bought, where does the money come from ?