Integration, commissioning and operation
SVT/SVT DAQ Review

Per Hansson Adrian

Introduction

This talk will address the interface to other sub-systems

- Slow control
- Beamline
- Software

What are the interfaces?
Who is responsible from the SVT group?
What are the major outstanding tasks/issues?

TDAQ integration discussed in Ryan's talk

All areas covered and exercised successfully in Test run

but Test run did not include high intensity electron beam

- Updates to beamline
- Operational safety
- Updates/improvements needed

Slow Control Interface

Dedicated slow control group (H. Egiyan, JLAB)

- Bi-weekly meetings since summer ’13
- SVT representatives: S. Uemura, P. Hansson, T. Maruyama
- Team intact from Test run

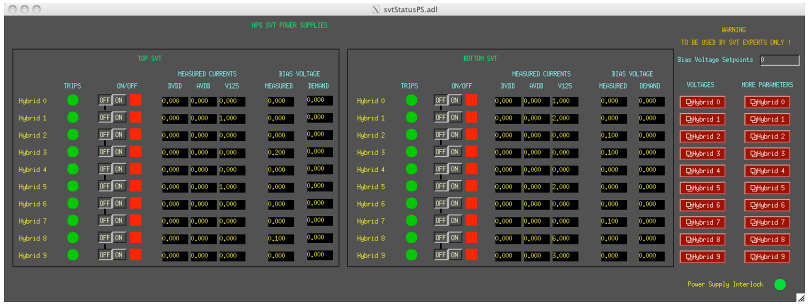
Slow control interface

- Power: control and monitoring — ✔Test run (new hardware)
- Cooling: control and monitoring — ✔Test run (new hardware)
- Motion control — Not exercised
- Interlocks — ✔Test run (need update)

EPICS control software used across HPS detector incl. SVT

- Developed and maintained by slow control group
- SVT representatives provide input as needed

SVT power control GUI in Test run



Slow Control: Power, Cooling and Motion Control

New MPOD power supplies compared to Test run [Hansson, Uemura, Reese]

- Well known system at JLab and in the slow control group

⇒ Receive end of Nov for testing and integration with DAQ tests

⇒ EPICS control software being implemented in slow control group

⇒ Bridge to SVT DAQ via CA server [Herbst]

Cooling system updates from Test run [Nelson, Hansson]

- New chiller for SVT modules (similar requirements)
- Additional cooling loop (T~20C, ~100W) for FE boards

⇒ Choose and acquire new chiller [slow control]

⇒ Chiller integration test during full system DAQ testing (spring 2014)

Motion controls not exercised during Test run [slow control, Maruyama, Uemura]

- Crucial for operational safety with electron beam
- EPICS based monitoring and control

⇒ Build control drivers, software

⇒ Fully test and calibrate (speed, precision, reproducibility)

⇒ Define installation and alignment procedure

Slow Controls: Interlocks

Test run interlock had inputs from

- Vacuum chamber temperature and pressure
- SVT cooling flow
- Software interlock (e.g. SVT temp.)

⇒ Add beam fast shutdown (FSD) signal from accelerator [beamline group]

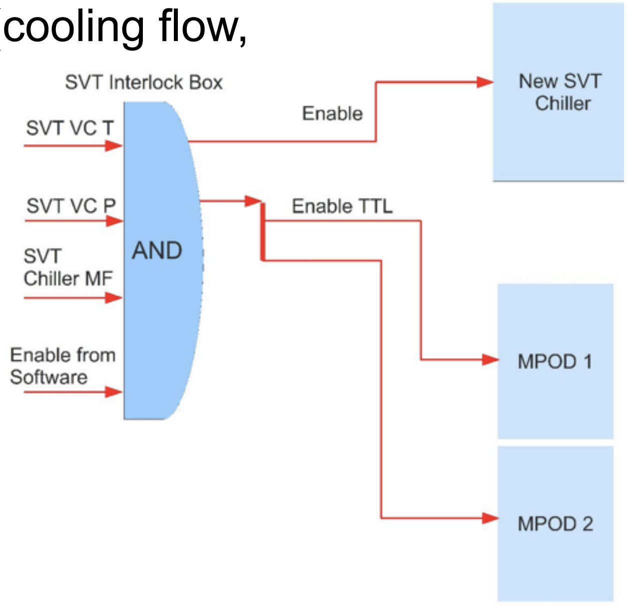
New interlock system being built by slow control group

- SVT power supplies will be shut down in any event (100ms delay)
- Chiller will be shut down depending on interlock signal (cooling flow, vacuum quality)

⇒ SVT rep. provides input as needed [Hansson, Uemura]

Issues from Test run are being/have been addressed

- New chiller and flow switches
- More reliable and sophisticated control (PLC system)
- System shakedown time!



Beamline Interface

Dedicated beamline group (K. Moffeit, SLAC)

- Weekly meetings
- SVT representatives: Maruyama, Nelson, Uemura, Hansson
- Team at SLAC and JLab intact from Test run

Beamline interface

- Installation — ✔ Test run
- Alignment
- SVT commissioning

} ✔ Test run (additional steps needed)

- Operational safety
- Radiation environment

} No electron beam in Test run

Installation and Alignment

Follow generally successful Test run installation and alignment [Nelson]

- SVT surveyed at SLAC
- SVT shipped to JLab
- Assembled and lifted into vacuum chamber
- Surveyed on beamline (touch & laser probe)

Additional steps for electron running [Maruyama, Uemura]

- Align and commission motion controls

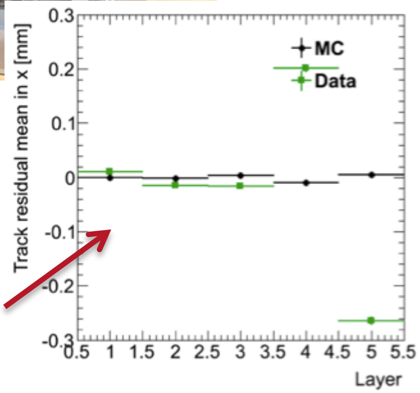
Survey alignment procedure brought sensors to within 0.2mm

Improvements [Nelson]

- Flatter/stiffer Si from module design (done)
- Less sag/roll from more rigid support plate (done)
- Improve geometry desc. and survey points
- Special runs w/ zero B-field and upstream target

**Track-based alignment discussed in software part*

Test run residuals within 200μm after survey



Commissioning and Calibration

SVT checkout and calibration [SVT group]

- Successful calibration in Test run (pedestals, noise, gain)
- DAQ debugging was crippled by schedule in test run

⇒ System shakedown time is now firmly in schedule (at SLAC and JLab)

⇒ Improved non-expert calibration interface [Moreno]

DAQ components ready	**Full DAQ tested**
3/1	6/2

Initial beam commissioning [beamline group, TDAQ, Nelson, Maruyama]

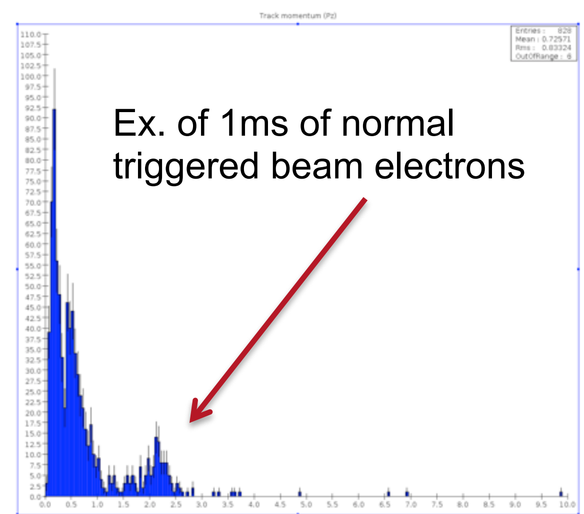
- Establish safe beam (low/high current) through HPS system
- Commission motor controls, interlocks, beam shutdown system
- Determine trigger latency and DAQ integration

⇒ Detailed beam commissioning plan developed in beamline group

SVT momentum scale and resolution [Graham]

- Initial estimates/cross-checks from ECal track matching
- Scattered beam electrons (prescaled trigger set)
- Trident full kinematic fit

⇒ Full simulation studies in analysis/software group (large overlap of people)



Protection Collimator

Purpose

- Keep focused beam from hitting active part of silicon detector
- Reduce flux penetrating protection collimator in silicon detector to an acceptable level.

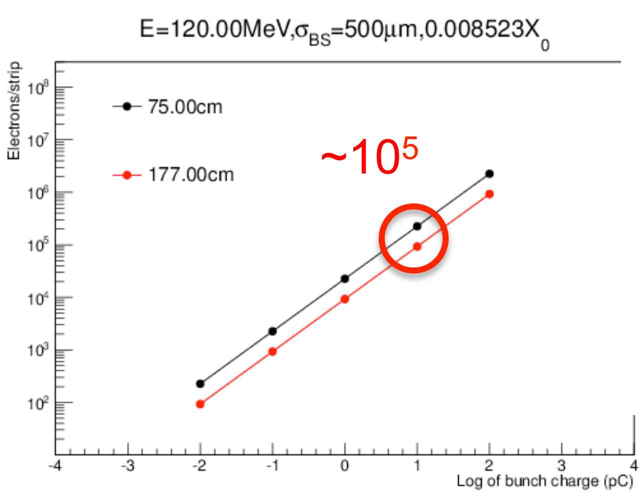
Design depends on damage susceptibility of SVT modules

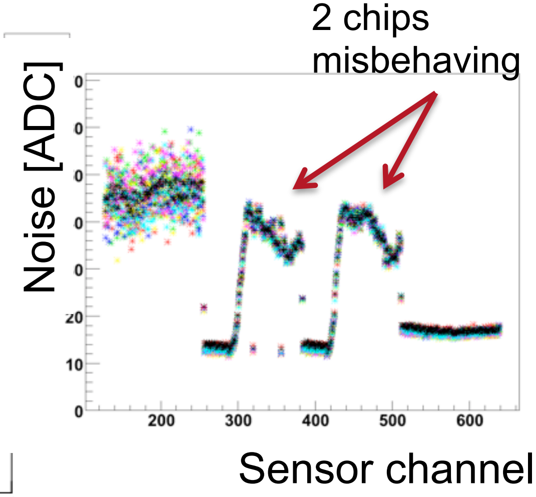
- Hard to reliably estimate susceptibility to damage

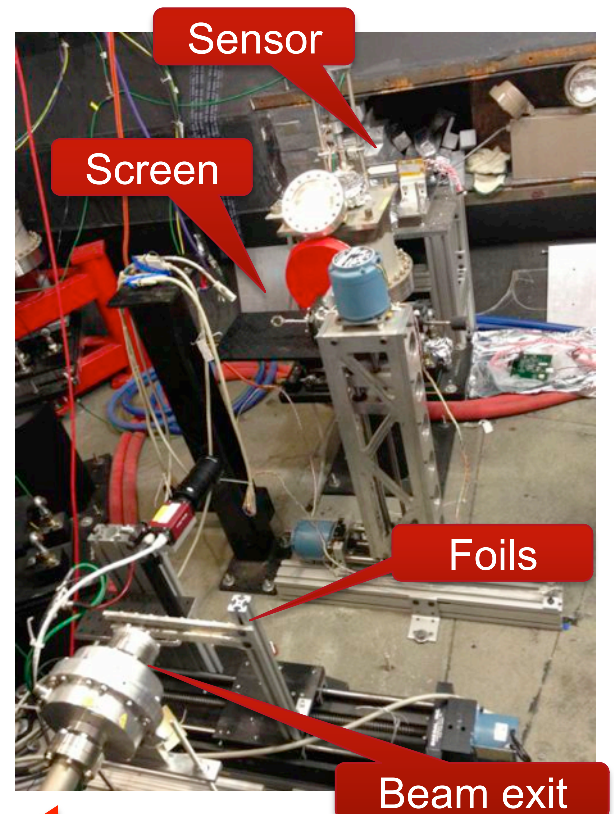
⇒ Test tolerance using a beam accident test beam

NLCTA test beam in Sep. ’13

- Scan charge density/bunch and bias voltage
- Damage first observed at **~10^5 e-/strip**







e^-

120MeV, 10Hz, 0-100’s pC

$\sigma_{x,y}$~500um

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Collimator preliminary design exists from beamline group

⇒ Keeps charge density at **~10³ e-/strip** (damage at ≈10⁵)

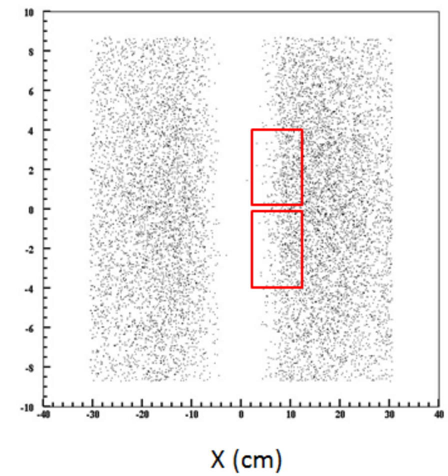
Remaining issues

⇒ Sensor edge damage susceptibility test beam [Hansson]

⇒ Final design, commissioning and testing procedures with initial beam [beamline group, SVT rep.]

Distribution at SVT Layer 1

1 cm W



~1500/strip in 40 μs @200 nA

38×10⁶/sec

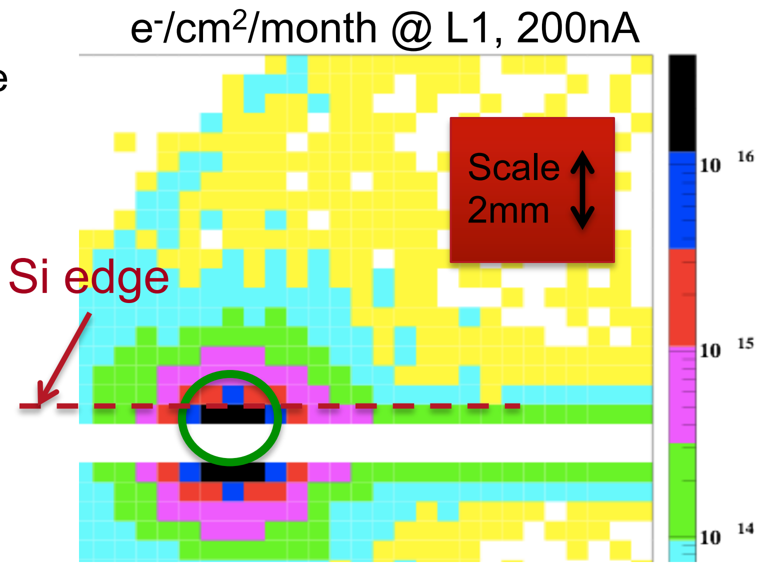
Test run sensor damage: ~10⁵/strip in ~ps

Normal run: 1% occupancy in 8 ns → 1.25×10⁶/sec

Radiation Damage to Silicon

Beam energy electrons (~1-6GeV) induce bulk damage

- Expected fluence close to sensor capability in active region (>1x10^{14}neq/cm^2)
- Higher localized fluence in edge guard structure
- SVT designed for easy replacement of modules



Localized damage in guard structure less studied

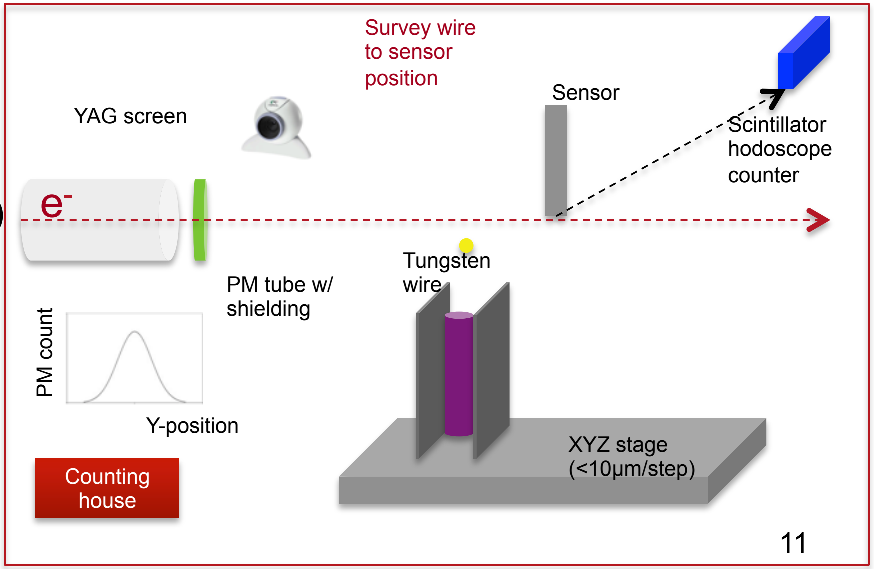
- Understand any impact on operation or physics performance (e.g. charge collection)
- Study with irradiation test beam

ESTB SLAC Irradiation test beam

- Irradiate sensor edge with primary beam (~days)
- Study sensor behavior (calibration, laser probing)

⇒ Proposal made; design and manufacturing to be made [Hansson, Nelson, Field]

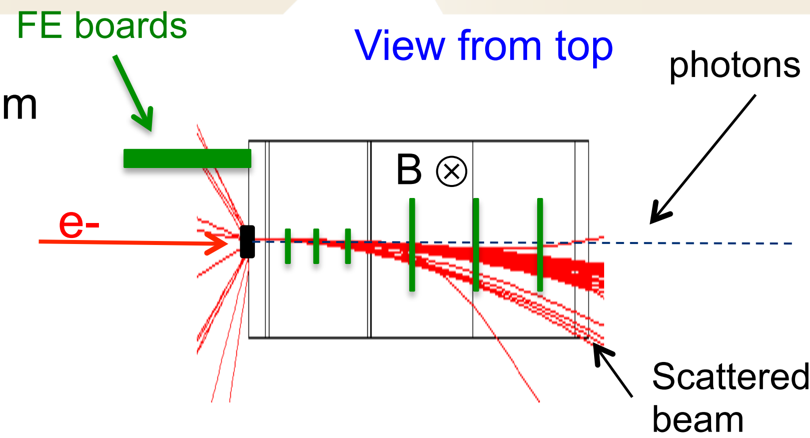
⇒ Hope for beam in early 2014



Radiation Environment for Electronics

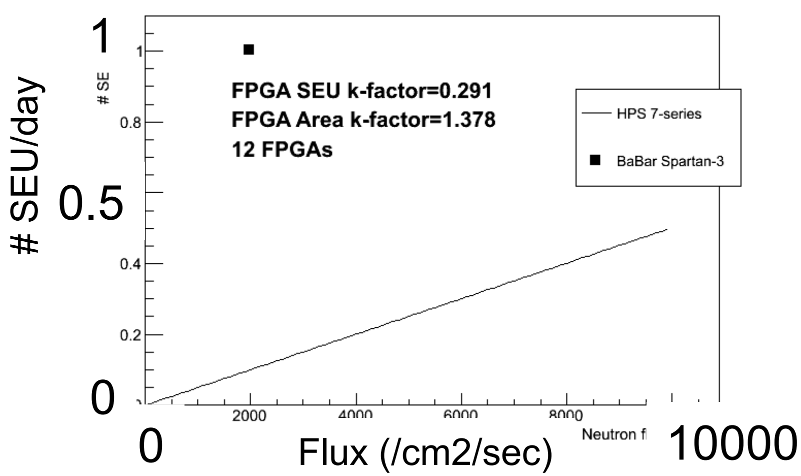
Neutron background from degraded beam

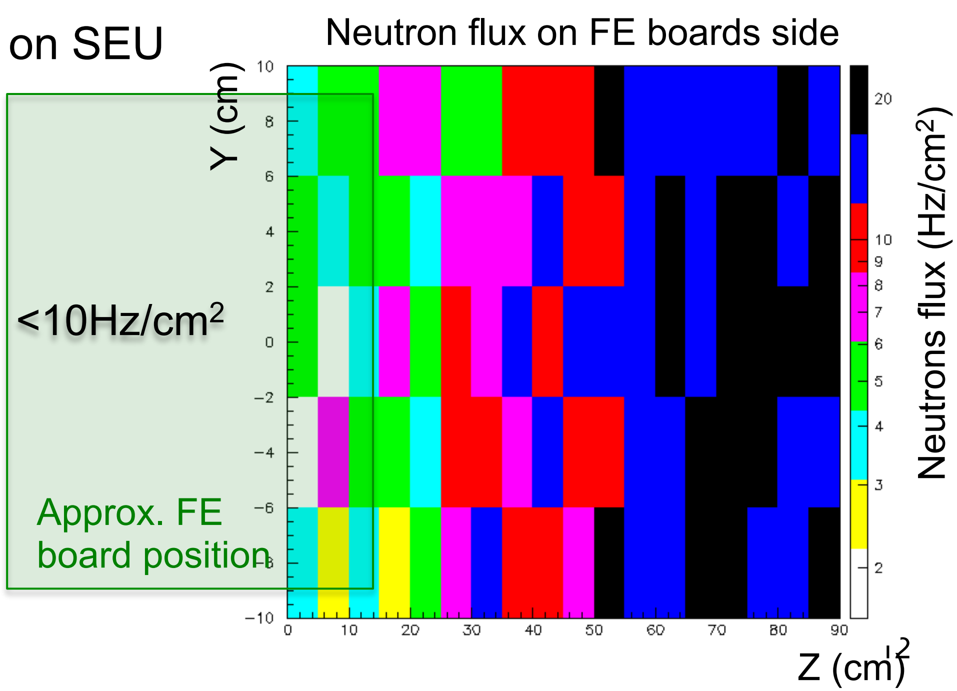
- Electronics are mostly outside degraded e$^-$ beam
- X-ray dose from target is small
- Simulate neutron background with FLUKA



Components

- Hybrids: APV25 tolerates >20Mrad, >10^5 neutrons/cm^2/sec in CMS)
- FE boards: normalize with BaBar data on SEU





⇒ Expect <<1 SEU/day

Software Interface

Dedicated software group (M. Holtrop) and analysis group (M. Graham)

- Weekly meetings
- Team at SLAC and JLab intact from Test run; additional manpower from new collaborators expected
- Large overlap of SVT manpower in these groups [Nelson, Hansson, Uemura, Moreno, Maruyama]

Software interface

- SVT Simulation ✔Test run
- Alignment ✔Test run (additional work needed)
- Conditions ✔Test run (interfacing with JLab, based on DB)
- Monitoring ✔Test run (updates needed)

Software Interface – outstanding issues/tasks

Track-based alignment [Hansson, Graham]

- MillipedeII for HPS (setup, ongoing tests)
- Flexible alignment framework (interface to cond. DB)
- Use of special runs (B-field=0)

Conditions [Moreno]

- New conditions DB interface for SVT (ongoing tests)
- Log SVT DAQ conditions info to JLab “archiver” DB

Monitoring [McCormick]

- Define low-level monitoring for SVT DAQ and user interfaces
- Alignment monitoring (residuals, χ^2)
- Trigger latency timing monitoring
- Monitoring during position scans