The HPS SVT and SVT DAQ Projects

Tim Nelson - SLAC

SVT/SVT DAQ Review

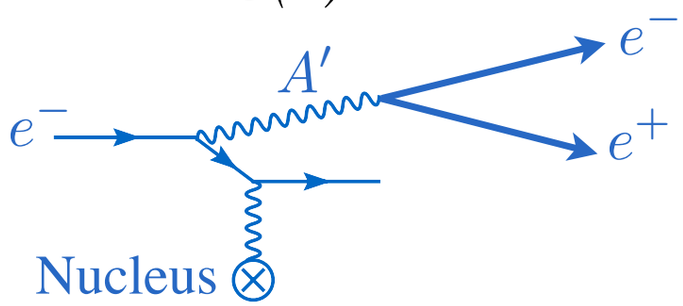
November 5, 2013

Outline

- Requirements and Overview
- Working prototype: HPS Test SVT
- HPS SVT for 2014-2015 running
- Tasks and project organization

Physics

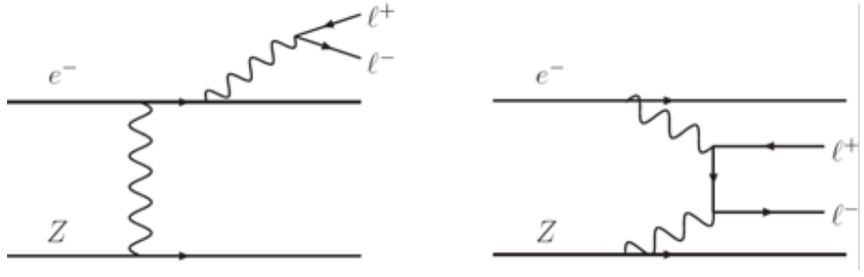
Fixed-target production of a dark-sector $U(1)$ we call A':

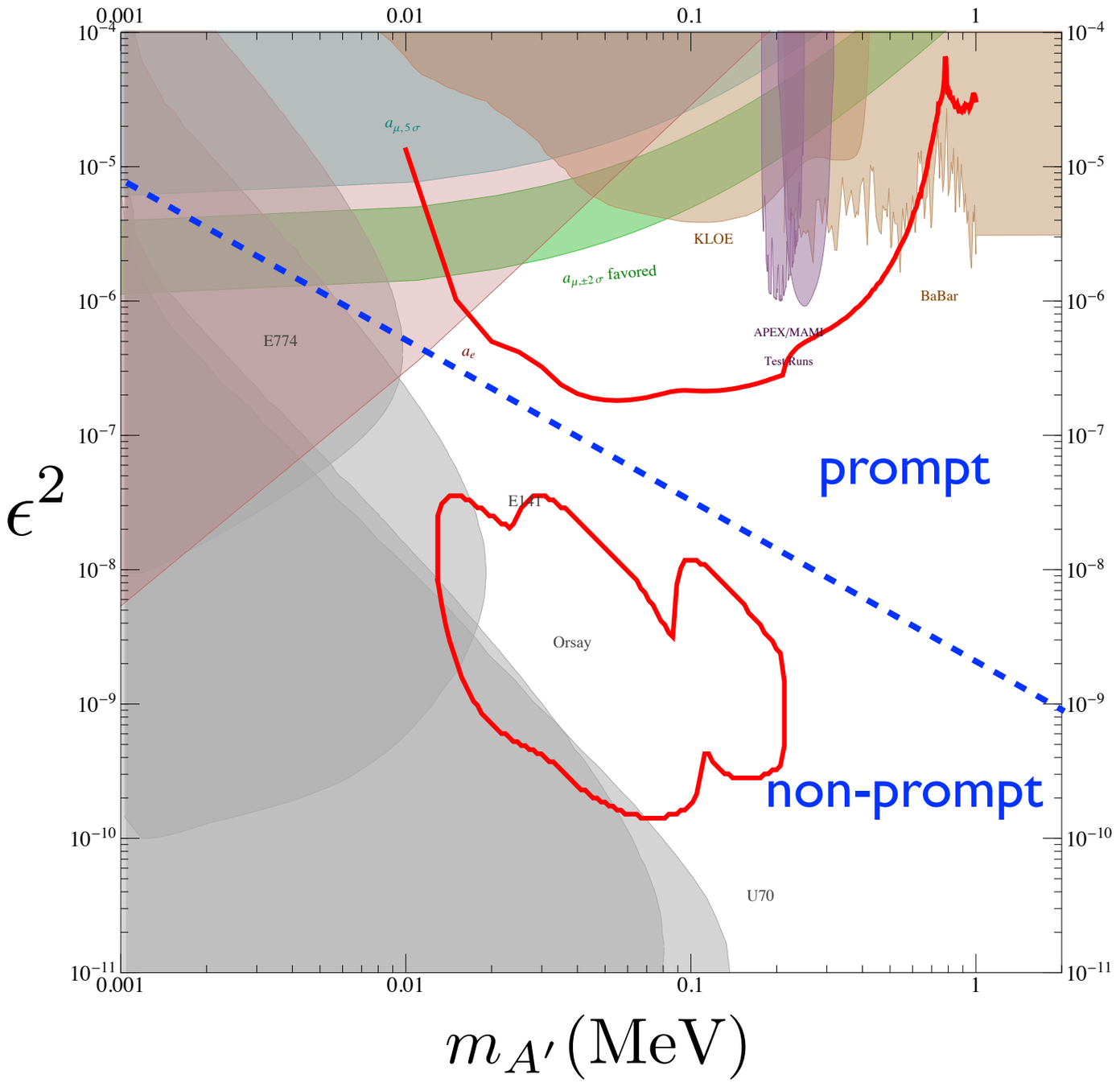


$$\sigma \sim \frac{\alpha^2 Z^2 \epsilon^2}{m^2} \sim O(10\ pb)$$

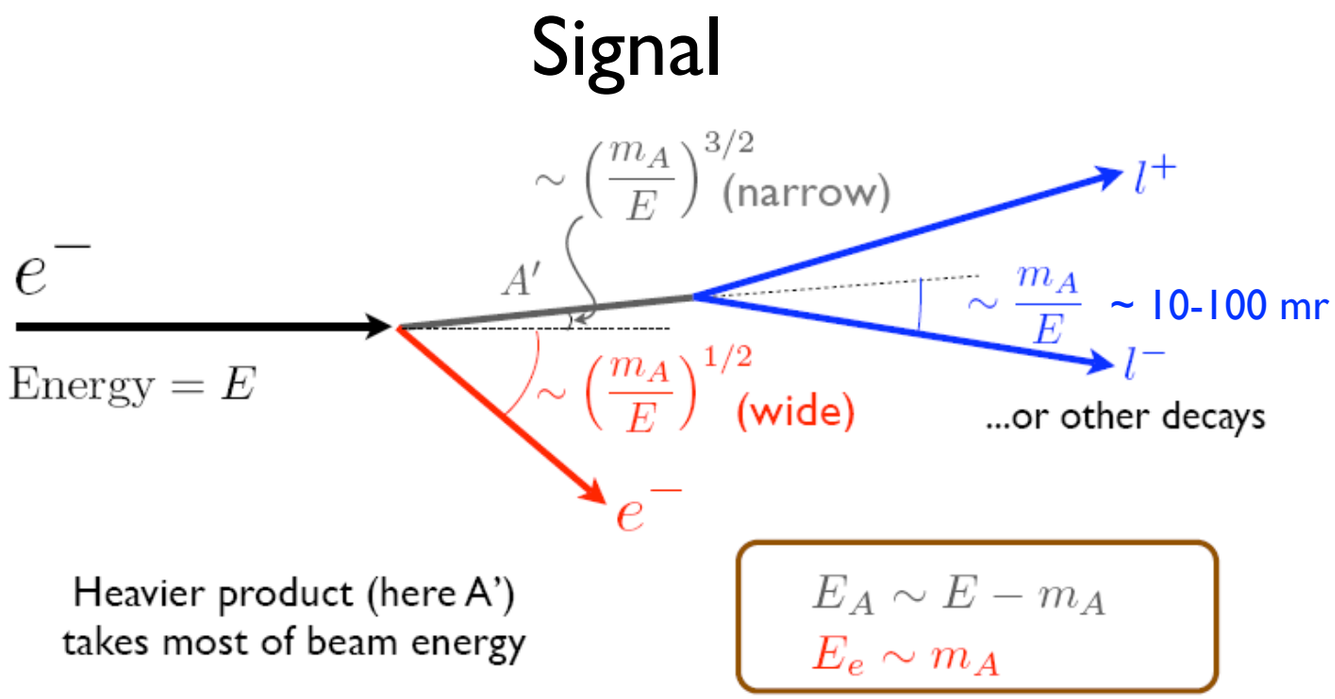
$$\gamma c\tau \propto \left(\frac{10^{-4}}{\epsilon}\right)^2 \left(\frac{100\ \mathrm{MeV}}{m_{A'}}\right)^2$$

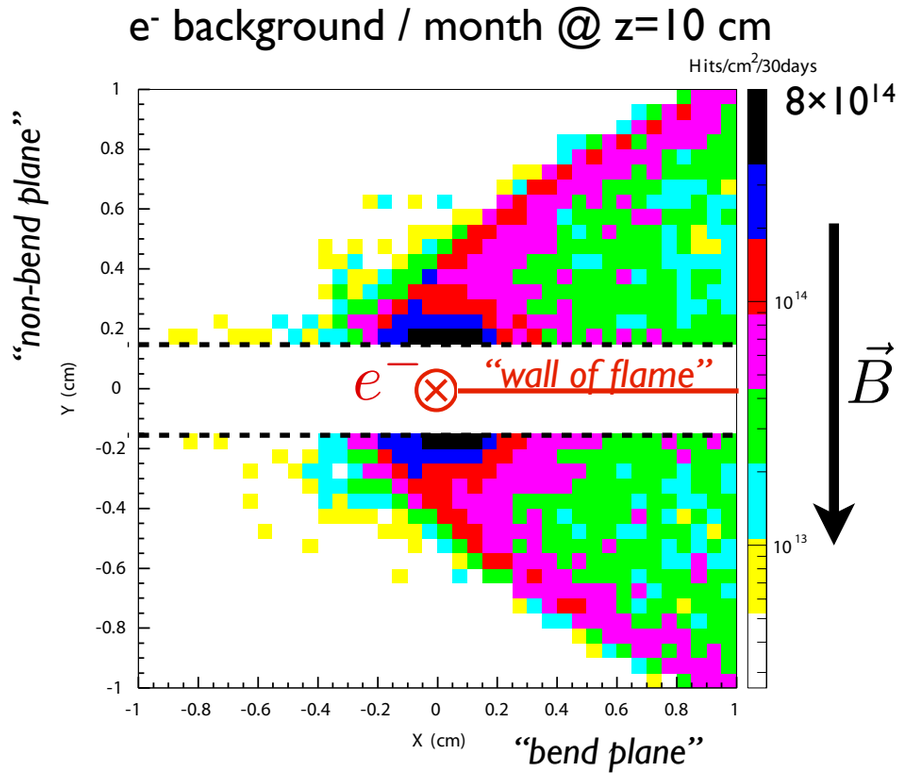
Physics backgrounds are tridents:





Beam Backgrounds Dominate Occupancy





To minimize, run with DC beam and...

- use fast ECal to trigger on coincident pairs
- trigger readout of tracker at highest possible rate in short window
- use excellent time resolution in tracker to select hits in trigger window

SVT Requirements

Detailed simulation of physics performance for proposal determines requirements

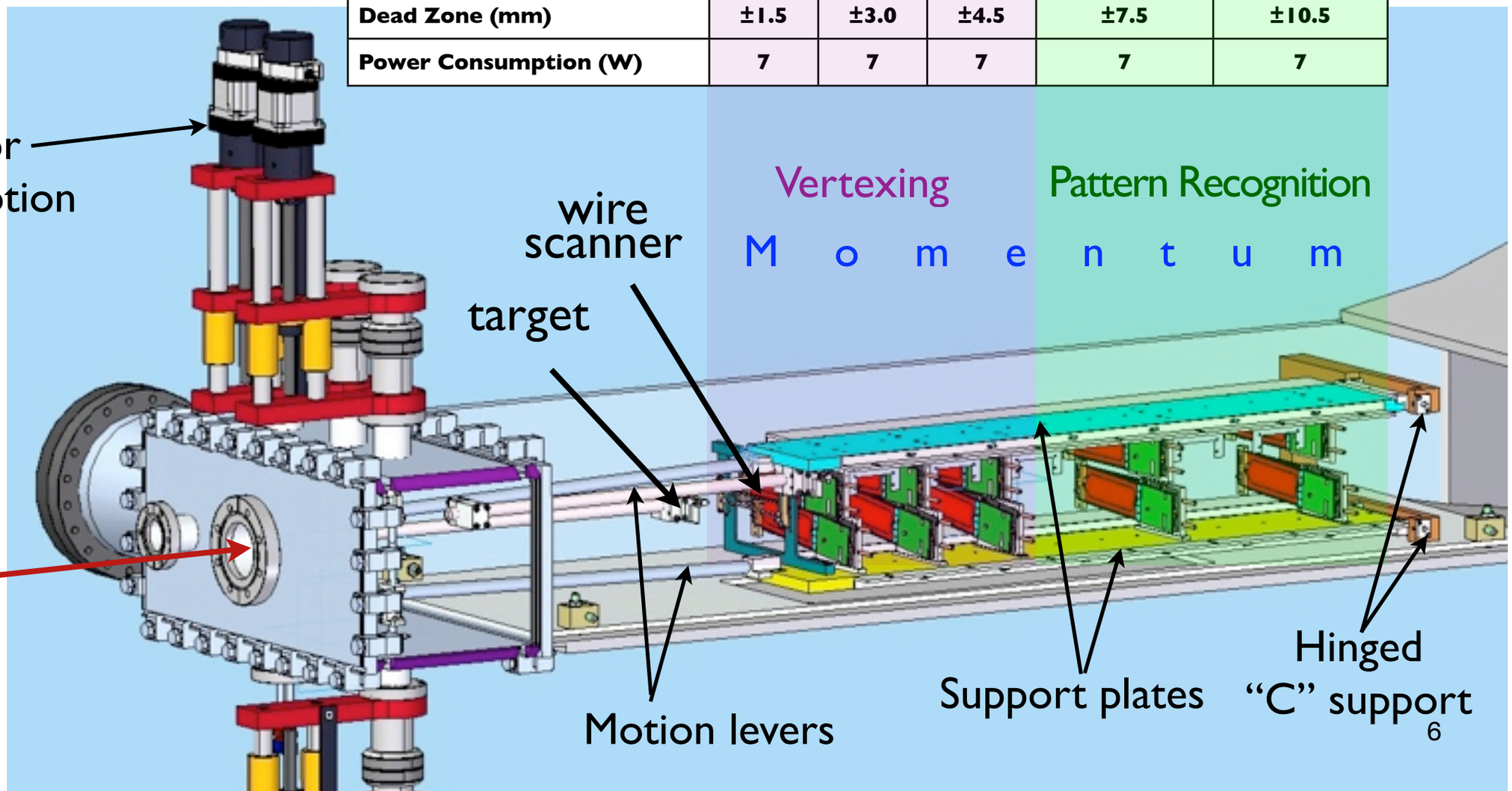
- Material budget
  - 0 material along beamline (detector in vacuum)
  - 0.7% X_0 / 3d measurement in tracking volume
- Acceptance
  - >15 mr from beam axis
- Hit efficiency and resolution
  - >99% single-hit efficiency
  - position: $\sigma_x < 125\ \mu m$, $\sigma_y < 10\ \mu m$ (performance limited by multiple scattering / beam size)
  - time: $\sigma_{t0} \approx 2$ ns
- Occupancy / speed
  - trigger rate > 20 kHz
  - peak occupancy ≈ 4 MHz/mm^2
- Radiation
  - Bulk damage from electrons equivalent to > 1×10^{14} 1 MeV neq.
  - Neutrons from backscattered beam
  - X-rays from target

HPS Test SVT

Proposed 3/11, Installed 4/12

- Develop technical solutions
- Prove operational principles
- Capable of A′ physics

	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
z position, from target (cm)	10	20	30	50	70
Stereo Angle (mrad)	100	100	100	50	50
Bend Plane Resolution (μm)	≈ 60	≈ 60	≈ 60	≈ 120	≈ 120
Non-Bend Resolution (μm)	≈ 6	≈ 6	≈ 6	≈ 6	≈ 6
# Bend Plane Sensors	2	2	2	2	2
# Stereo Sensors	2	2	2	2	2
Dead Zone (mm)	±1.5	±3.0	±4.5	±7.5	±10.5
Power Consumption (W)	7	7	7	7	7



SVT Requirements: Test Run

Due to JLab Hall B schedule constraints, test run did not include high intensity electron beam:

- Material budget
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  - 0.7% X_0 / 3d measurement in tracking volume
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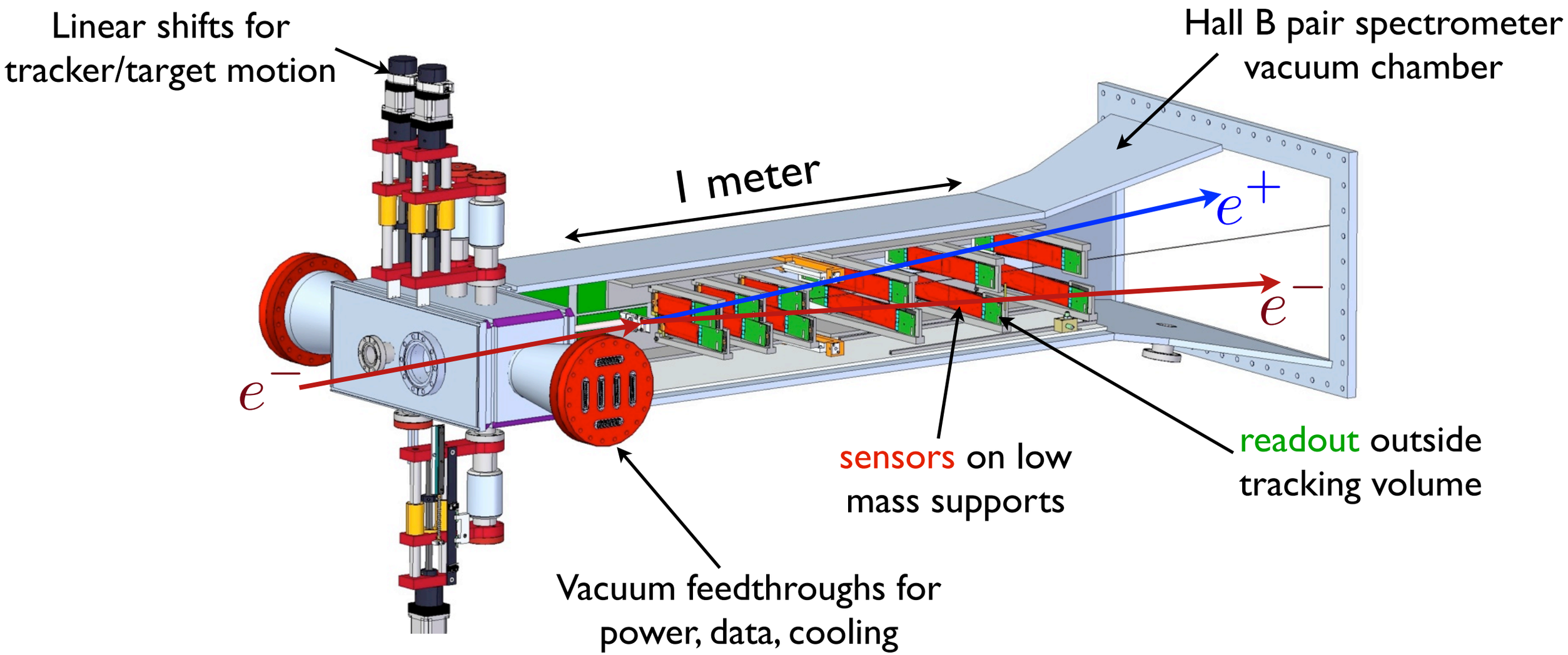
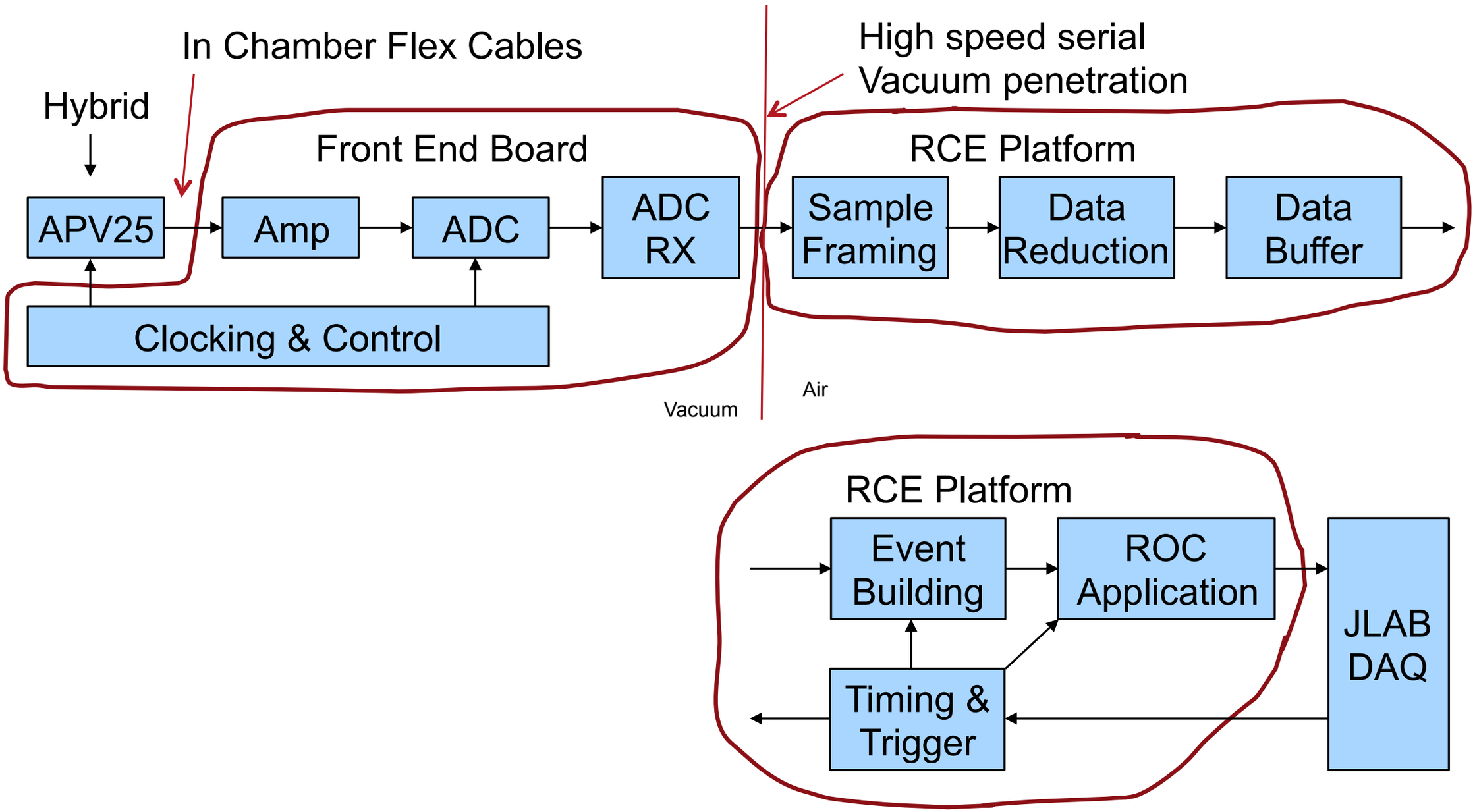
Met and verified
Met, not verified
not met by design

SVT Overview - SLAC, UCSC, FNAL



Details in next talk...

SVT DAQ Overview - SLAC



Details in Ryan's talk...

Everything Else - SLAC, JLab, UCSC

Many other things required for success!

- Controls and Interlocks
- Beam protection
- Software
- Testing and integration with JLab DAQ
- Alignment, calibration, commissioning

Details in Pelle's talk...

Schedule, Budget, Resources

- Schedule: detector tested and ready for shipping 8/15/2014
- Budget:
  - SVT: $506K + $149K contigency
  - SVT DAQ: $608K + $174K contingency
- Resources: three strong silicon groups
  - SLAC: Nelson (SVT), Herbst (DAQ), Hansson, Jaros, Maruyama, Reese, Oriunno + *designers, techs, students*
  - UCSC: Grillo, Fadeyev, Martinez-McKinney + *techs, students*
  - Fermilab: Cooper + *techs*

Details in final talk...