Cornell University

X-ray Beam Size Monitor Update

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ILC Workshop 08

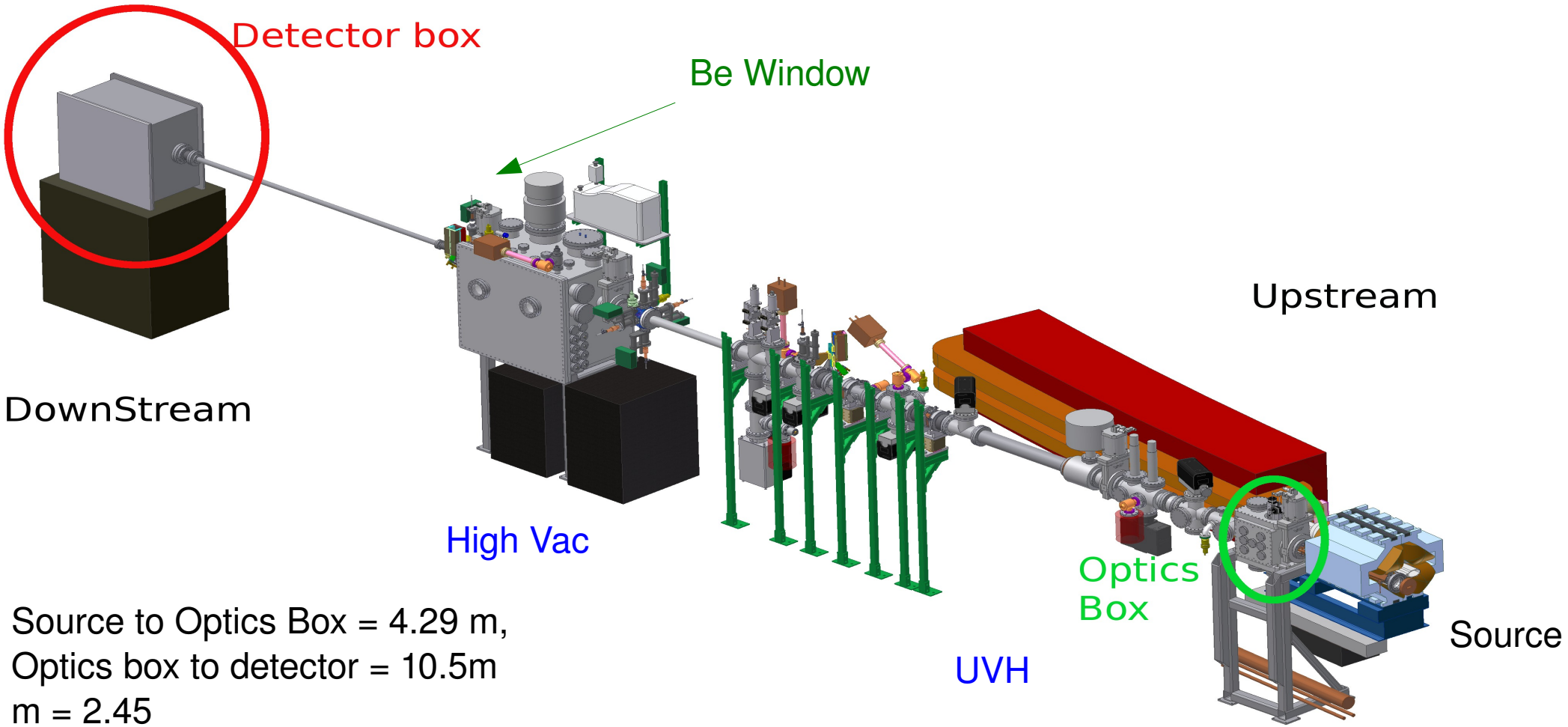
November 17th 2008

XBSM Overview

- Measure beam size bunch by bunch for 4 ns bunch (currently 14 ns) separation
- Non destructive measurement
- Start simple and upgrade
- Flexible Operation
  - DC or Digital readout
  - With/without Monochromator
  - Zone plate, Coded aperture, or pinhole

This talk will focus on detectors, for detailed optics update see John Flanagan's talk.

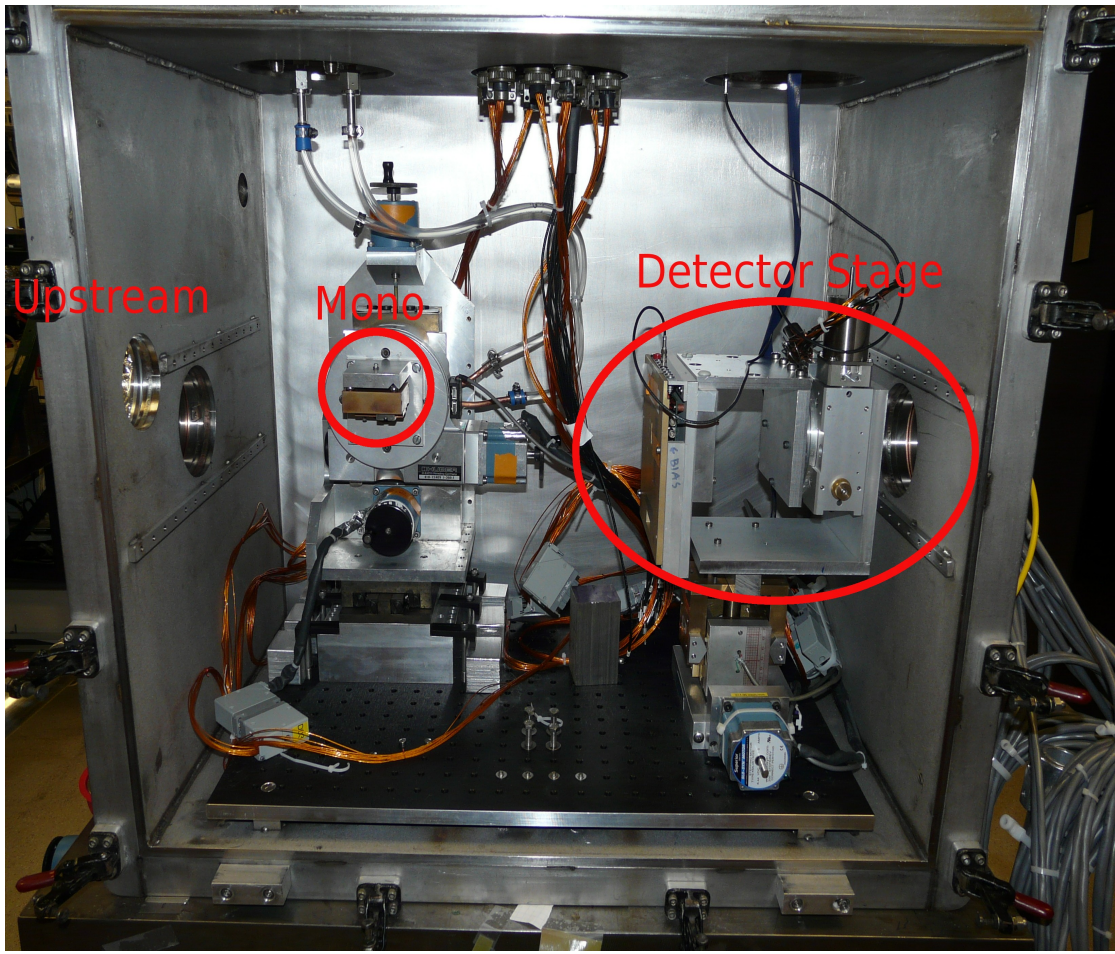
Basic Setup



Source to Optics Box = 4.29 m,
Optics box to detector = 10.5m
m = 2.45

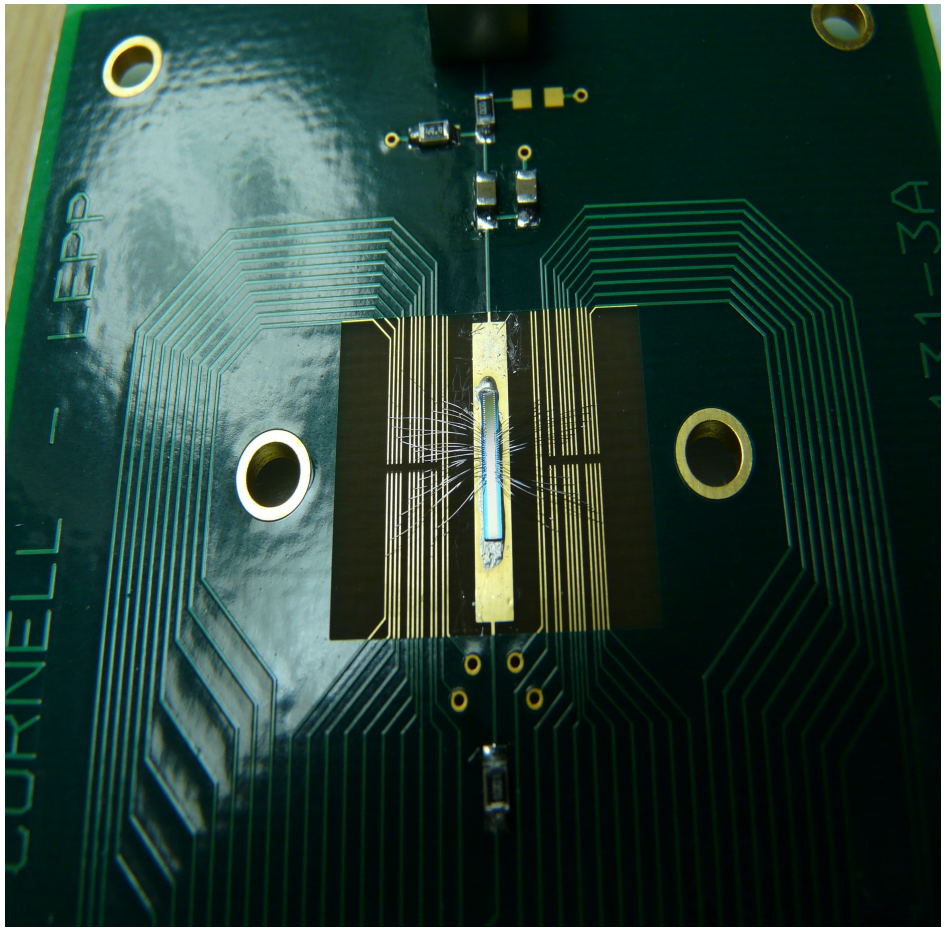
New Setup

- New Detector Box
  - Detector
  - Monochromator
- Run in He, future plans are in vacuum
- Motors control motions of mono and detector independently
- Still have Be window



Detector update

- Worked with two new detectors: Fermionics & Kyosemi
- Added RC circuit to deal with slow response (which was seen with Hamamatsu detector)
- Modular detector board
- Both Fermionics and Kyosemi detectors had longer photosensitive strips than the Hamamatsu



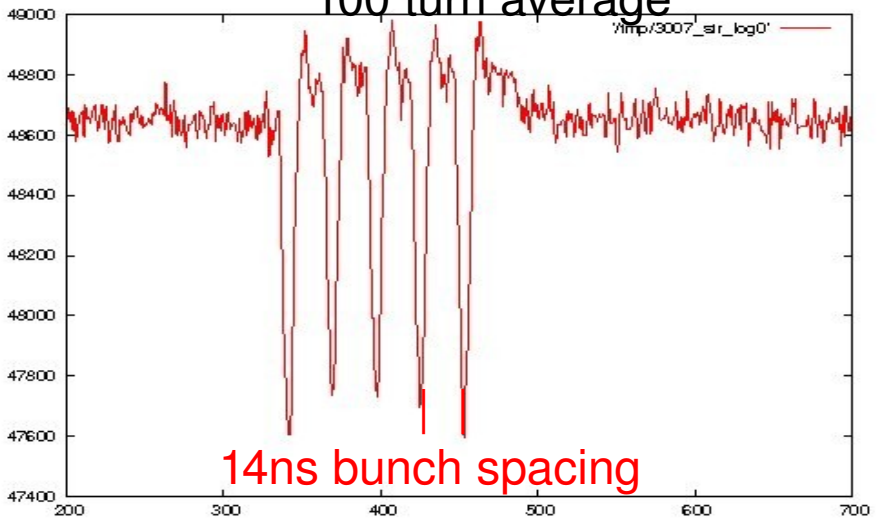
Detector Geometry:

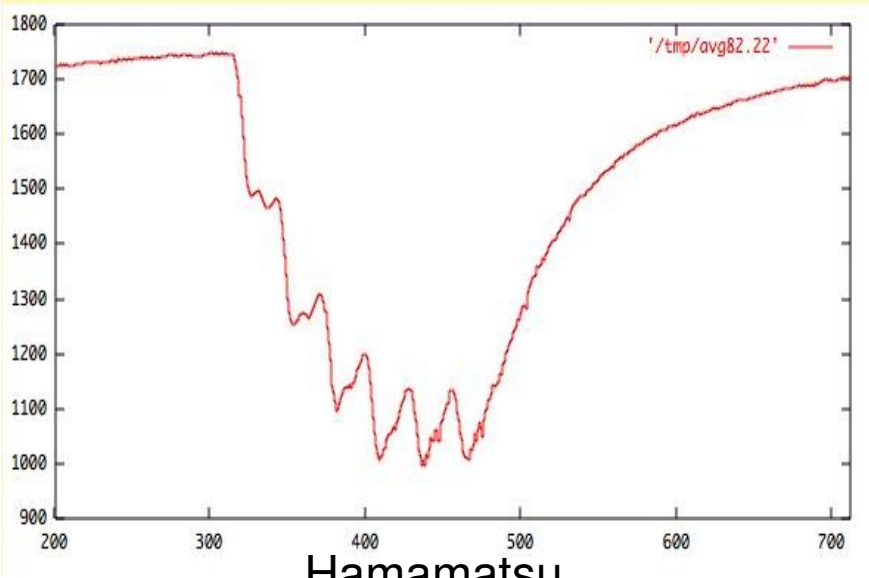
	Hamamatsu	Kyosemi	Fermionics
Pitch (um)	50	50	50
Length (um)	25	500	500
Width (um)	25	25	25

Detector Readout

- Much faster response for both Fermionics and Kyosemi detectors
- Stronger signal due to longer photostrips
- Signal at low energy (2 GeV positron beam), which Hamamatsu didn't have
- No noise reduction (Fermionics)
  - Turn off motors
  - Improve cable shielding
  - Decouple detector ground from box

Fermionics
100 turn average





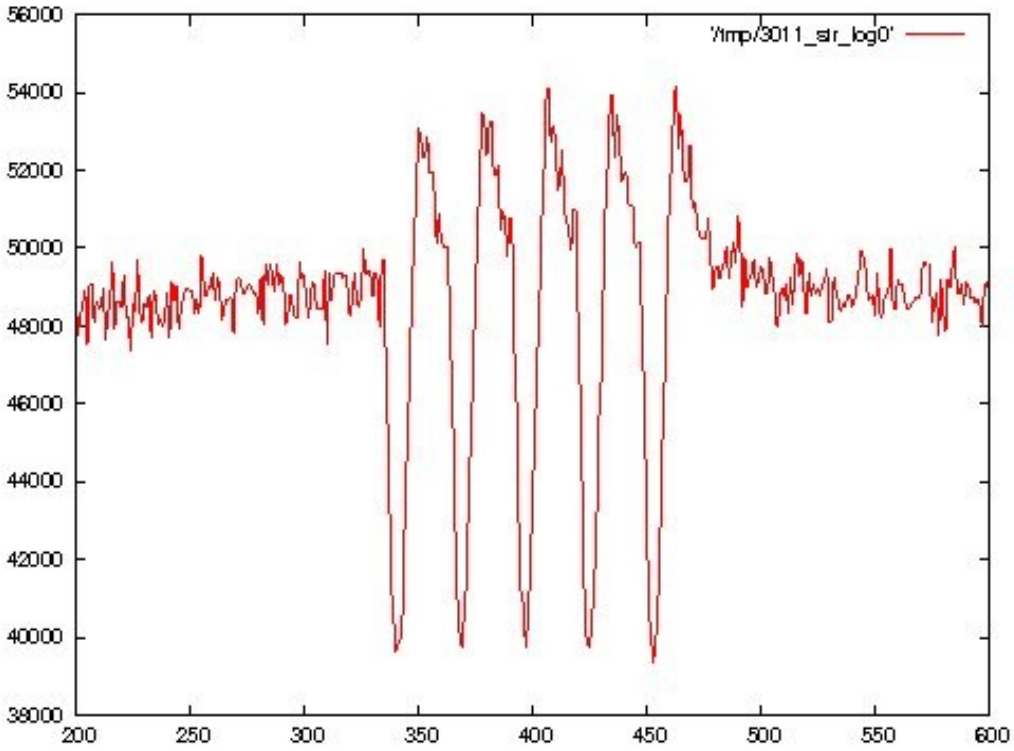
Hamamatsu
100 turn average

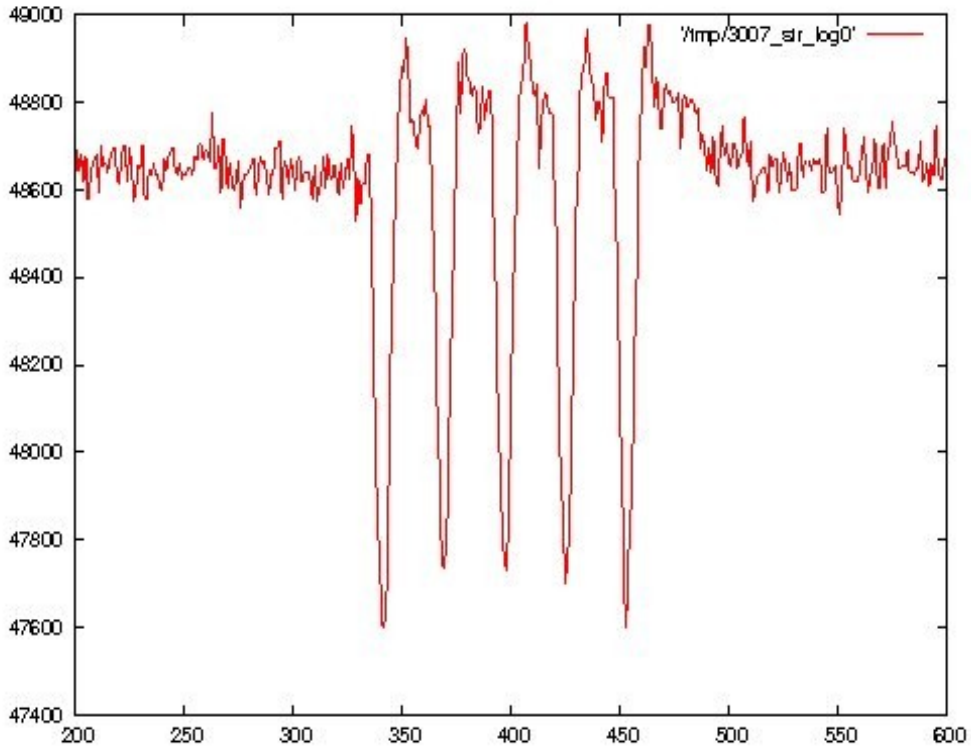
Kyosemi and Fermionics (low energy)

Kyosemi

Amplitudes are average over 100 turns

Fermionics



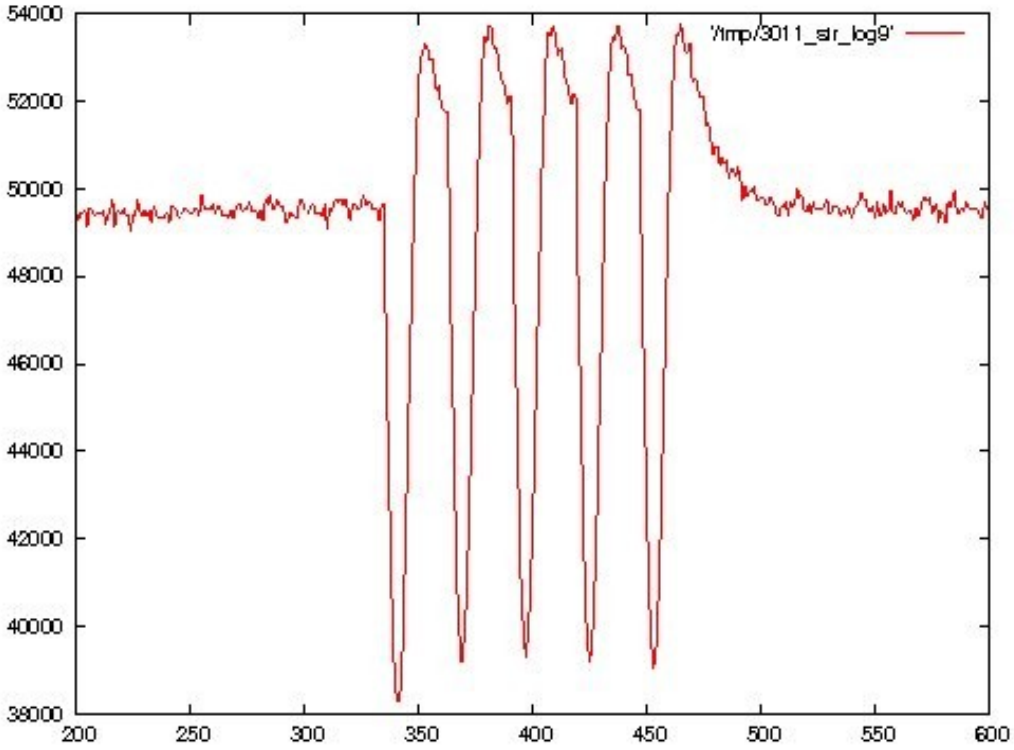


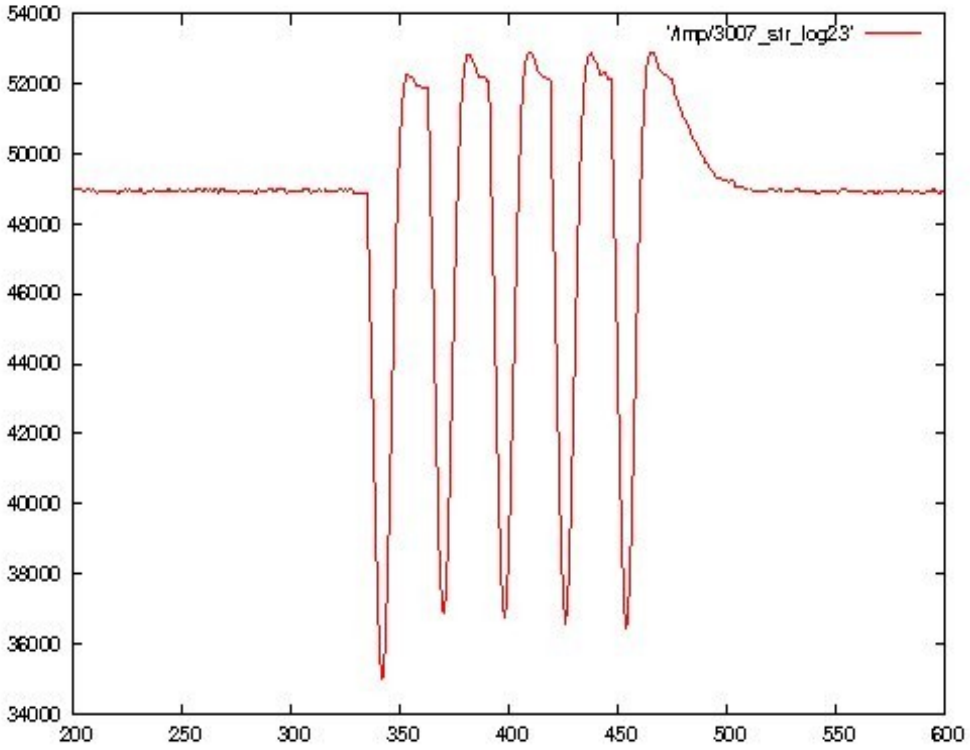
Kyosemi and Fermionics (low energy)

Kyosemi

Amplitudes are average over 100 turns

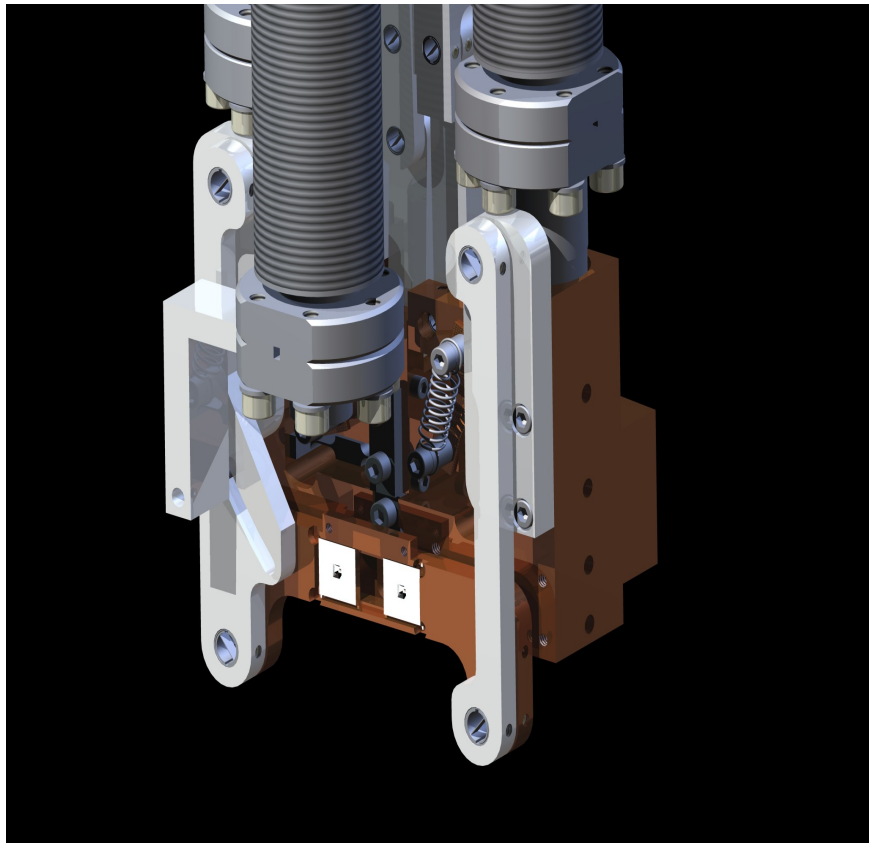
Fermionics





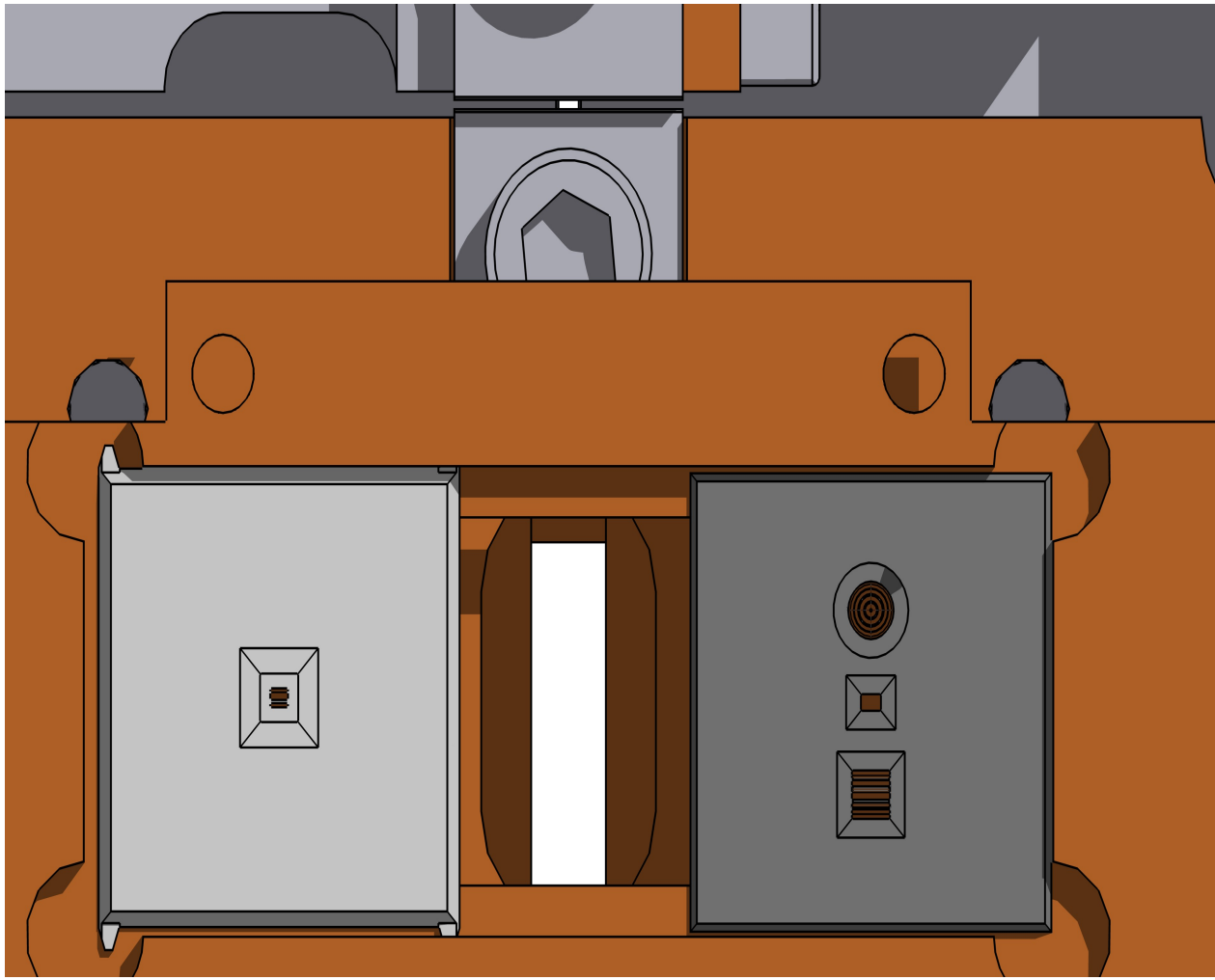
Optics

- New optics box that can hold new and old Coded Aperture, FZP, and slits
- New Coded Aperture and FZP on same substrate
- Slits used as pinhole
- New Coded aperture installation: Early January
- Multilayer Monochromator is in detector box not optics box
  - Minimize impact of angular smearing from multilayer mirror surface
  - Mono is mainly for FZP, the Coded Aperture and slit can use white beam



Slit Mechanism

- Gives us optical choices:
  - Old and New Coded Aperture (provided by John Flanagan)
  - Slit, with separations between 30 and 120um
  - FZP
  - Raw beam



Vertical Beam Profile (Simulated)

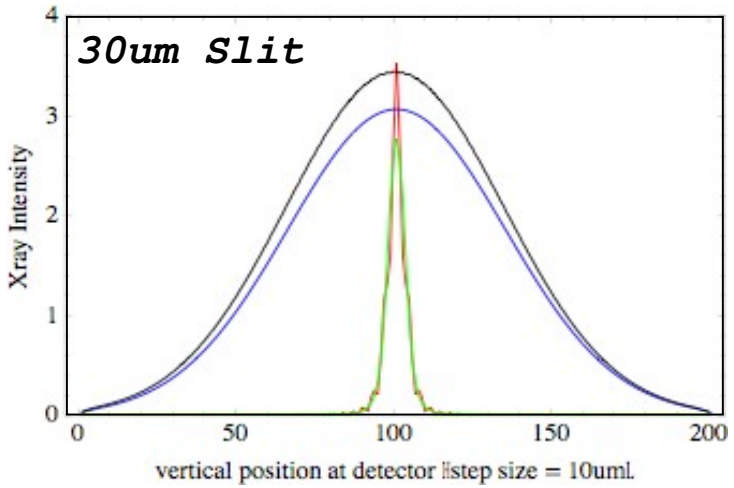
- Simulated beam size of 140um

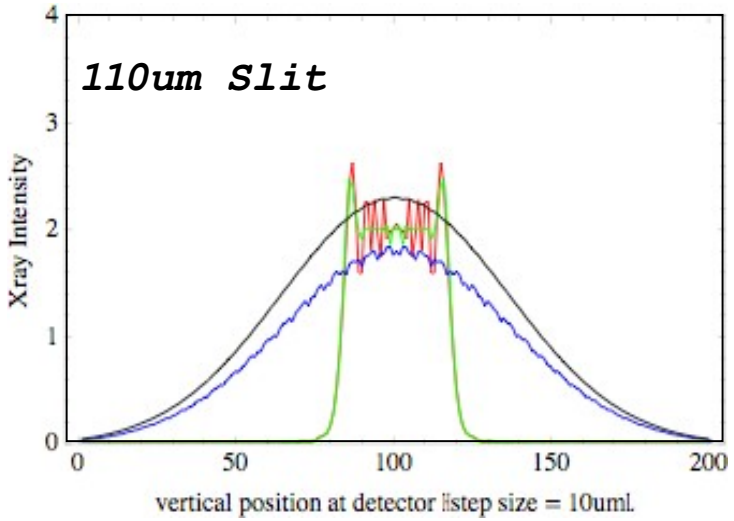
Red: 3.0 keV monochromatic, point source

Green: integrated over spectrum, point source

Blue: 3.0 keV monochromatic, integrated over source profile

Black: fully integrated over spectrum and source profile



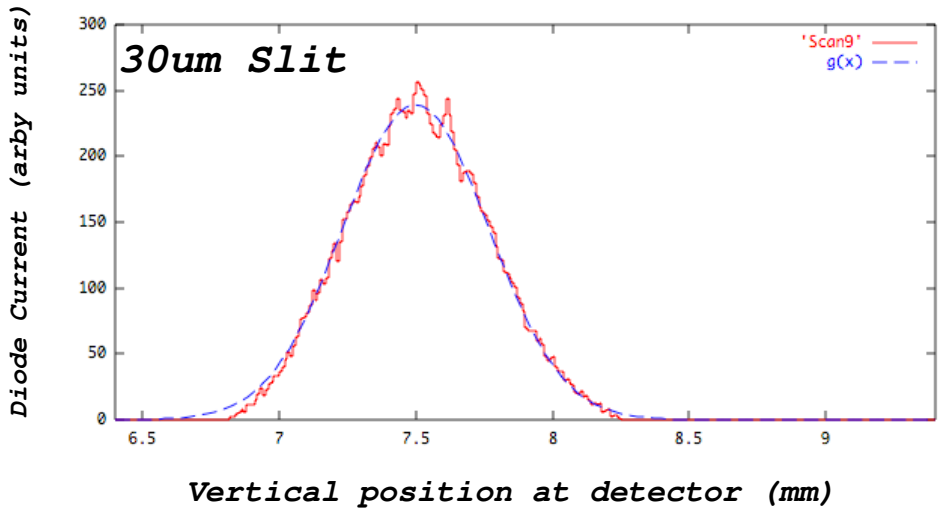


Extracted beamsize is 141um in each case.

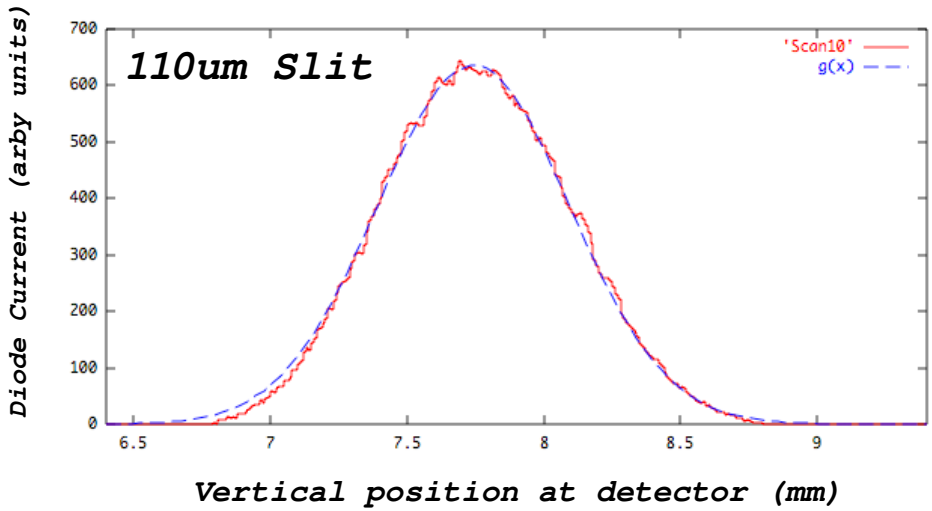
Vertical Beam Profile (Measured)

2.1 GeV electron beam

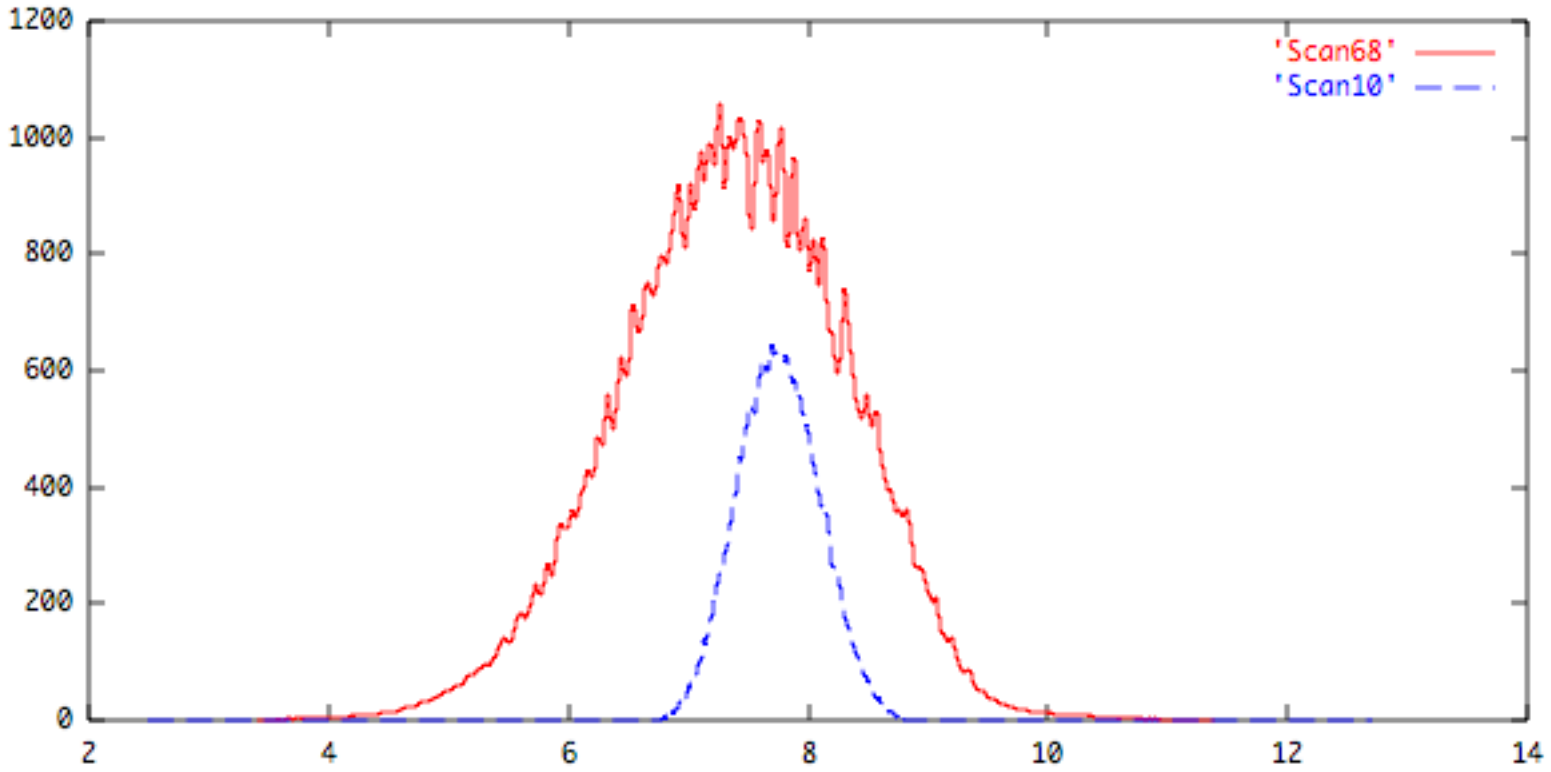
Extracted beam size = 105um



Extracted beam size = 135 um



Compare Large Beam with Normal Size Beam



Future plans

- Change from He to vacuum and use diamond window to avoid profile 'bumps'. The diamond window would also absorb less.
- Use Fermionics detector with more working diodes
- Fine tune RC circuit, or remove if not necessary
- Install new Coded Aperture and Fresnel Zone plate

Summary

- New beamline completed and commissioned (positron line)
- New optics box puts optical elements very close to source (z=4.3m). Multiple choices, selectable remotely during operations
- New sensors show needed speed performance
- Vacuum line will be improved: beryllium window --> diamond window
- Optical Element Array with new CA and FZP will be installed in December
- Ready to provide beam size measurement