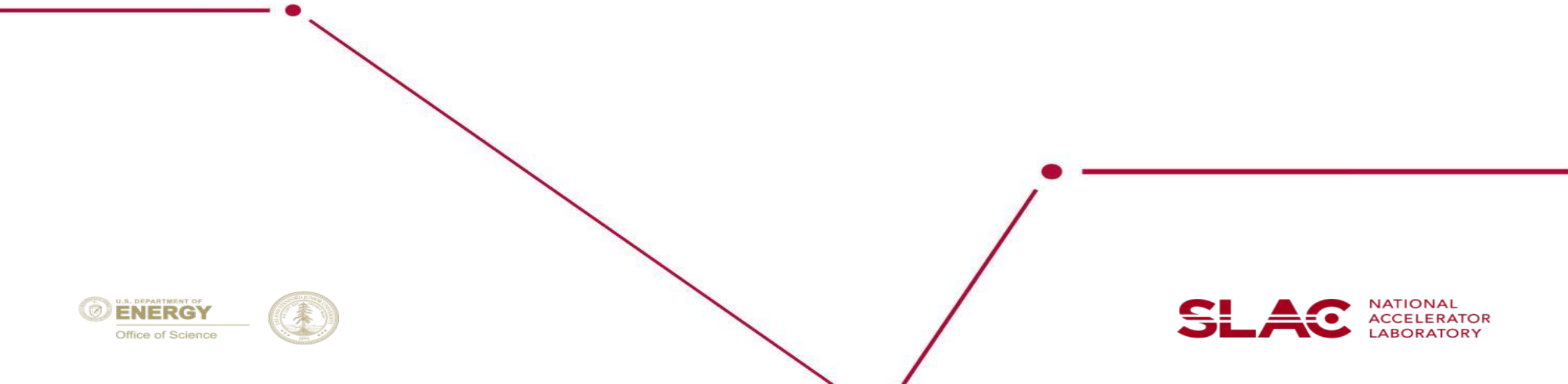
Wave8 Commissioning
HXR Meeting 9/17/2018



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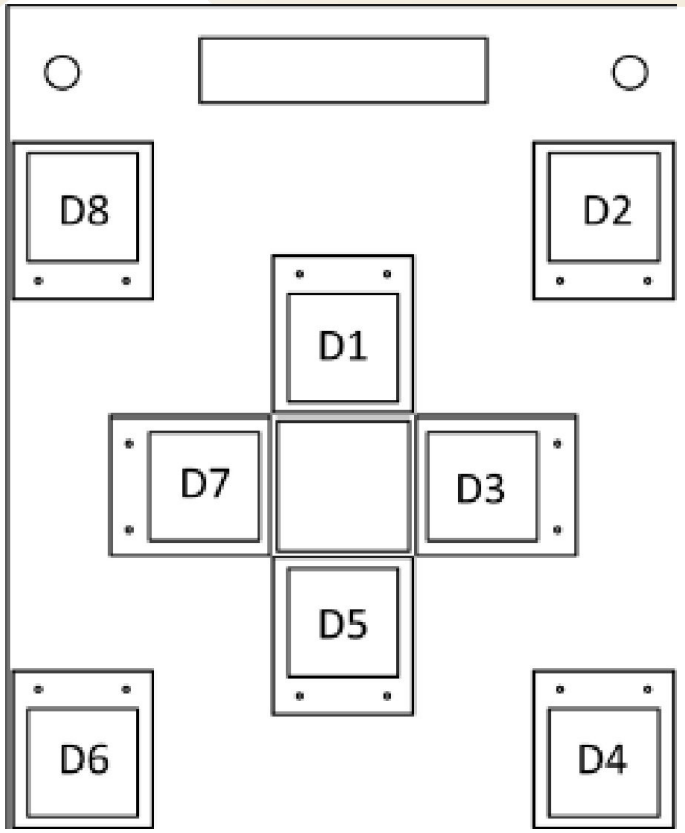
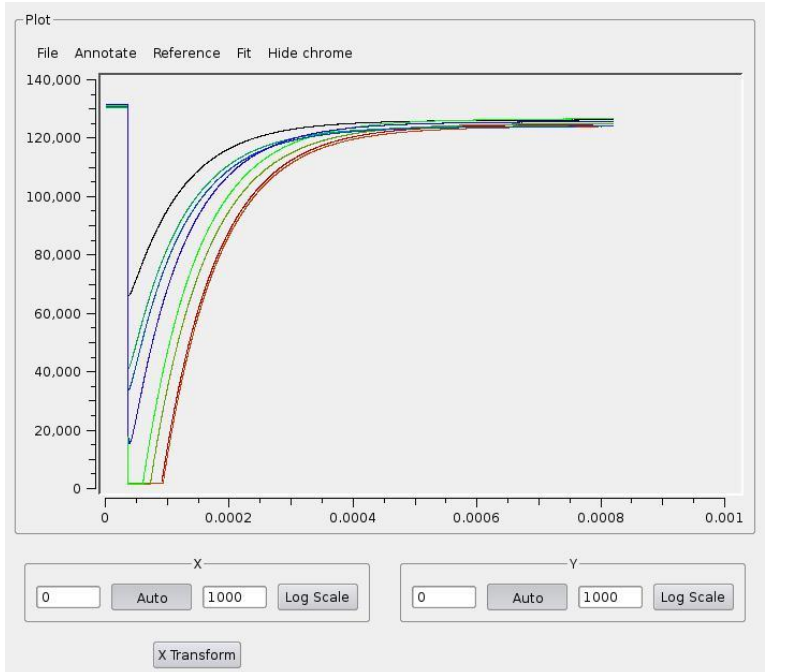
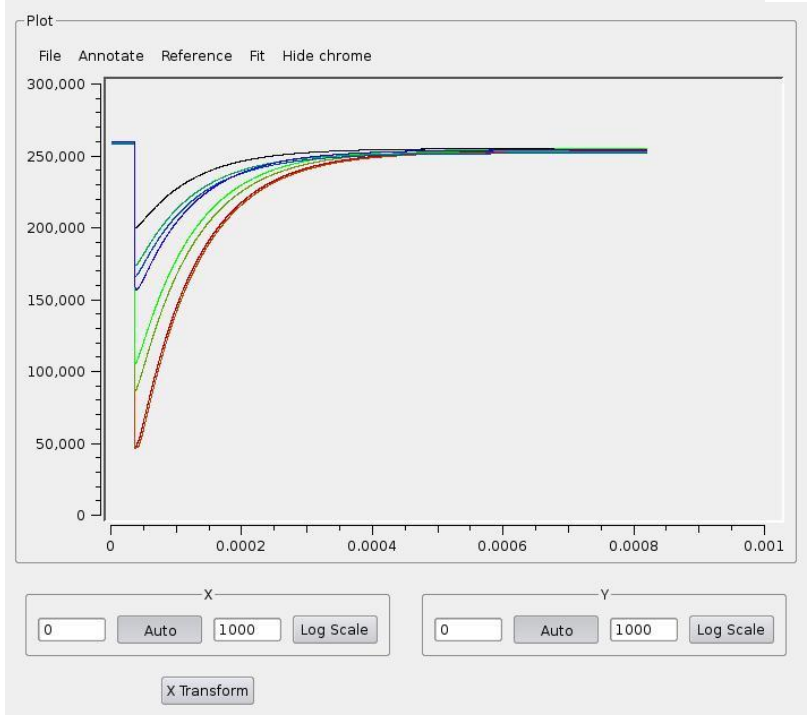
Wave8 Beam Intensity and Position Monitor

- ✔ Measure beam intensity and position for each shot
  - Replace older 4-diode boards
  - 8 diodes per PCB board – Hamamatsu S3590 photodiodes.
  - Diodes face downstream ⇒ detects Xrays back-scattering from silicon nitride target.
  - Custom readout electronics for improved dynamic range and resolution. No longer saturates at full beam.







Raw Waveforms on a shot-to-shot basis for each of the 8 diodes. 5MHz ADC = 200ns time resolution.

Dynamic Range:

- Signals can be offset to adjust for saturation
- Offset works.

What was done?

- Total of 13 Wave8s installed across HXR lines.

XPP: SB1 (laser alcove in SXR), SB2, SB3

HXR: HFXDG2

XCS: SND, DG1, DG2

MFX: DG1, DG2

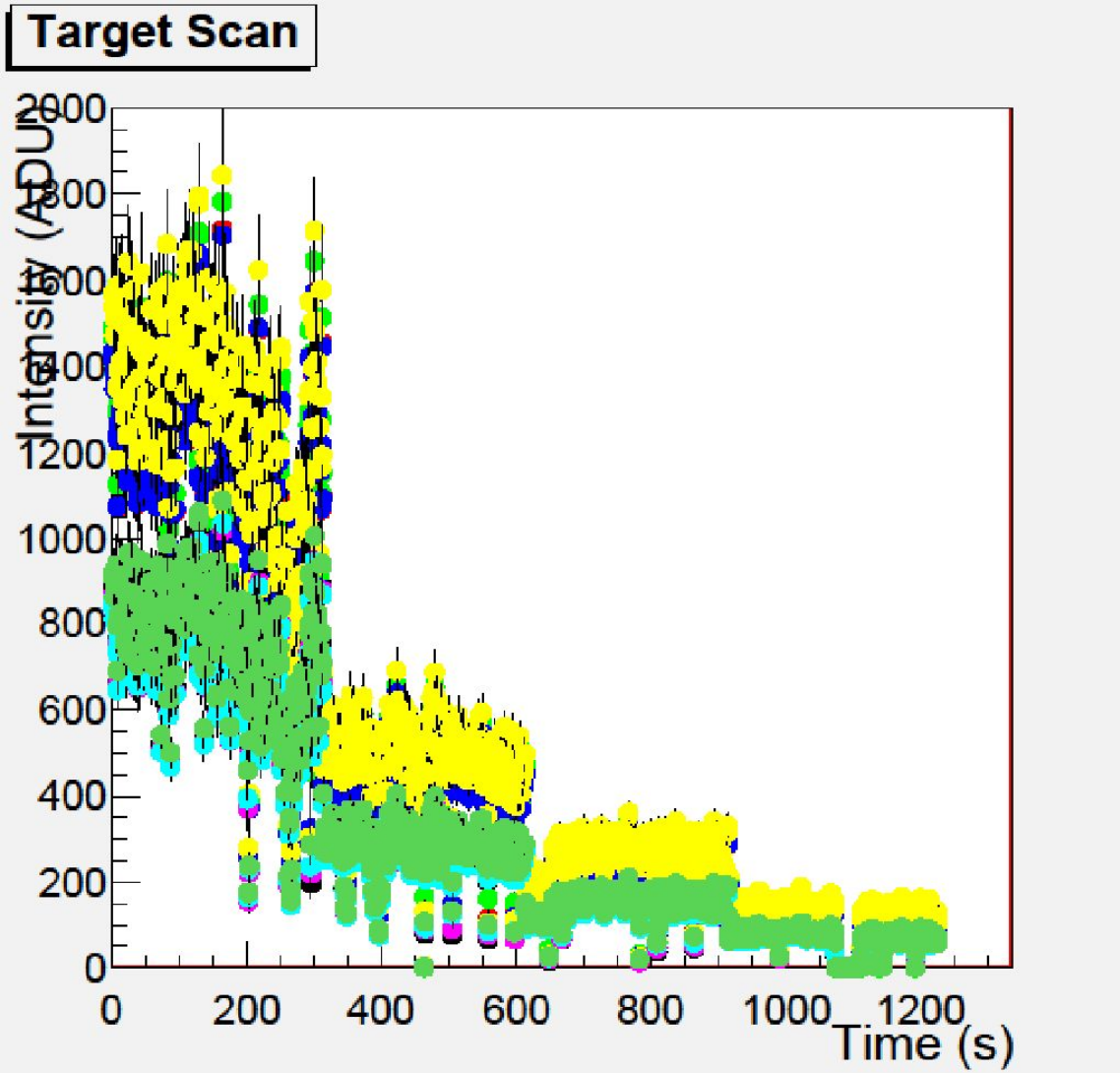
CXI: DG2, DG3

MEC: IPM2, IPM3

All but CXI DG3 read into DAQ.

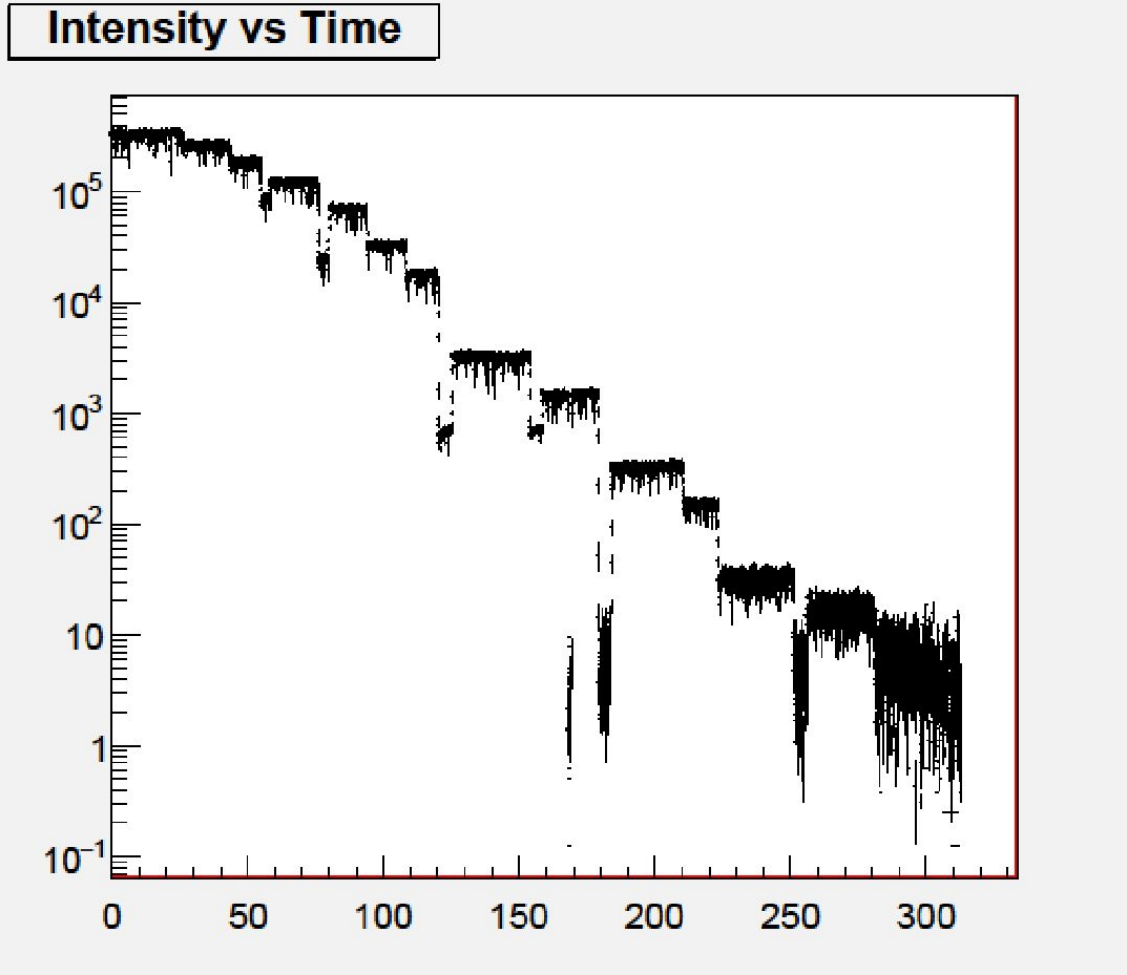
Tested during commissioning 9/1 and 9/2.

XPPSB2: Target Scan (Intensity vs time)



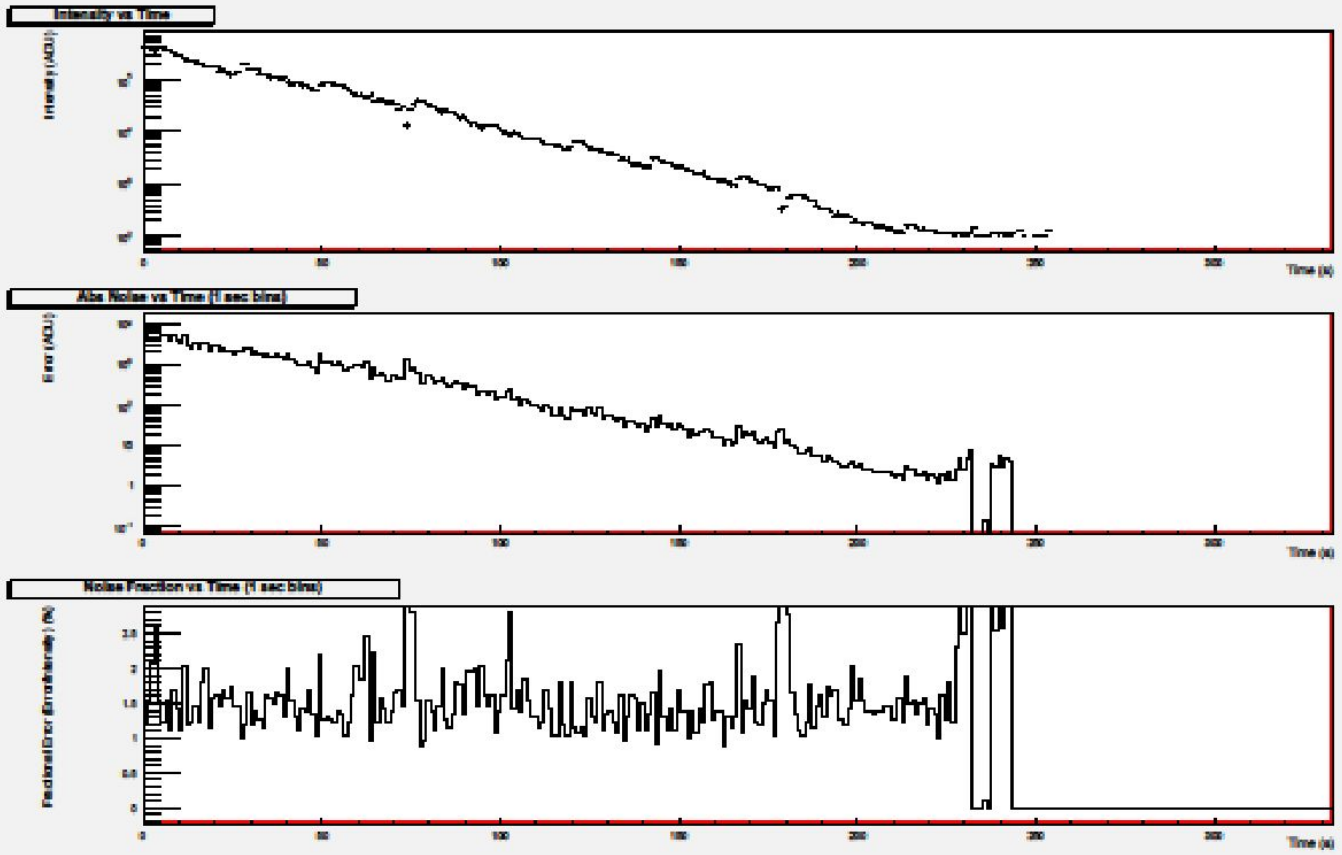
- Scanned targets 1 through 4 (in that order). 4um, 2um, 1um, 0.5um thickness
- Different colors = 8 diodes.
- 1 second bins.
- Diodes saturate at ~120,000 ADUs. Target 1 shows maximum signal at ~2,000 ADU without saturating. □ maybe good to move diodes closer.
- Approximately x2 steps between targets (Note: this is not always true for all Wave8s)

MEC Dynamic Range (Intensity vs time)



- ✔ MFX & MEC: Scanned from 100% transmission to 10^{-5}
- ✔ CXI & XCS – scanned ~2-3 orders of magnitude
- ✔ XPP - MONO

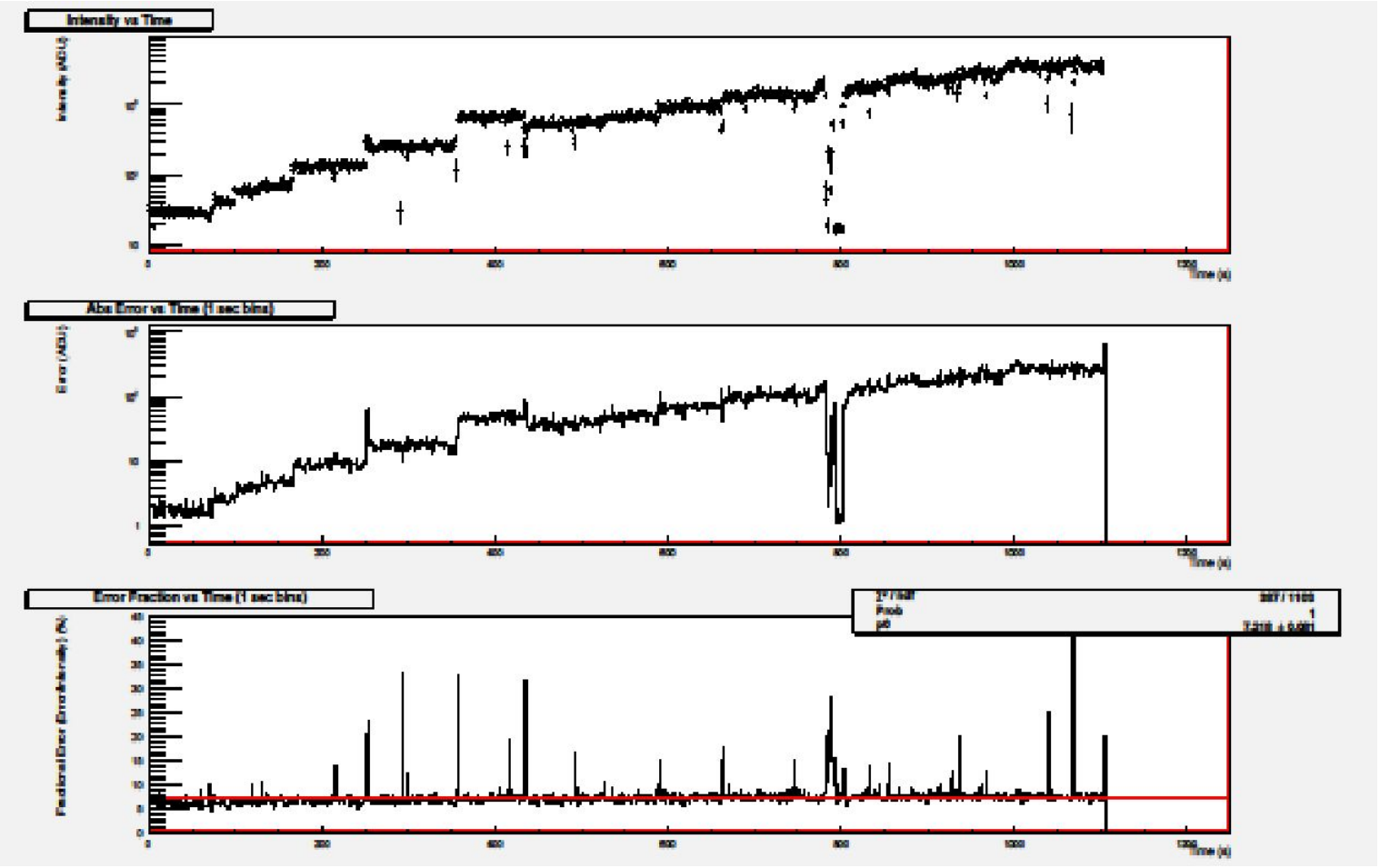
MFXDG1: Error Fraction



- Plot1: Intensity vs time (1s bins)
- Plot2: Error vs time (1s bins)
- Plot3: Error fraction vs time (1s bins)
- Error scales with intensity.

- Average fractional error of 1-2% after 1s of beam.
- Spikes in fractional error places where attenuators were inserted, beam dropped out, etc.

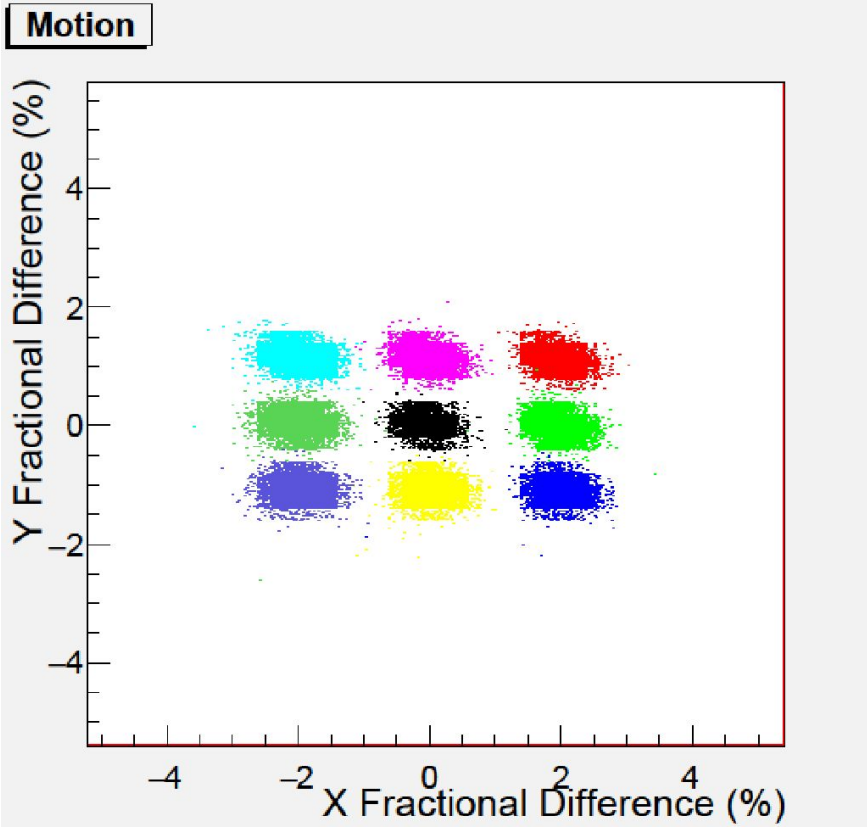
XPPSB3: Error Fraction



- Exception is XPP SB2 and SB3: 6-7% measurement in 1s.

MEC IPM2: Position Scan

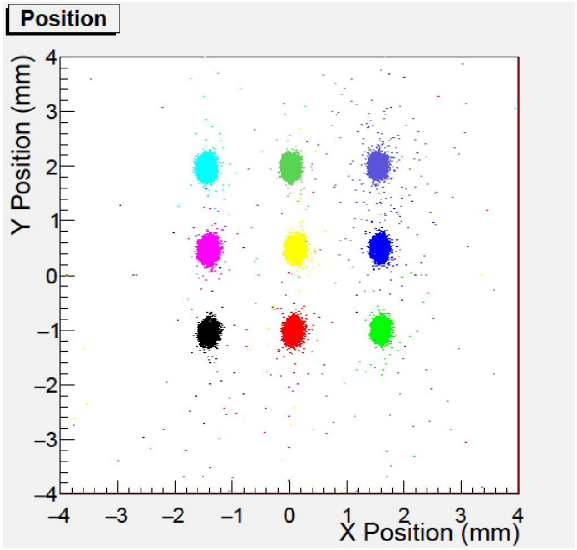
- ✔ Used inner opposing diodes to calculate fractional difference:
  (Right – Left) / (Right + Left)
  (Top – Bottom) / (Top + Bottom)



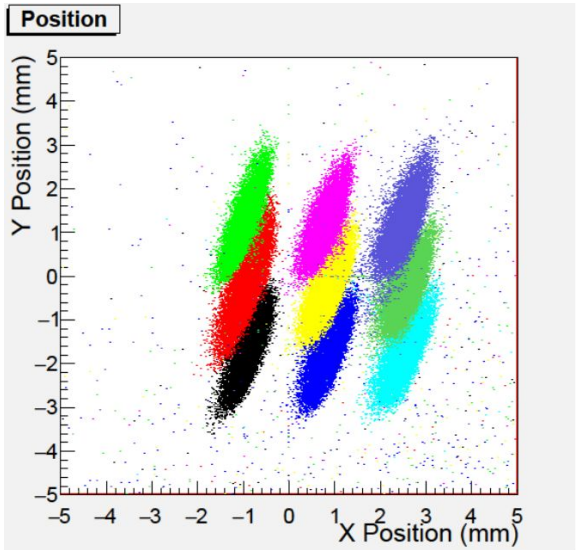
From Fractional difference to millimeters. Calibration constants available for each Wave8.

Position Scan

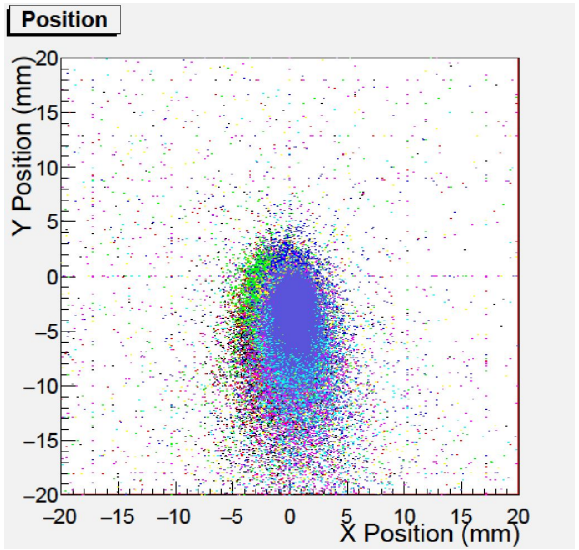
- ✔ Used inner opposing diodes to calculate fractional difference:
  (Right – Left) / (Right + Left)
  (Top – Bottom) / (Top + Bottom)



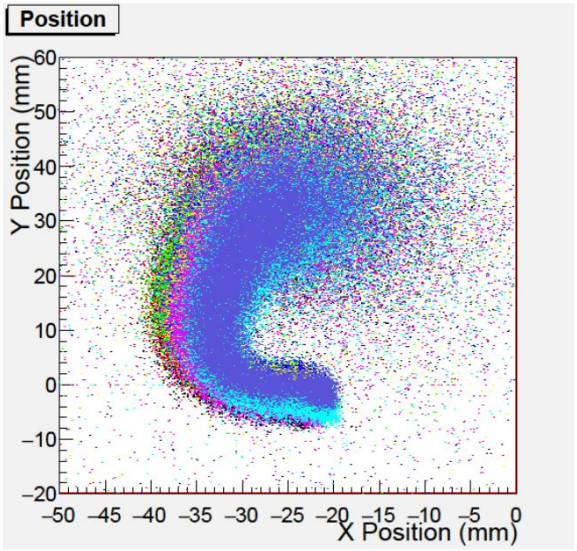
MFX DG2 – canonical example: 3 exceptions



CXI DG2

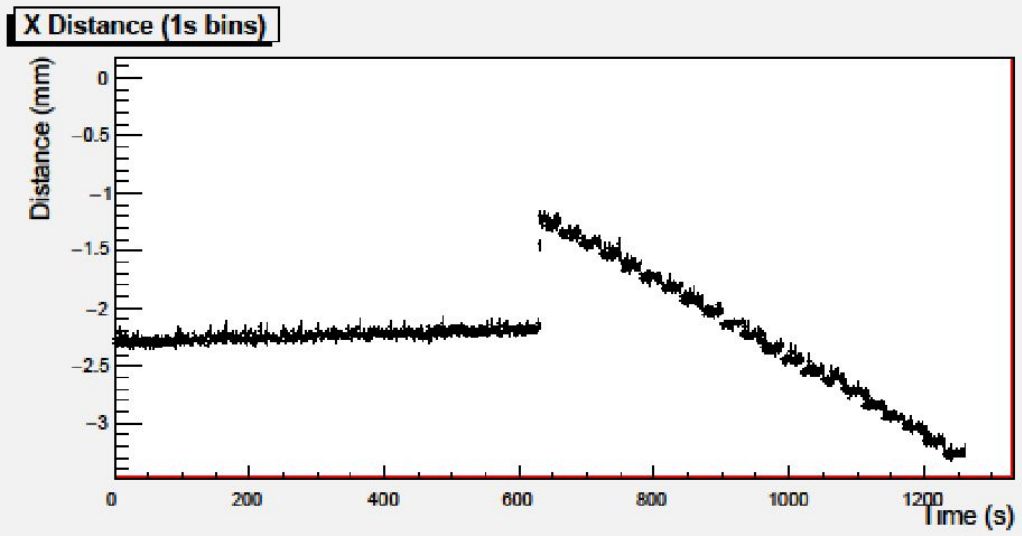


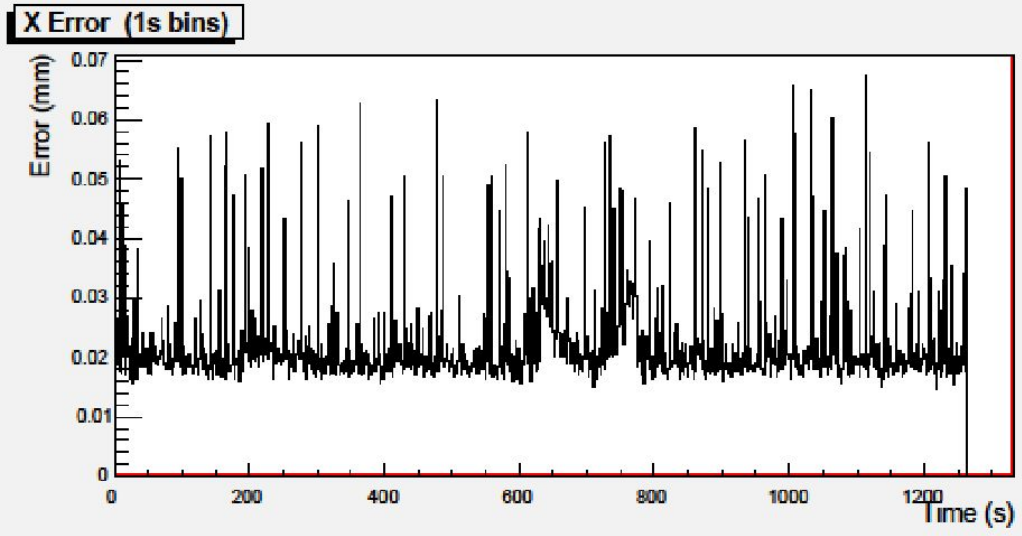
XPP SB2



XPP SB3

XCSSB1: X Position Error





- Plot 1: Position vs time
- Plot 2: Error vs time
- Typically, 10-20um measurement after 1s.
- Locations where beam drops off shows large errors □ inflates the fit
- Invariant of position.

- CXI DG1 – 30um in X, 50um in Y
- XPPSB2 - ~80-100um.

Next Steps?

- MFX DG2 diode board has ~1-2 noisy diodes. replace
- MFX DG2 and HFX DG2 needs new targets.
- CXI DG2 needs to be read into DAQ.
- XPP SB2 and SB3 – may want to move diode board closer to accommodate both MONO and PINK.
- XCS SND Wave8 is not responding (replaced controller but still not responding…check again Wednesday).

- Position visualization in AMI?
- Send sums/positions to ACR?