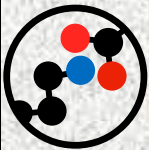# Implementation of a Dectris RIGI 4S and Libera Photon at 17-ID.
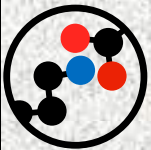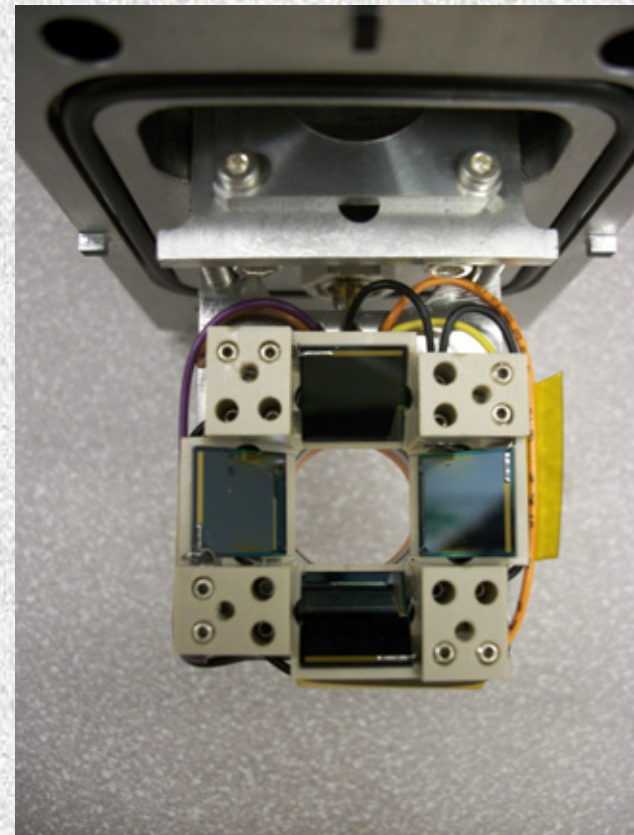
Kevin Battaile
IMCA-CAT
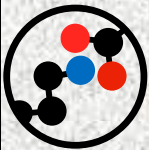**Hauptman-Woodward Medical Research Institute**

Previous Equipment

- Oxford quad-diode BPM
- Oxford IC Plus Electronics

- Perceived problems
  - Sensitivity dependent on foil choice.
  - Foil is consumable.
  - Apparent lack of linearity with beam intensity.
  - Questionable product support.
 - Electronics box out of production.

Equipment Choice

- ## Dectris RIGI 4S
  - Pad size 2 x 1 mm
  - 6 μm gap between pads
  - 4.6 x 2.6 mm window area
  - 12 μm thick

- ## Instrumentation Technologies Libera Photon
  - Recommended by Dectris
  - Position calculations can be done in the box
  - Cost effective vs individual current amps
  - Provides bias voltage
  - Expansion possibilities
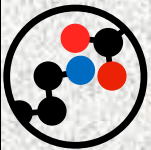
Perceived Benefits

- Direct X-ray detection
- Better linearity
- More durable
- No consumable parts
- No maintenance required
- Better customer support

- Downsides
  - Not a single-vendor option.
  - Requires some fabrication to integrate.
  - RIGI is very sensitive to beam shape.
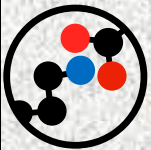
Implementation

- Integrating the Libera into the control system.
- Fabricate a box for the RIGI 4S.
- Determining the bias voltage for the RIGI.
- Beam position calibration.

I-Tech Libera Photon

- RS485, ethernet and SFP data ports on front.
- Current inputs, PMC slot, triggers and sync ports on back.
- Connected to control system via ethernet.

Libera Current Range

- The Libera has 7 input current ranges.
- Operation can be on a single current range or autoranging.
  - Range is updated at 4 Hz.
  - Hysteresis is 0.3 V.

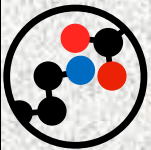| Range Change	Threshold	
	Increasing current	Decreasing current
0 – 1	~1.9 nA	~1.6 nA
1 – 2	~19 nA	~16 nA
2 – 3	~190 nA	~160 nA
3 – 4	~1.9 μA	~1.6 μA
4 – 5	~19 μA	~16 μA
5 – 6	~190 μA	~160 μA
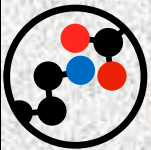
RIGI 4S

- Smaller sensor appropriate for focused beam closer to sample.
- We designed and machined our own enclosure.
- Unit is installed in rough vacuum.
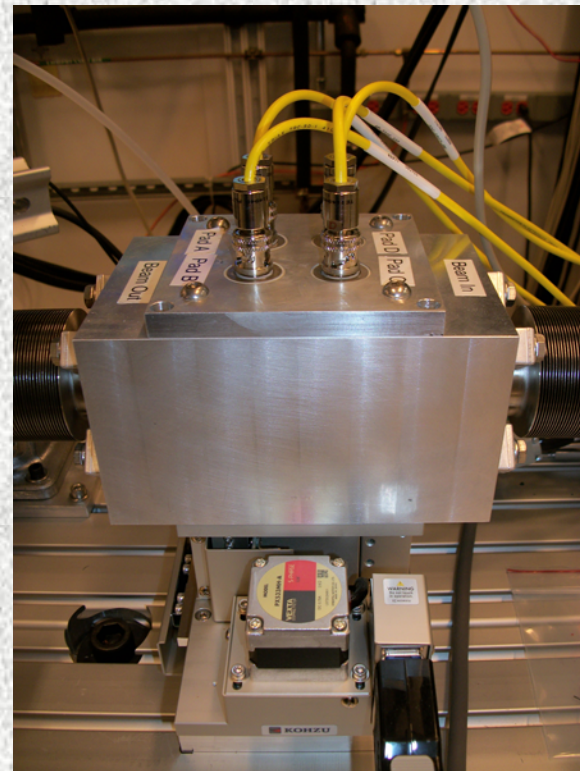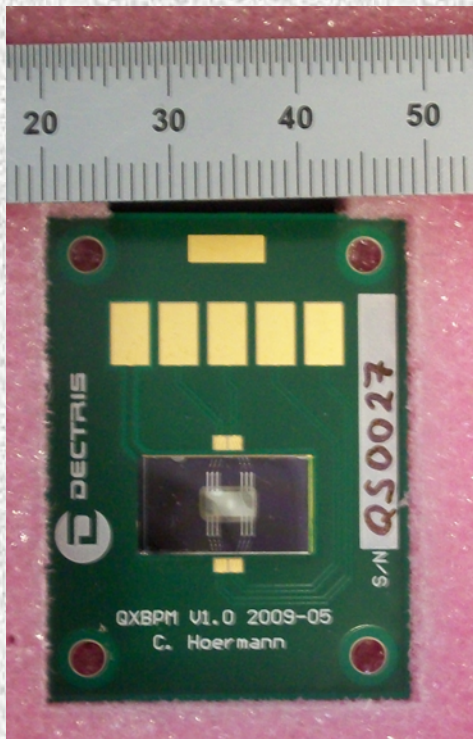
RIGI 4S Bias Voltage

- Voltage is supplied by the Libera.
  - Voltage is adjustable from -1 to -150 V.

- Dectris suggests -10 to -20 V.
  - 'High' flux: -10 to -20 V
  - 'Low' flux: 0 to -20 V

- -12 V was optimal.
  - Measured from -10 to -20 V with beam on and off.
  - The peak of background-subtracted intensity was at -12 V.
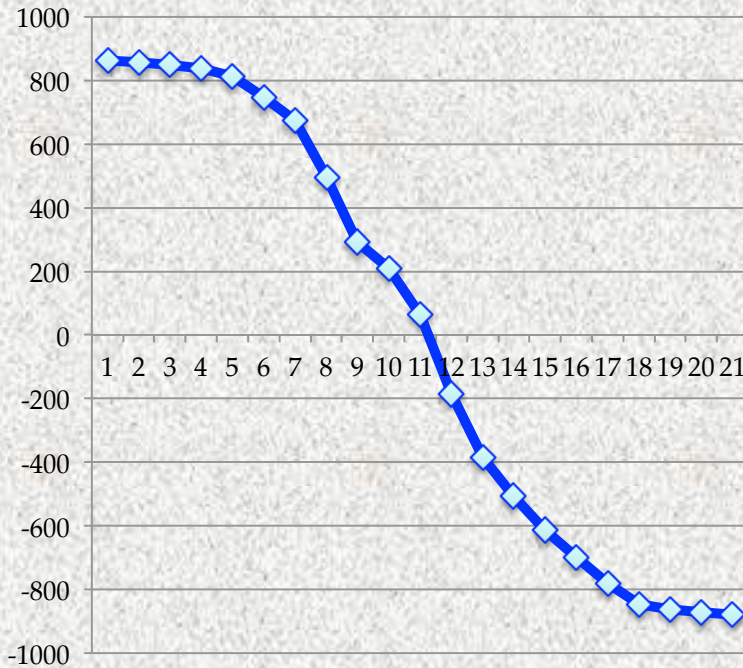
Libera Calibration

- Determine slope and offsets for beam motion.
  - $X = K1((a+d)-(b+c))/(a+b+c+d) - Off1$
  - $Y = K2((a+b)-(c+d))/(a+b+c+d) - Off2$

- Center beam.

- Center sensor in beam.

- Scan sensor through beam in 10 μm steps.

  - Measure reported position.

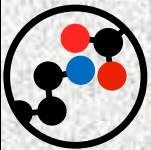 - Calculate slope and offsets from graph.

  - Set parameters in Libera.
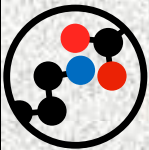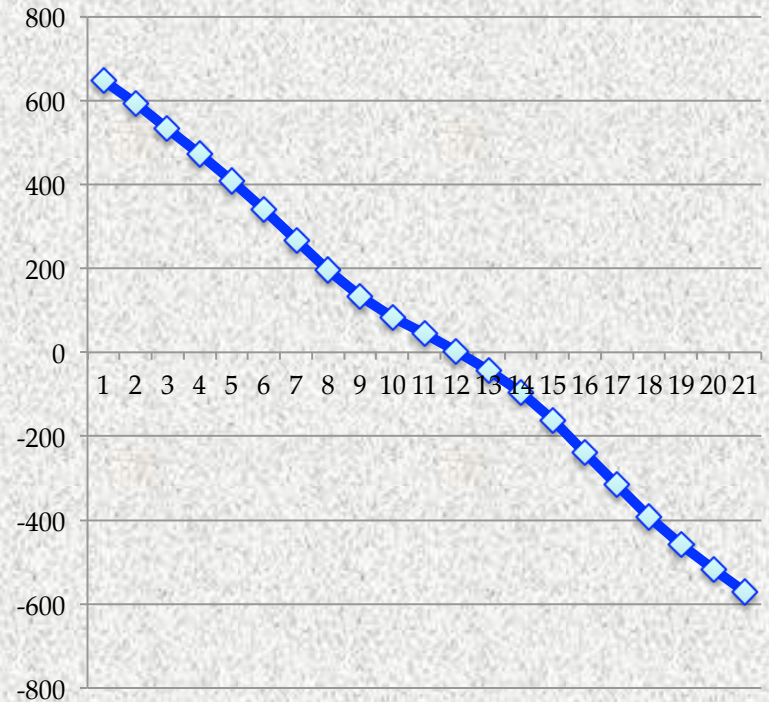
Calibration, pt 2

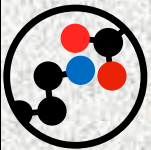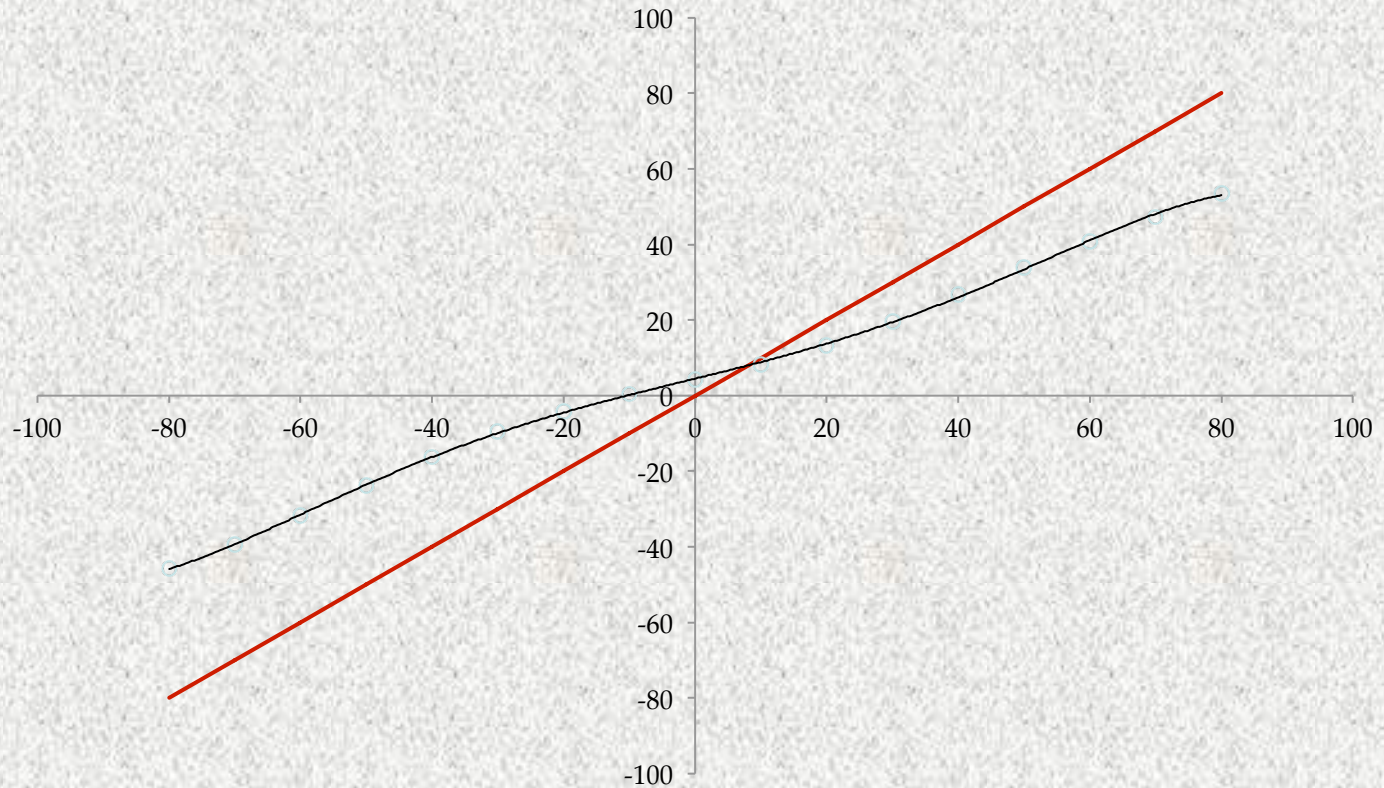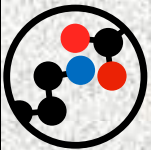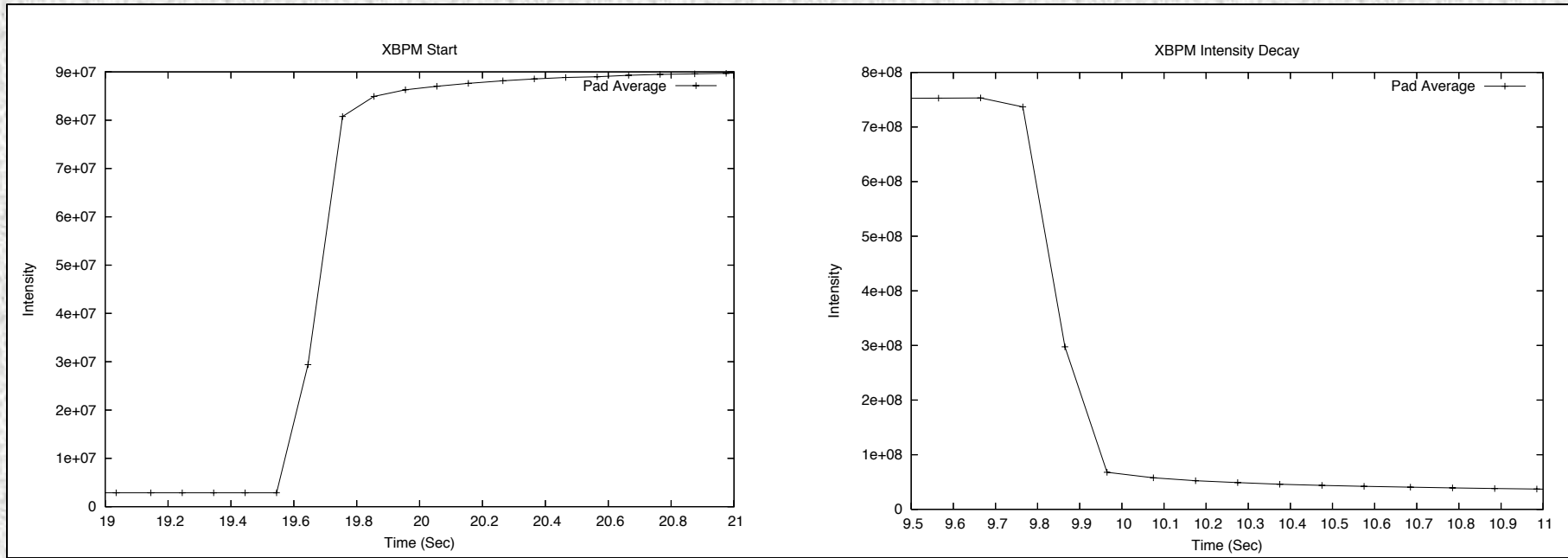Scanning sensor through beam

Vertical

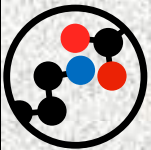Horizontal

Calibration, pt 3
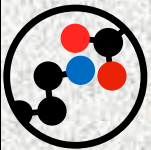
Calibration curve

On/Off Delay

Energy vs Attenuation

- Moved from 8 keV to 13.5 keV
  - 1st harmonic, 500 eV steps
- Optimized and centered beam.
- Moved beam off-center then started correction.
- From ~68% - ~98% attenuation, correction was successful.
- At low flux, beam position was not reported correctly.
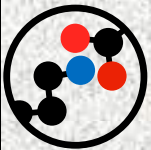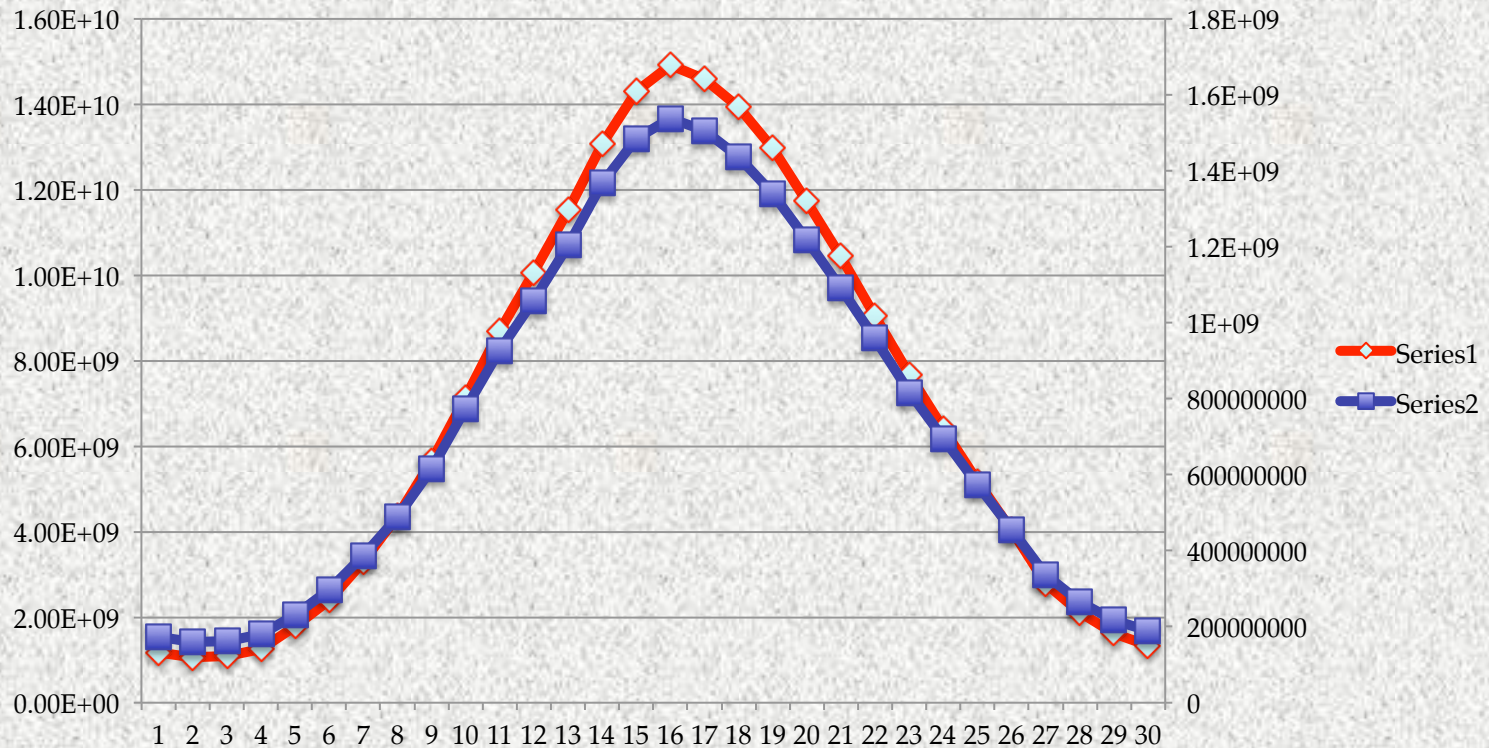 - High flux seemed to be less an issue.

Detector for Scans

- Monochromator 2nd crystal pitch scan.
  - Libera in autorange mode.
  - Autoranging makes scan interpretation difficult.
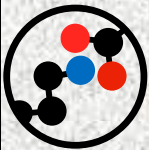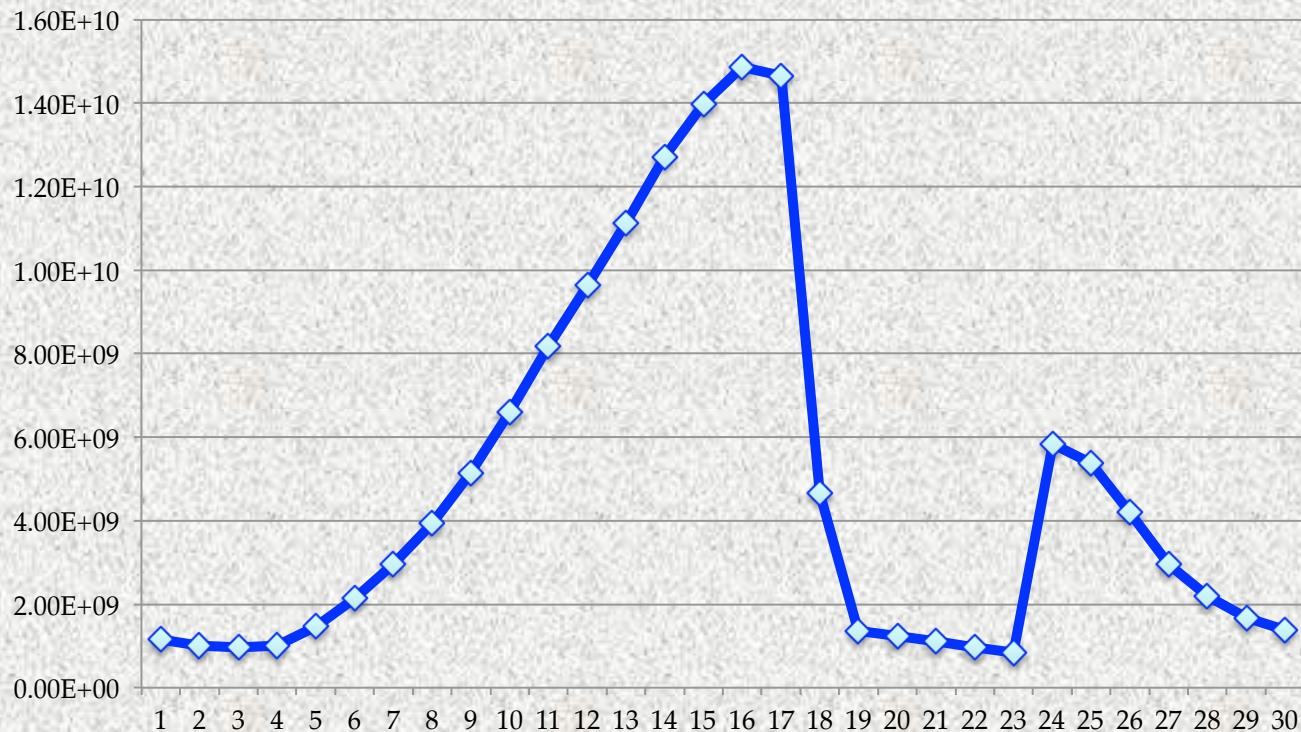
Detector for Scans, pt2

- Monochromator 2nd crystals pitch scans.
  - Libera in manual range 1 or 2.

Conclusions

- Integration and implementation was relatively easy.
- Sensitivity and linearity is useful over a large attenuation range.
- Autoranging can limit utility as a scan target or intensity monitor.
  - Just set it to manual mode and it can work fine.
- The RIGI has shown to be physically durable.
- The Libera has substantial built-in capabilities.
- Alterations to beam shape will require recalibration.
- Sensor gaps don't appear to produce scan artifacts.

- Customer support from Dectris and I-Tech has been outstanding.

Acknowledgements

- Dectris
  - Clemens Schulze-Briese
  - Benjamin Luethi

- Instrumentation Technologies
  - Peter Leban

- IMCA-CAT
  - Lisa Keefe
  - Anne Mulichak
  - Eric Zoellner (hardware integration)
  - Lewis Muir (EPICS integration)
  - Joe Digilio