

Generating X-Rays through Channeling Radiation

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Background Information

- ASTA
 - Beamline Components
 - Photoinjector
 - Crystal $\sim 40\mu\text{m}$ diamond
 - Goniometer
 - X-ray Detector

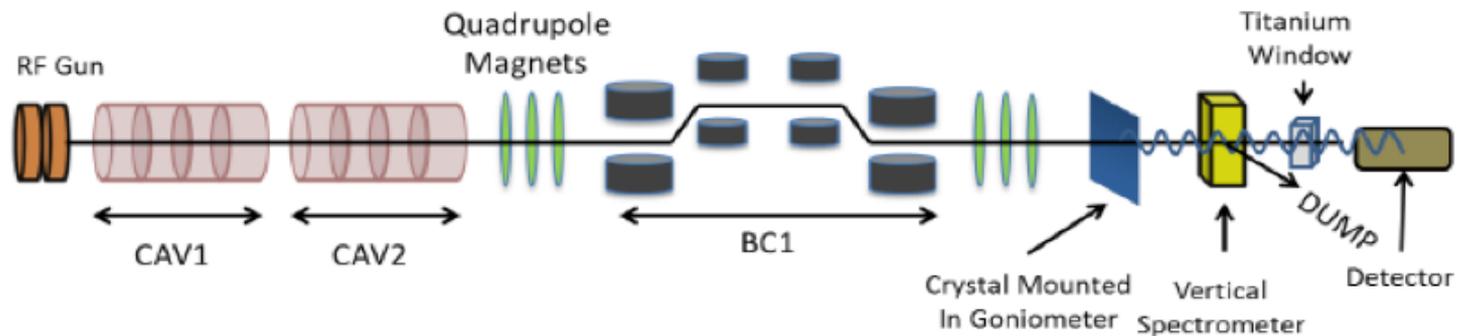
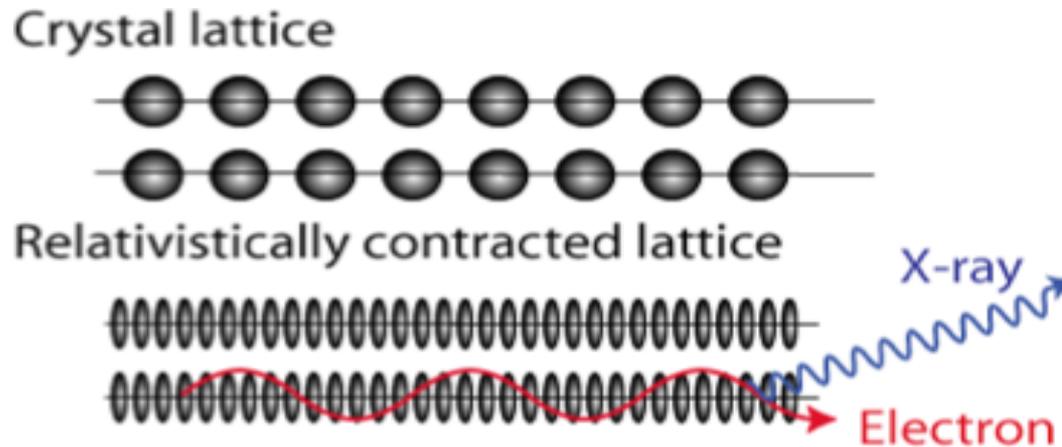


Figure 1. Design and placement of the devices in the beamline

The Goal

- Produce X-Rays from $\sim 40\text{MeV}$ electron beam



- Channeling Radiation
 - Sheet of positive charge in a crystal
 - Relativistic electron
 - Radiation from transitions between quantum states

Location of Devices

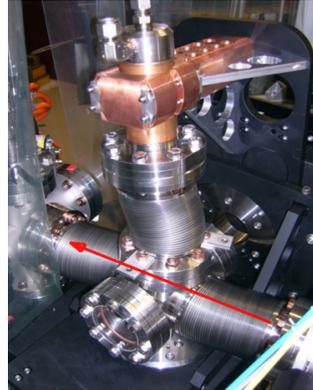
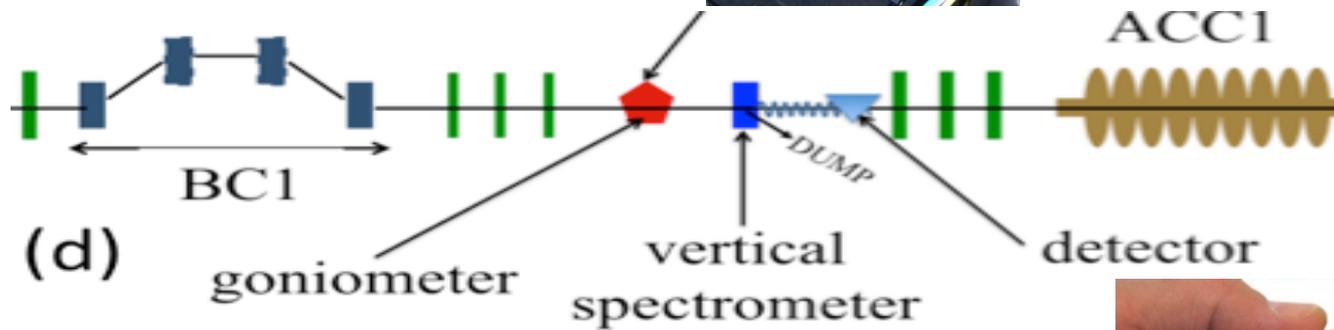


Figure 2. Goniometer Photo



(d)

Figure 3. X-ray Detector



Goniometer

- My previous assignment was to design a program to rotate/ translate the machine
- We attempted to connect to it via the control system

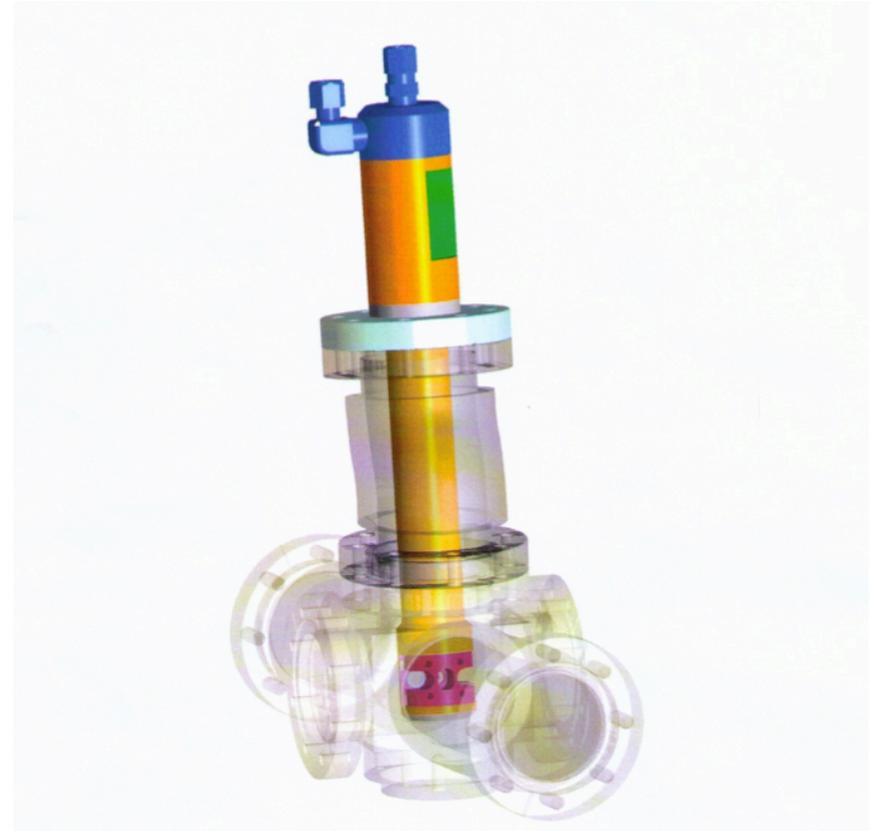


Figure 4. Sketch of Goniometer

Goniometer design

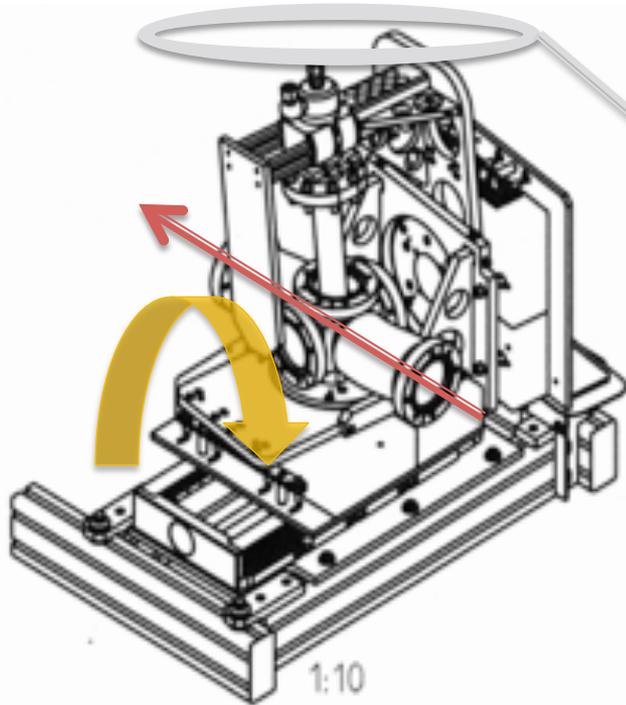
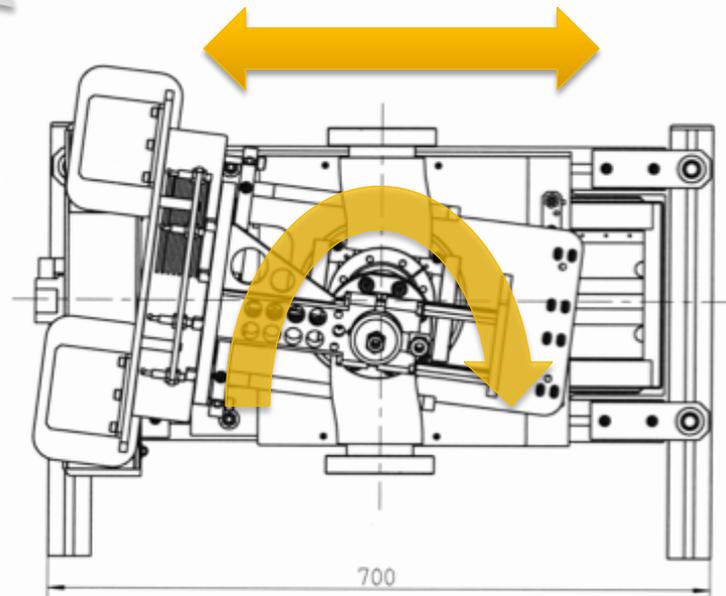


Figure63. Sketch of goniometer assembly

Figure 5. Sketch of the Top View of the Goniometer assembly



X-ray Detector

- We attempted to connect via the control system and communicate with it
- Device that will read the signal
- Most of my scripts will contribute to this device and its data



X-ray Spectrum

- Measured X-ray signal

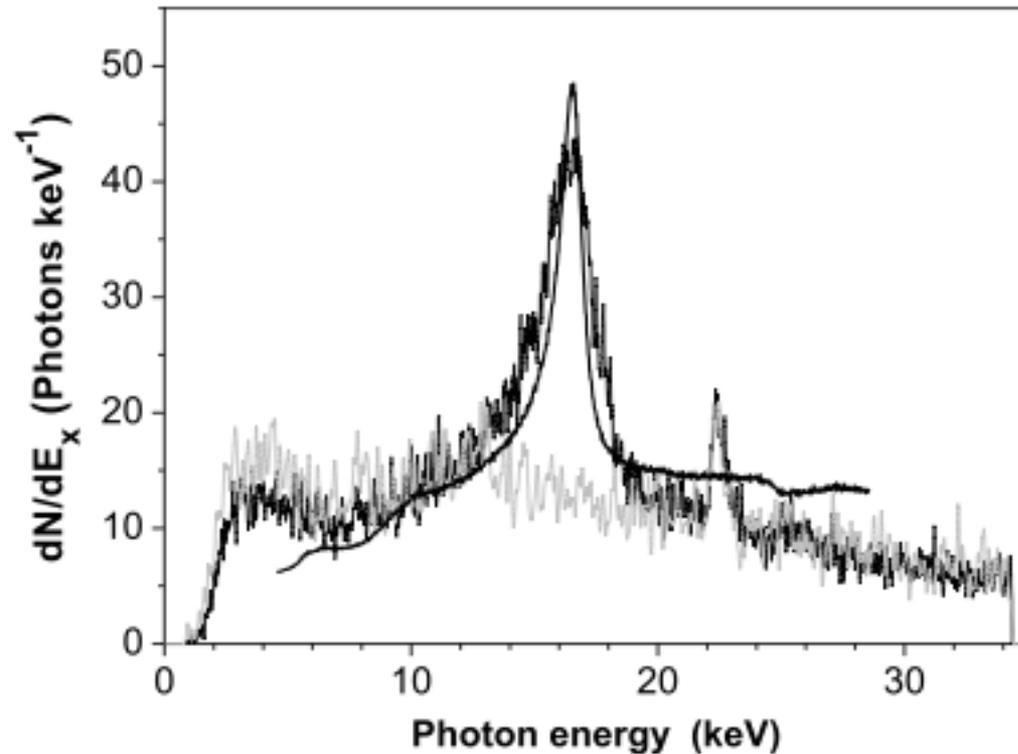
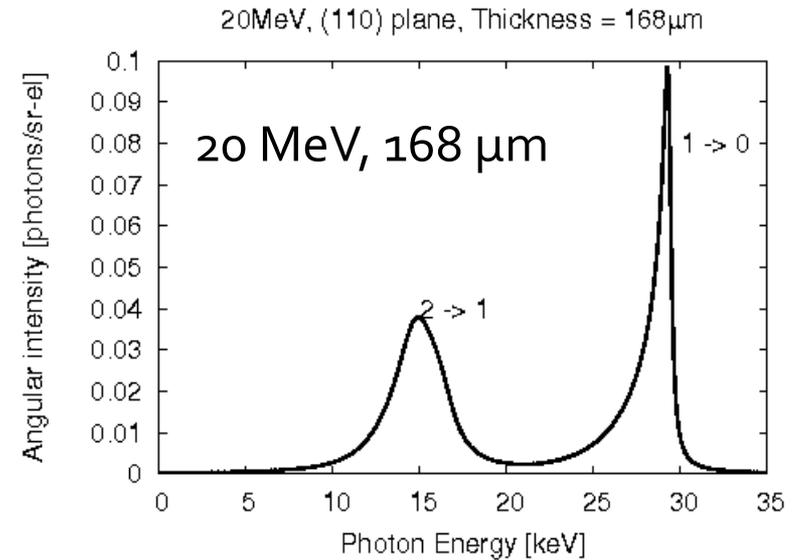
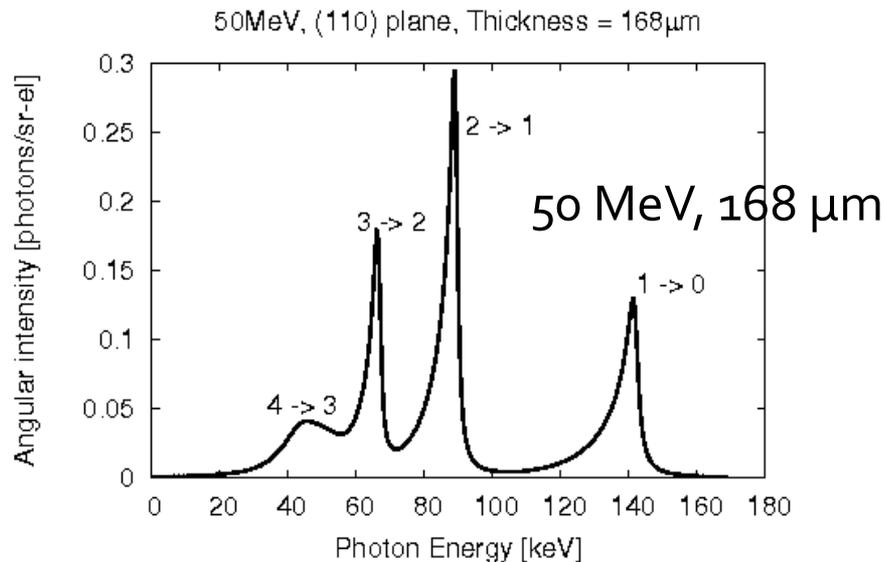


Figure 5. Measured signal. Conducted experiment in 2007 (W. Wagner, *An intense channeling radiation source*)

X-ray Spectrum

- Simulated X-ray signal



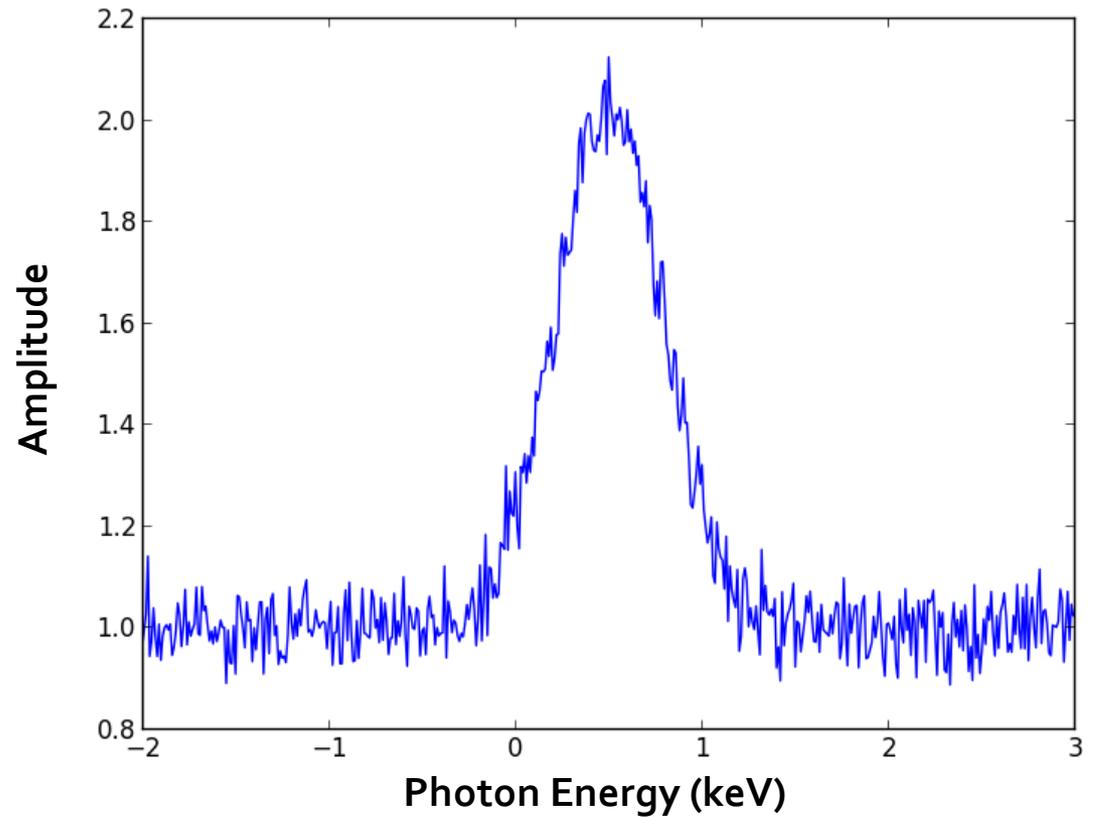
Analysis of X-ray Signal and Beam Current

- Corrected Signal
 - Subtracted Background
- Bunch Charge (Q)
 - Integrated Beam Current

Normalized Photon Intensity =
Signal / Q

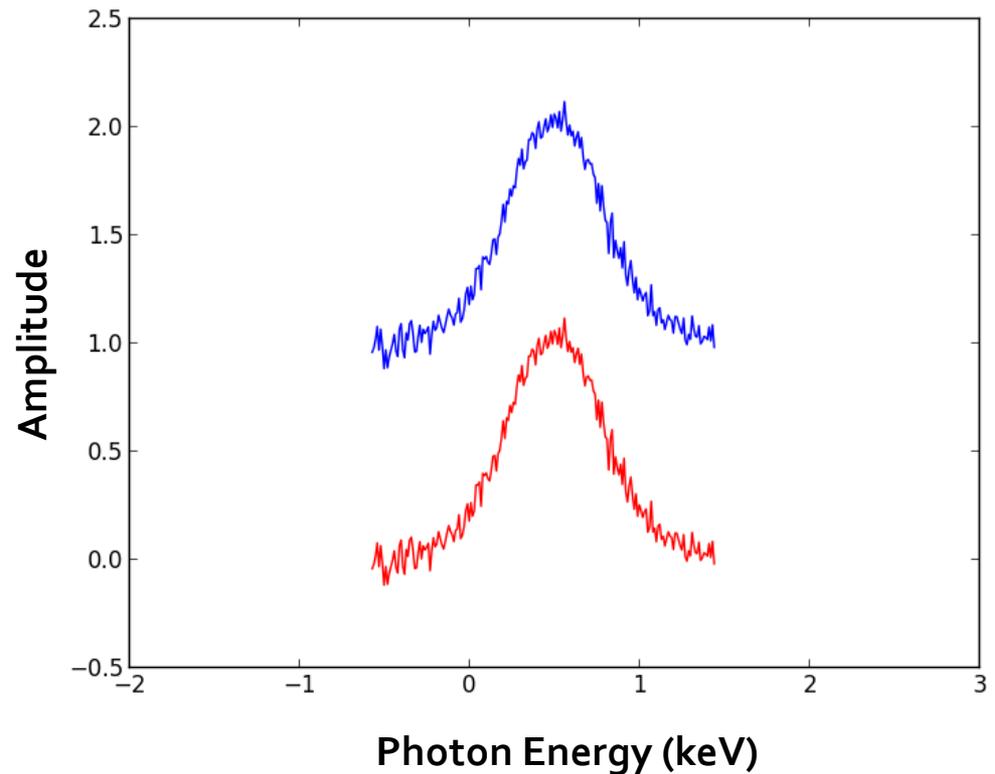
Signal

- Simulated X-ray signal done by declaring set values and made by a gaussian function
- Axis values are not true values*
 - For all plots



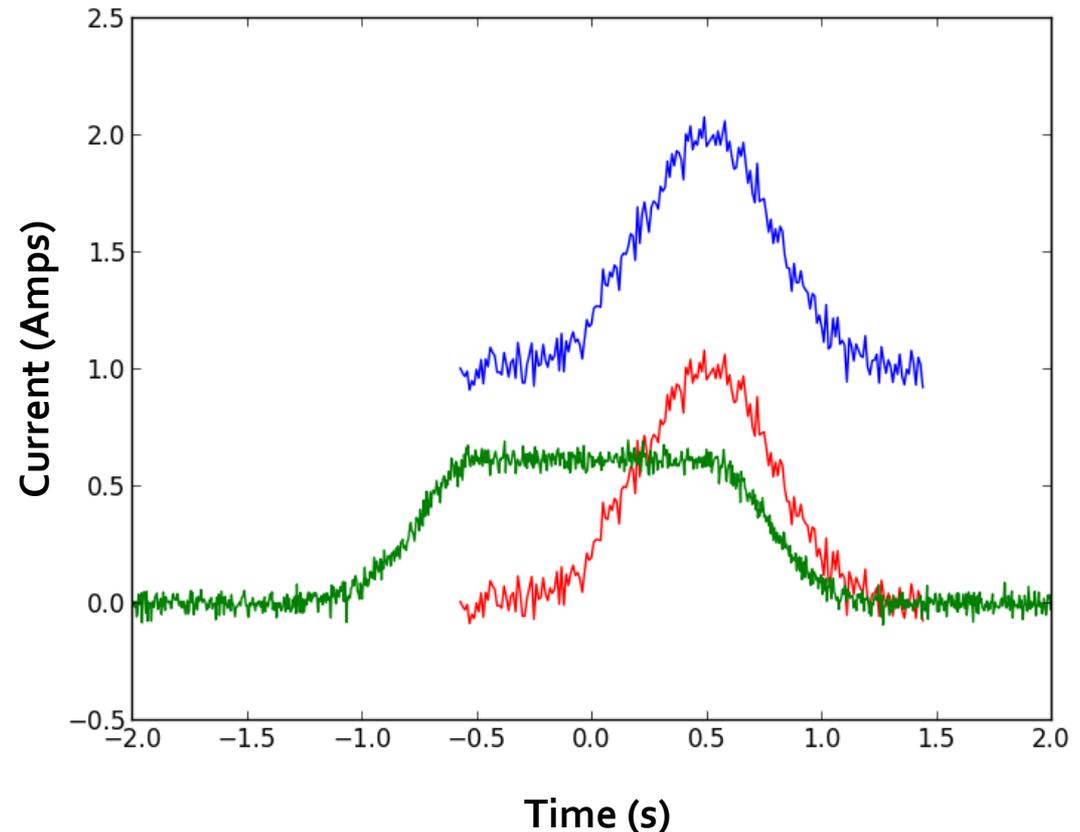
Signal minus Background

- Simulated signal minus the average of the background
- Background noise is not significant when finding the signal
- Blue – the original plot
- Red – the corrected signal



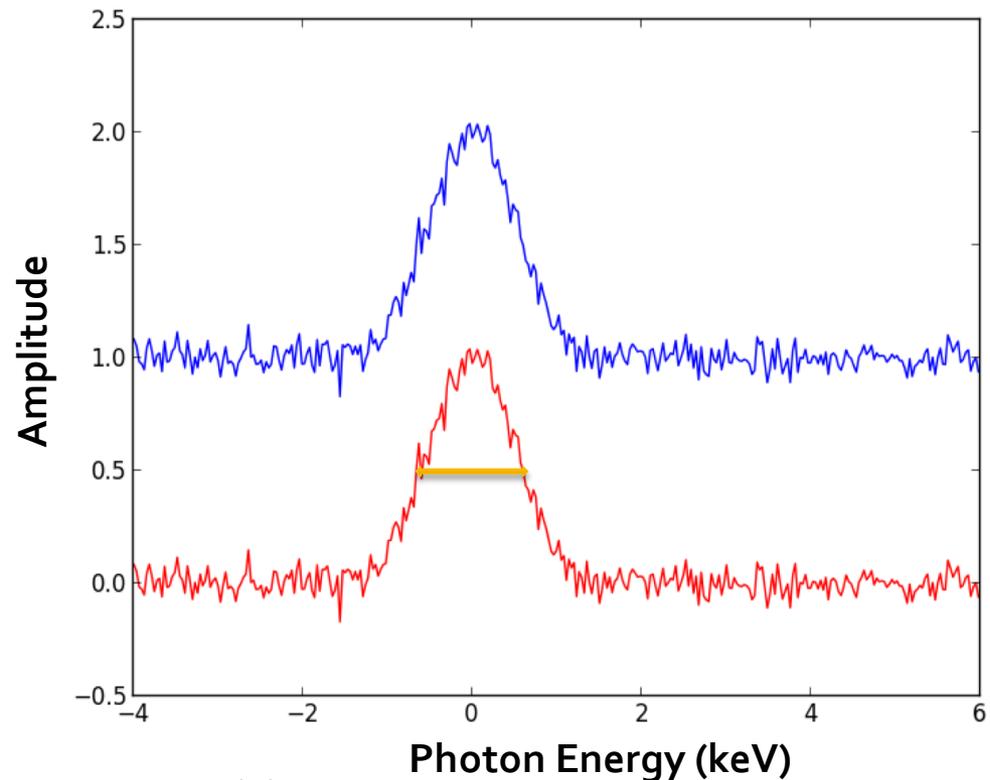
X-Ray Signal and Beam Current

- Simulated plot with both the X-ray signal and Beam Current (green)
- Axis are set for Beam Current only
- Must take the integral of the current for the **total bunch charge (Q)**



Full width at Half-Maximum

- Using the signal, the full width at half-maximum value is a standard value to find
- Need to find the value for distance comparison

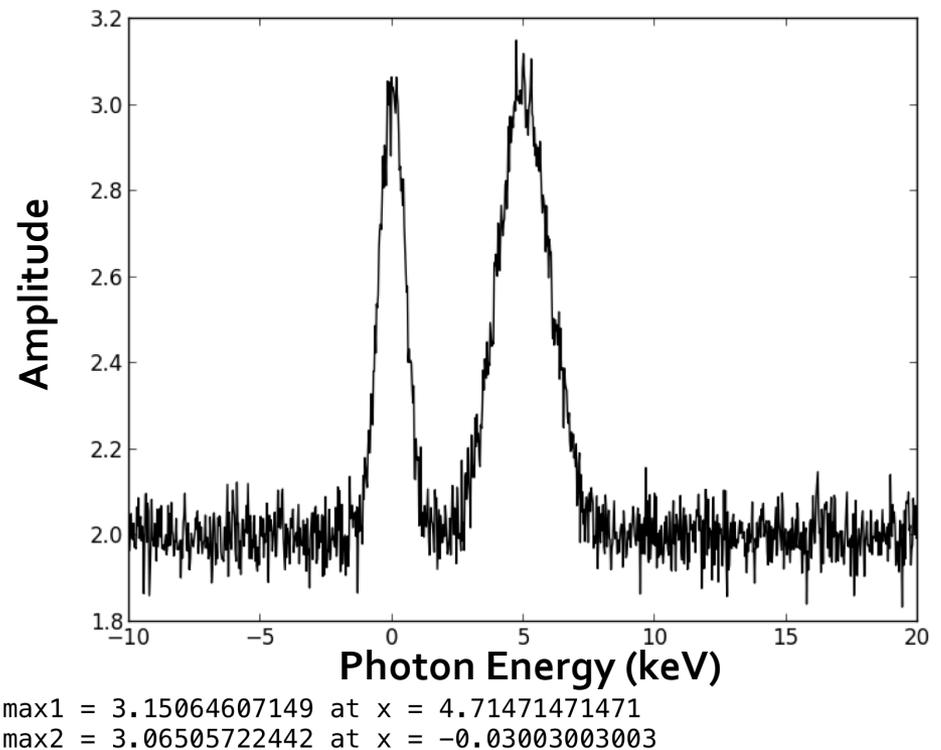


Peak Significance

- The peaks are what define the x-ray
- Any of the background noise is unnecessary because it is not coming from CR
- The more narrow the curve, the better quality of the signal

Finding Multiple Peaks

- Find the absolute peak
- Scan through the plot for next peak
- Record what the peak value is and where it is located



Conclusion

- What my work will contribute to
 - No real data yet
- The significance of this experiment
 - Develop a compact X-ray source
- Further work that it can benefit
 - Hospitals
 - Homeland security
 - Materials

Acknowledgments

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THANK YOU!

Questions?

