

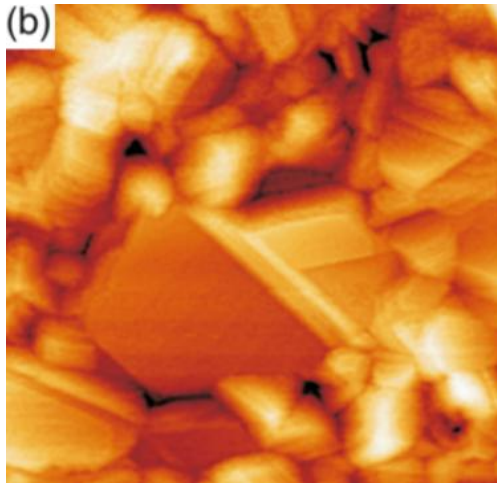
Constructing an X-Ray Diffractometer for the Analysis of Thin Metal Films at Houghton University

Owen Fall

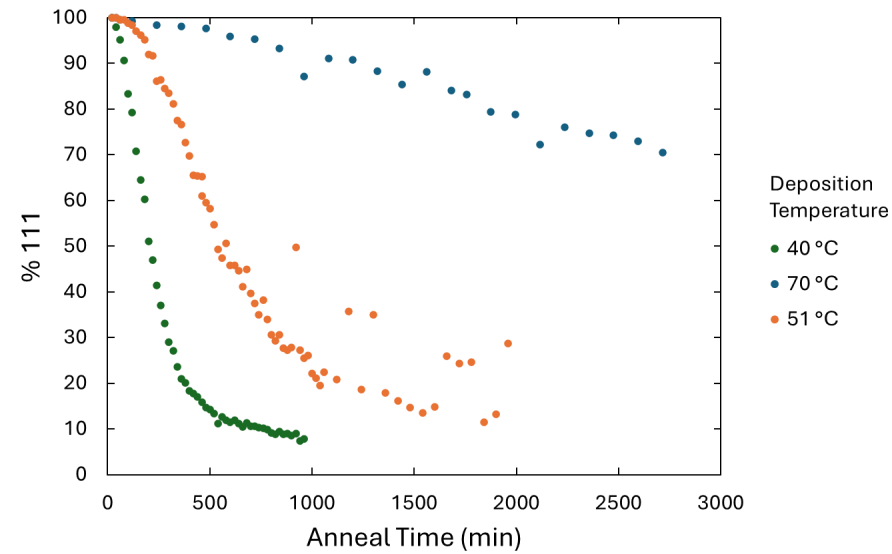


Overview

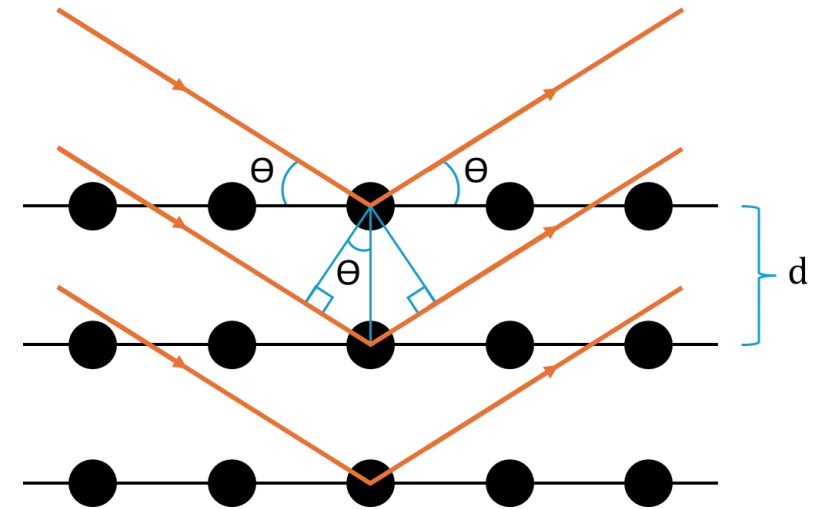
Thin Metal Films



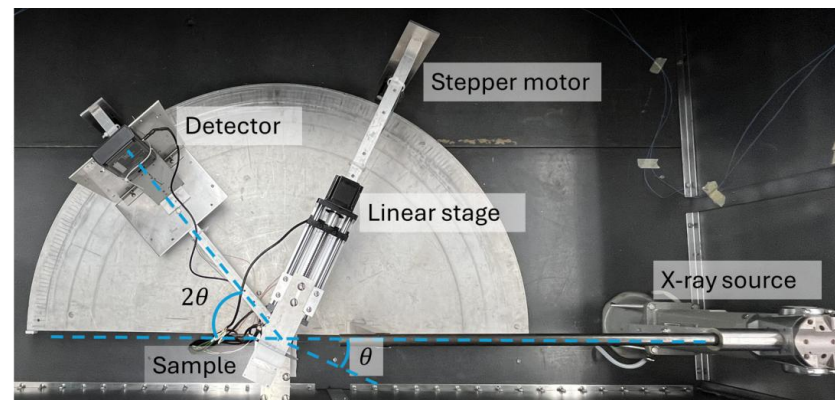
Previous Research



XRD Theory

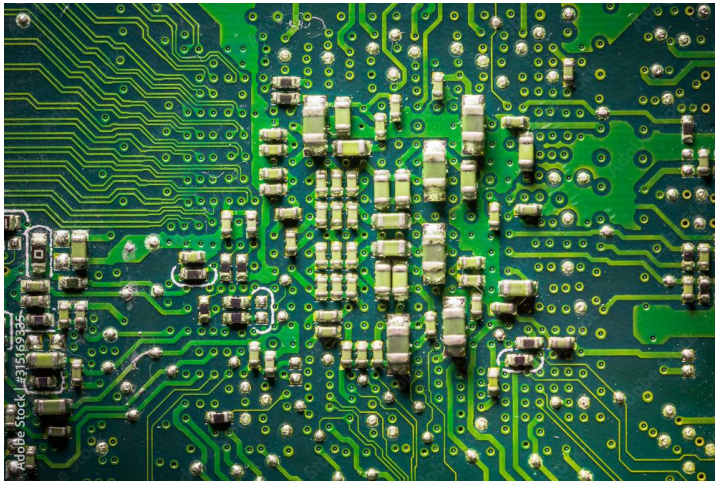


Houghton's XRD



Thin Metal Films – applications

Microelectronics



Optical Coatings

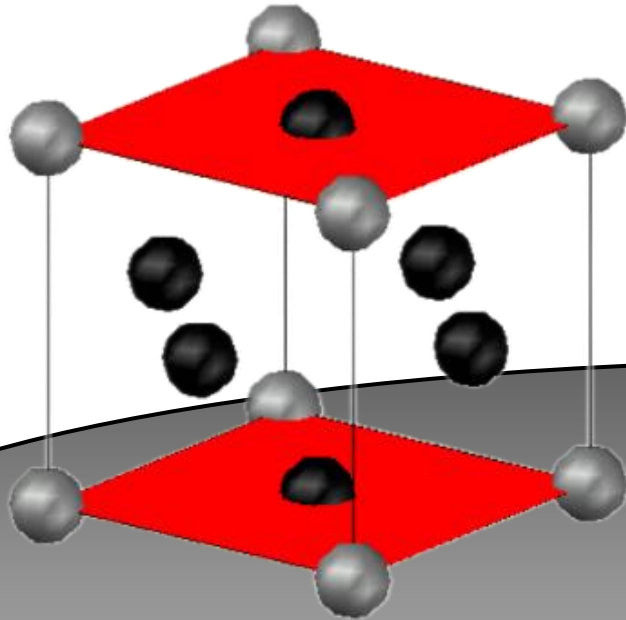


Solar Cells

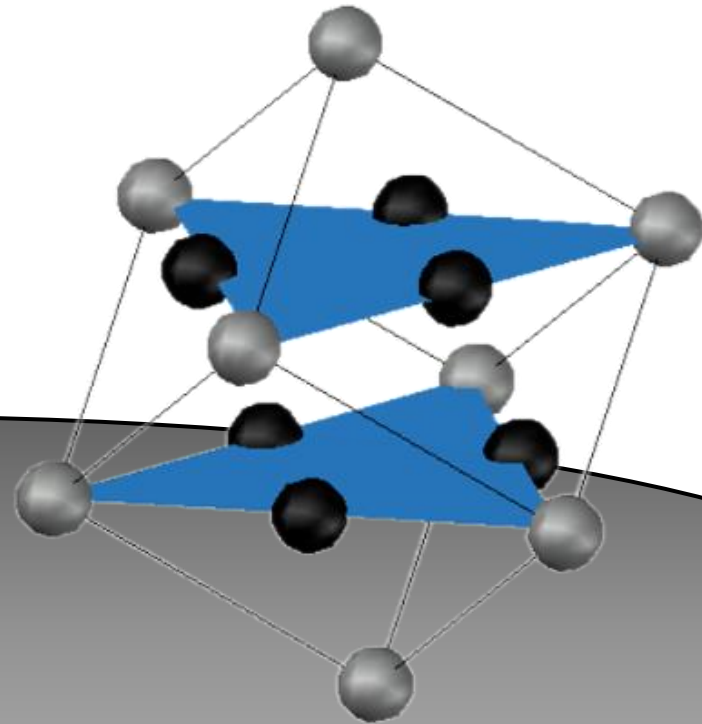


Thin Metal Films – atoms form cubic structure

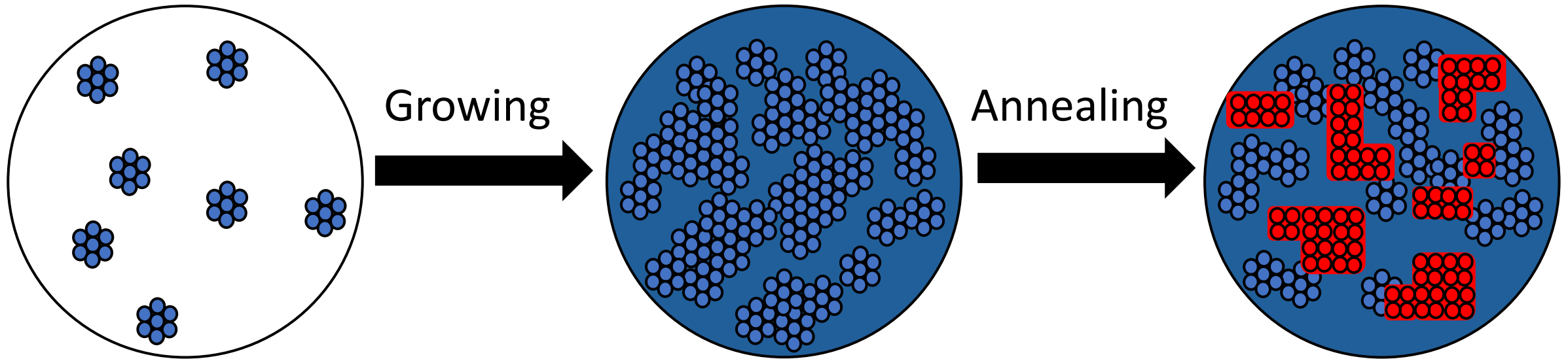
(100)



(111)

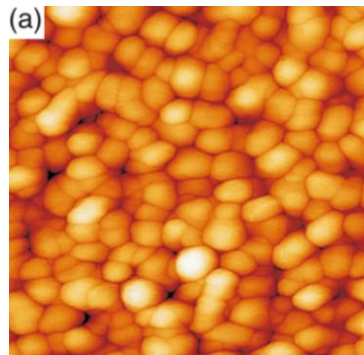


Thin Metal Films – growth and transformation



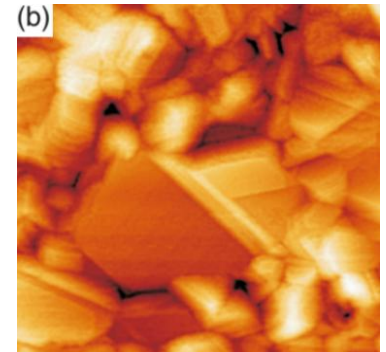
- (111)
- (100)

Ag film

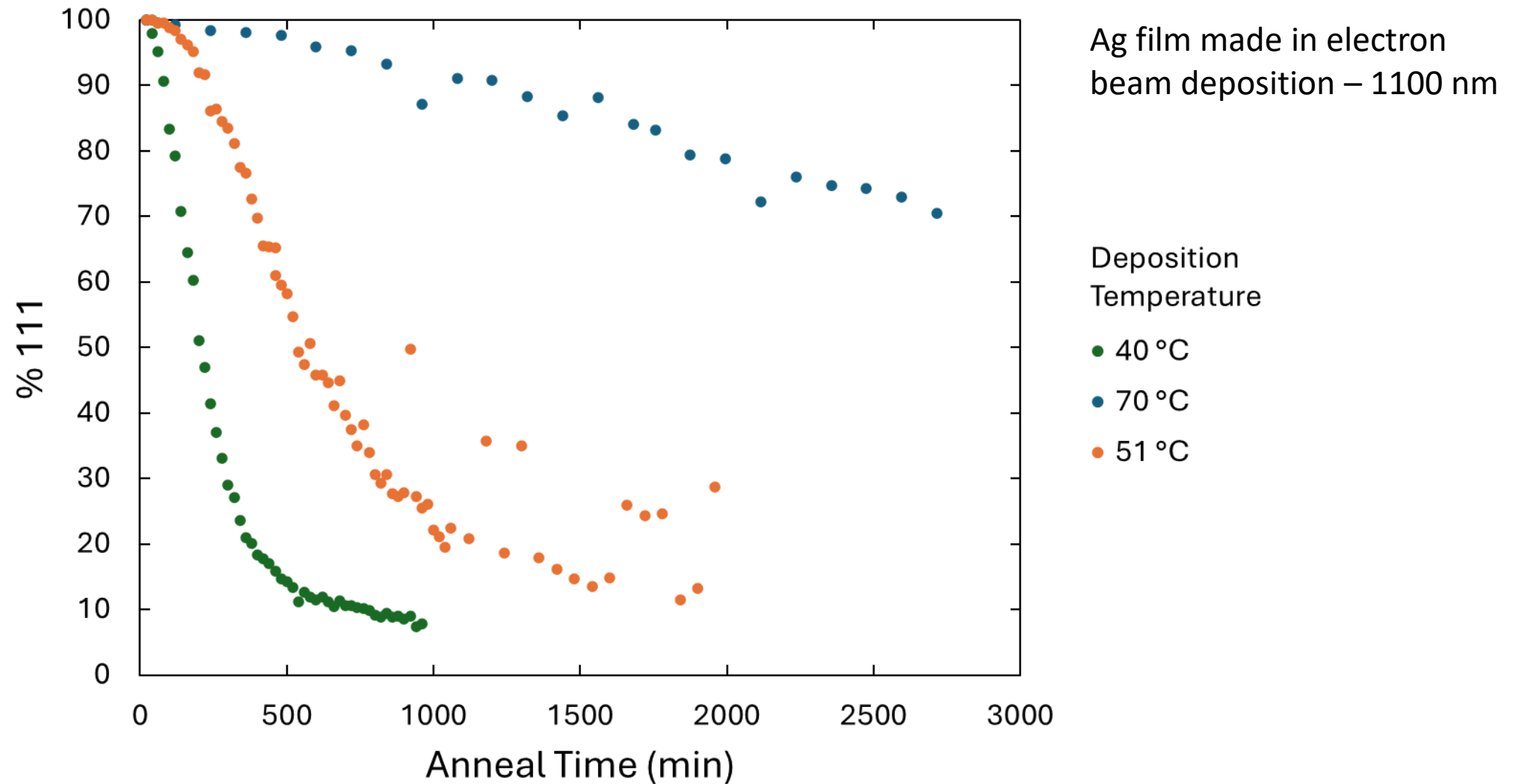


175 nm

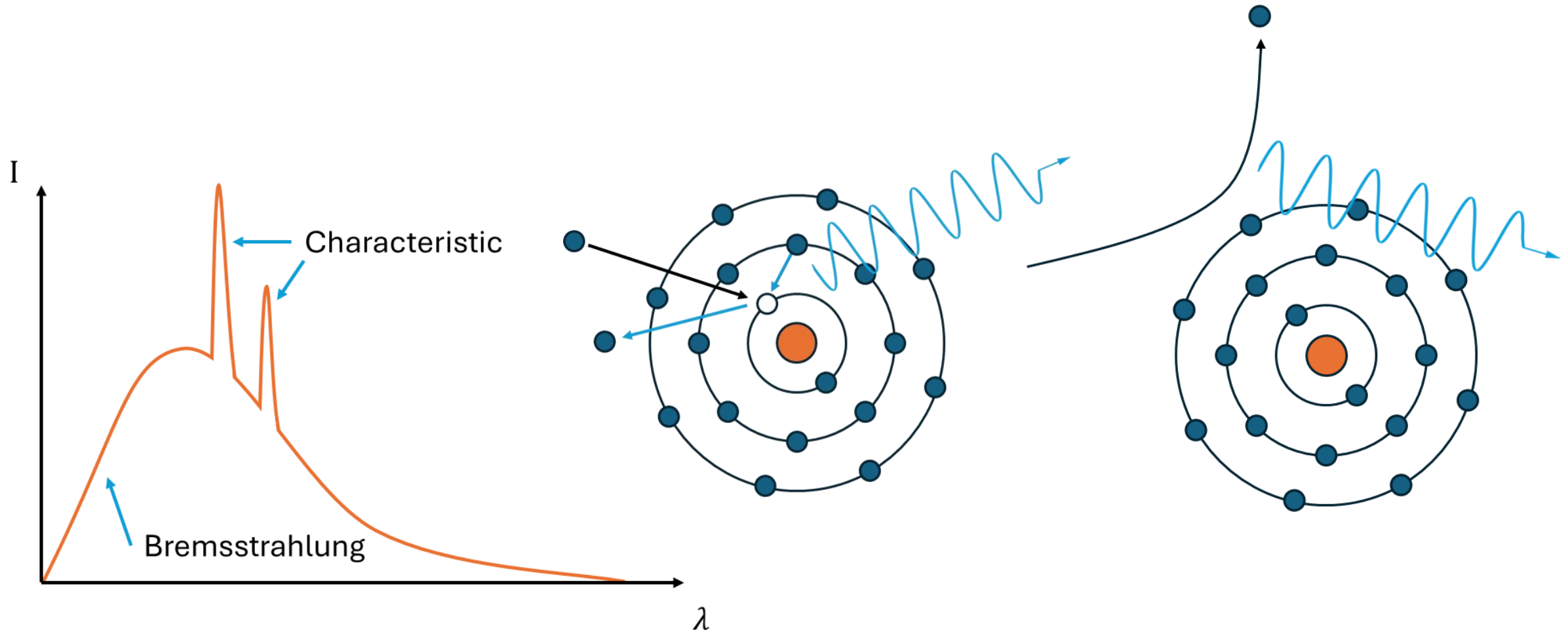
Annealing



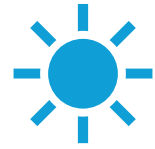
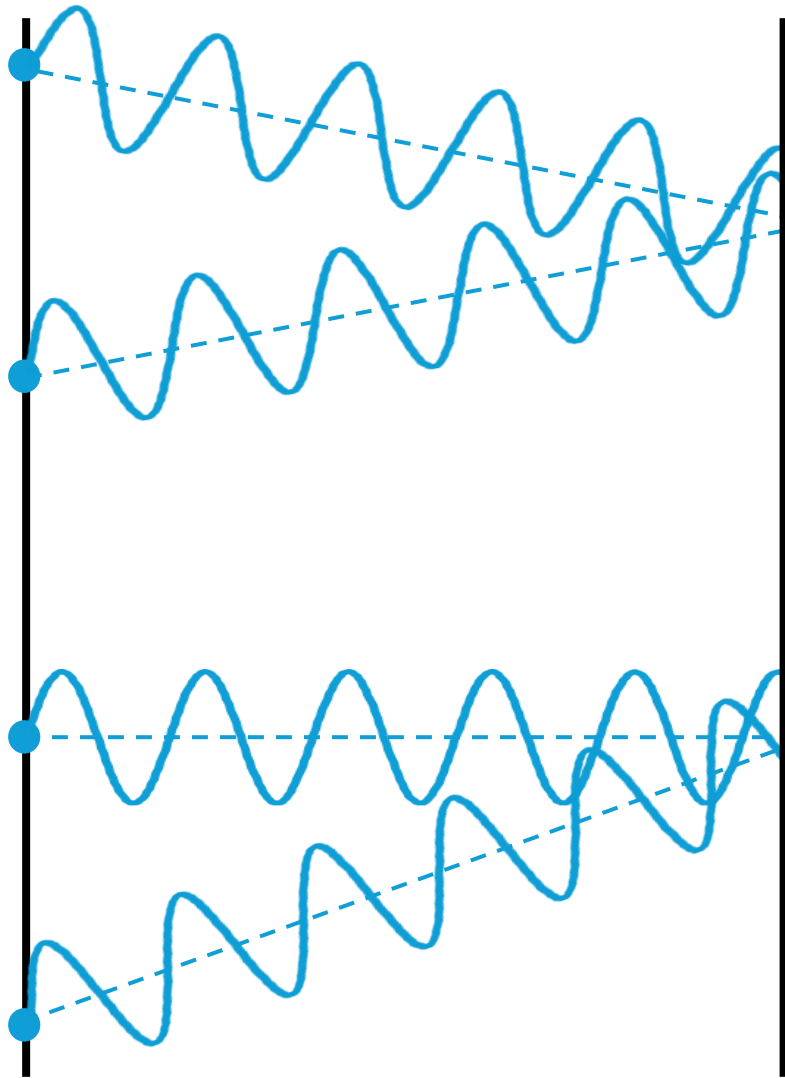
Previous Research – texture transformations



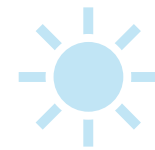
Characteristic and Bremsstrahlung Radiation



Path Length Difference



Path length difference = $n\lambda$

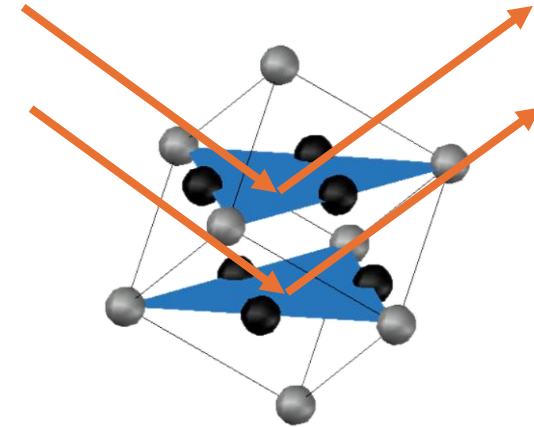
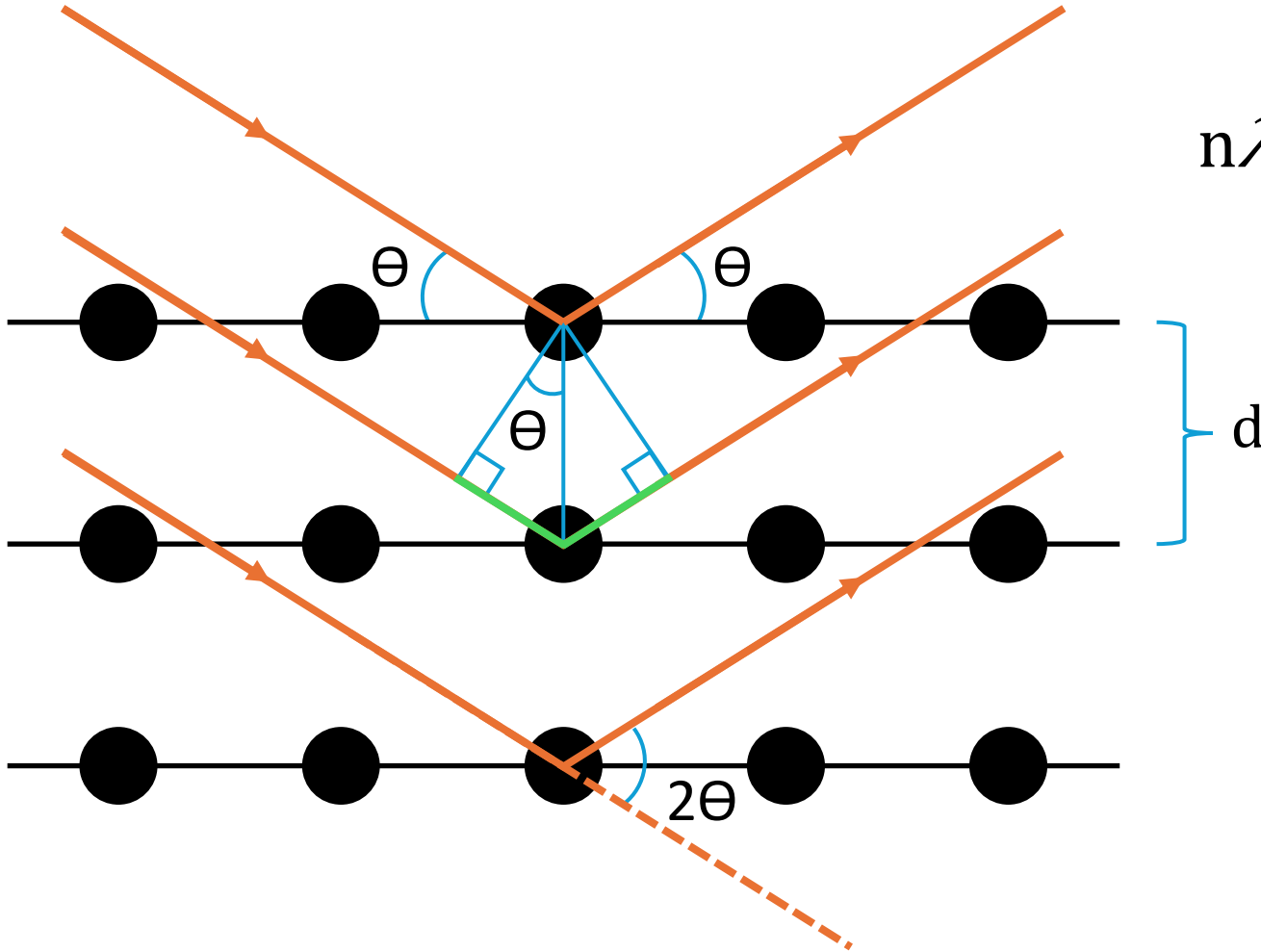


Path length difference $\neq n\lambda$

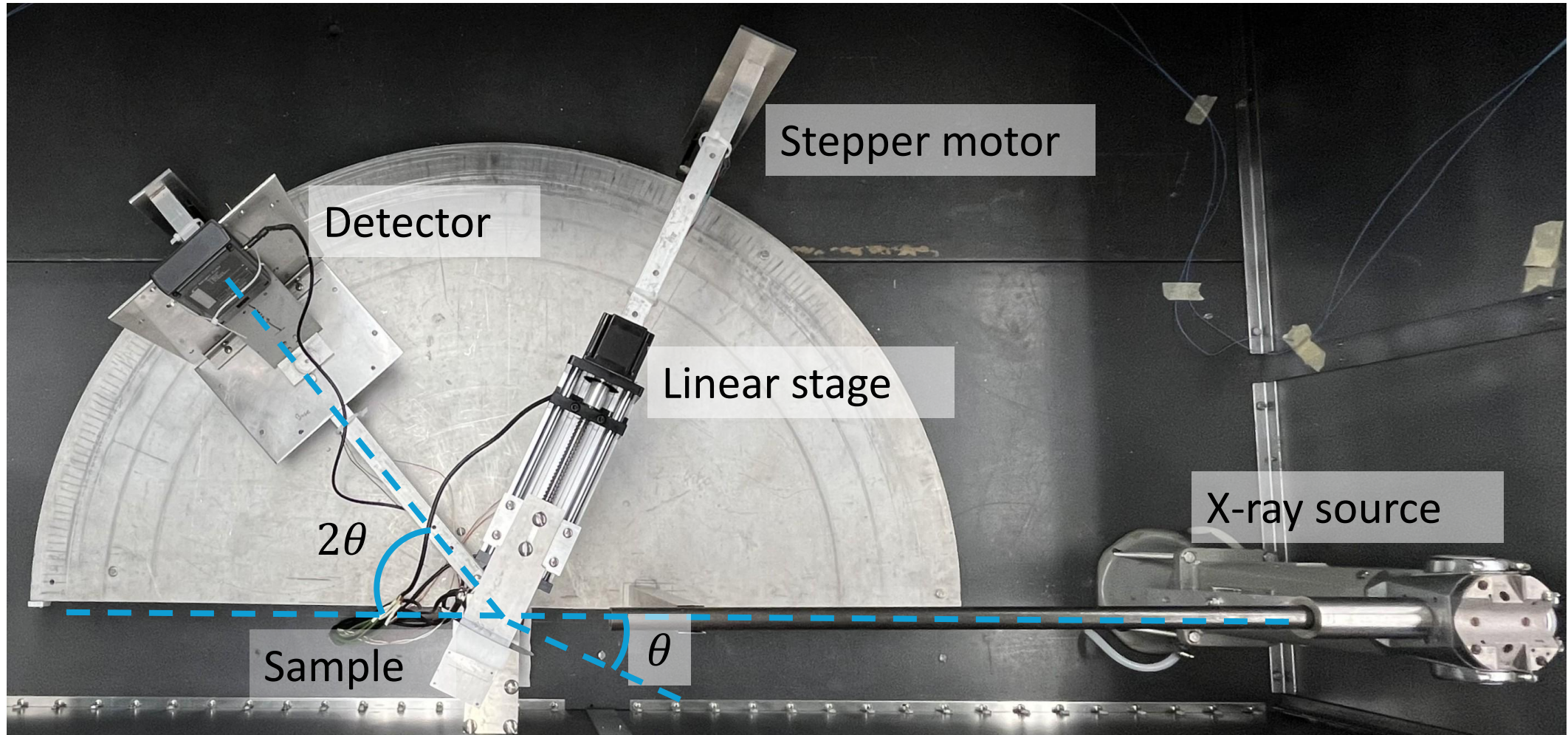
Bragg's Law

Path length difference = $2d \sin \theta$

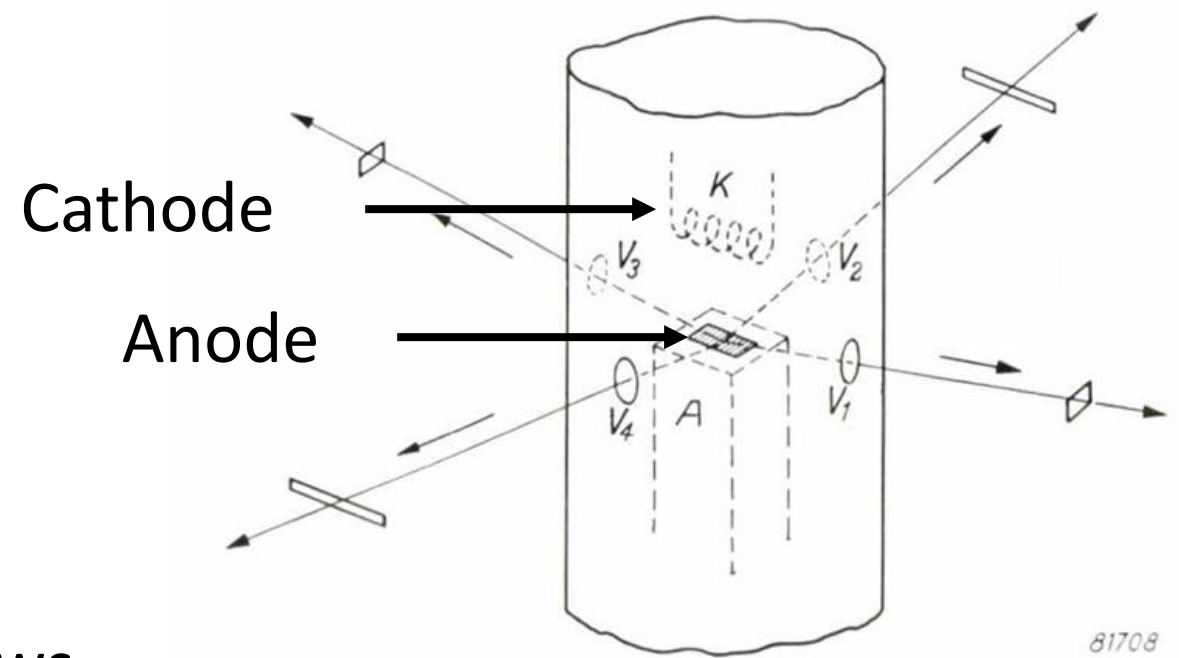
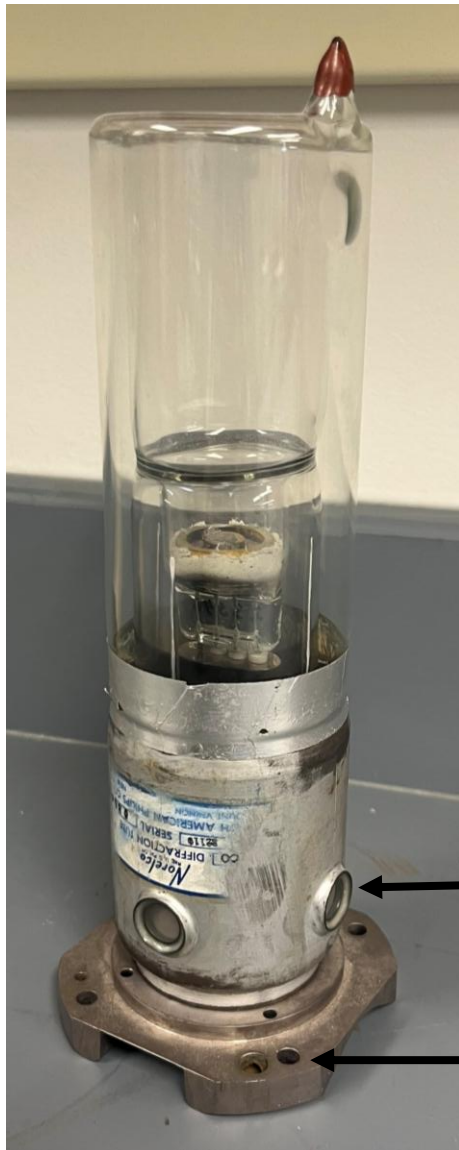
$$n\lambda = 2d \sin \theta$$



Houghton University's XRD – top view



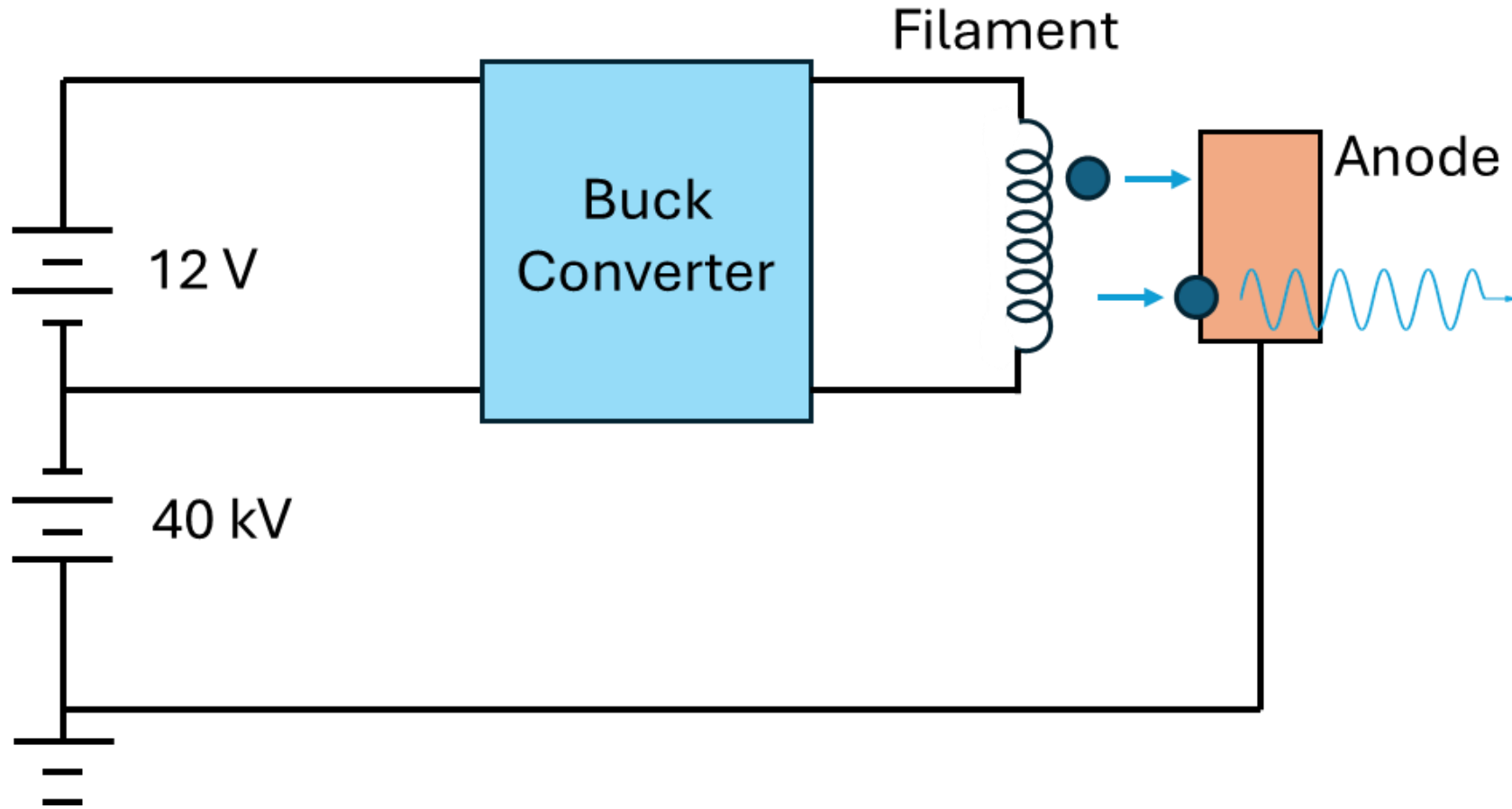
X-Ray Source – Norelco Diffraction Tube



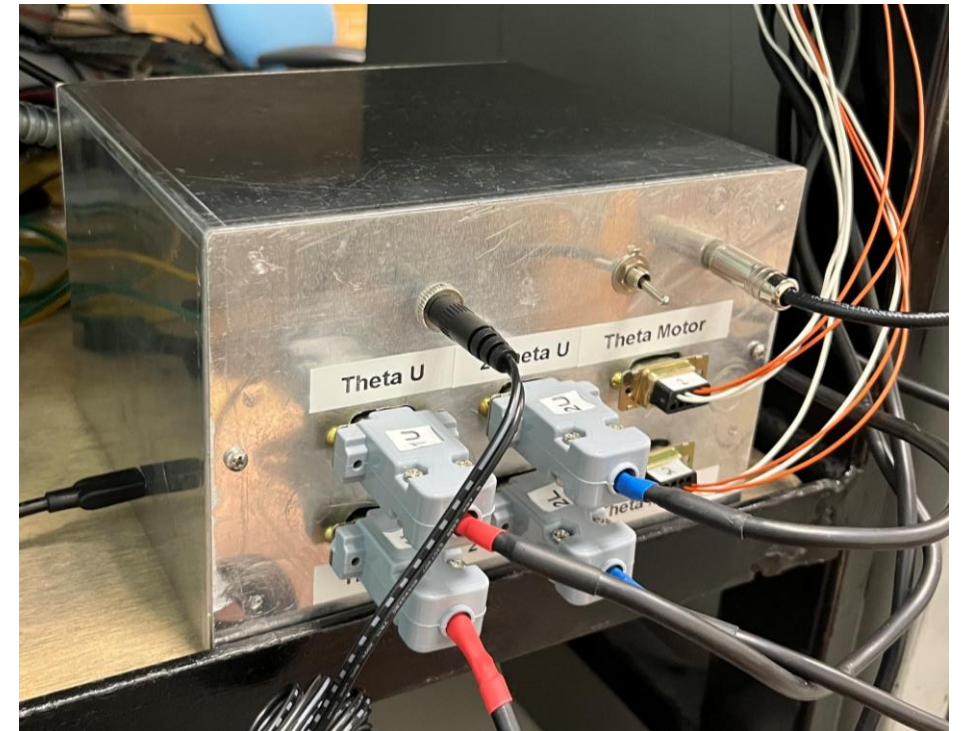
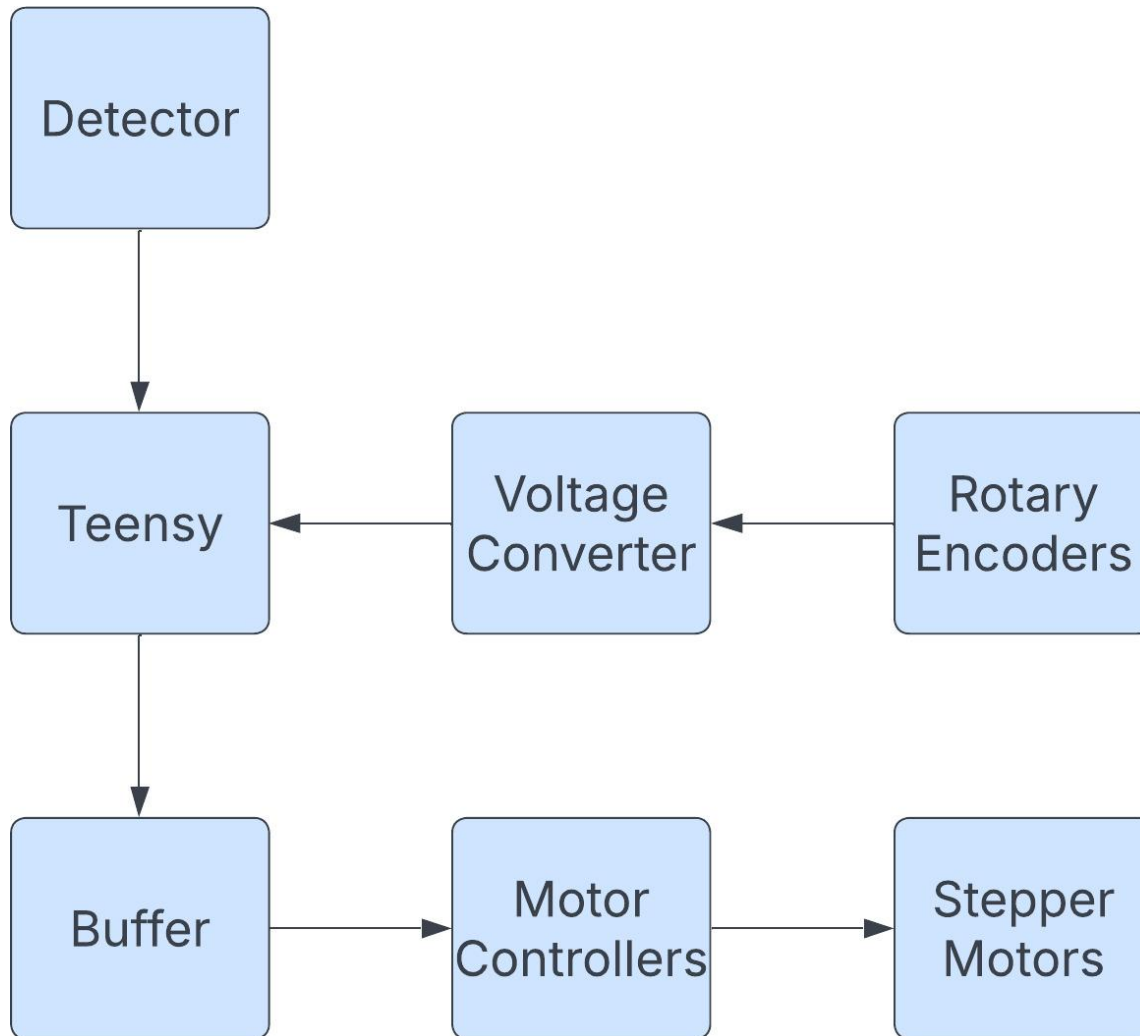
Windows

Water cooling tubes

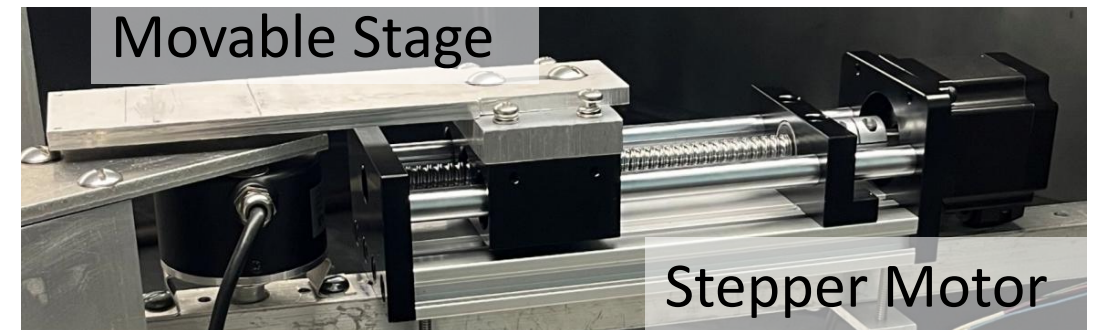
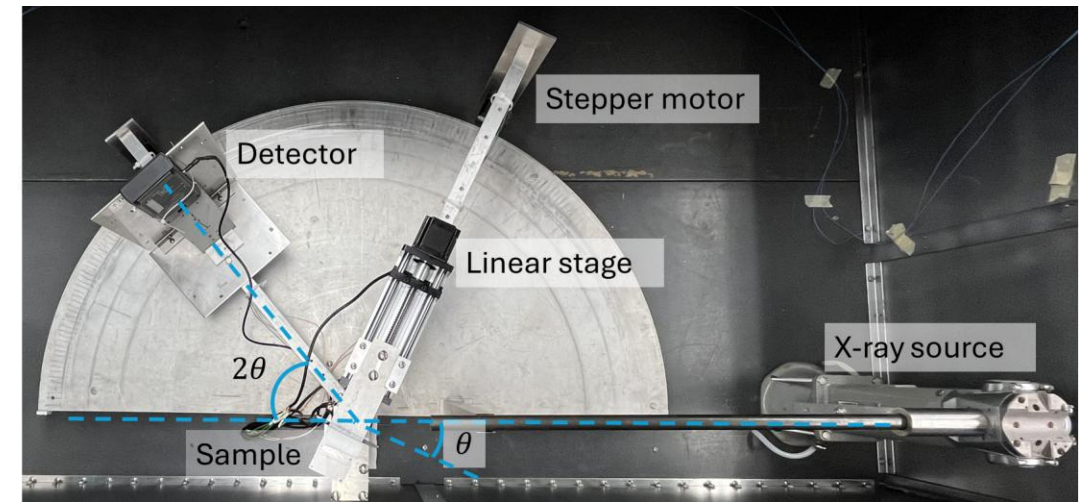
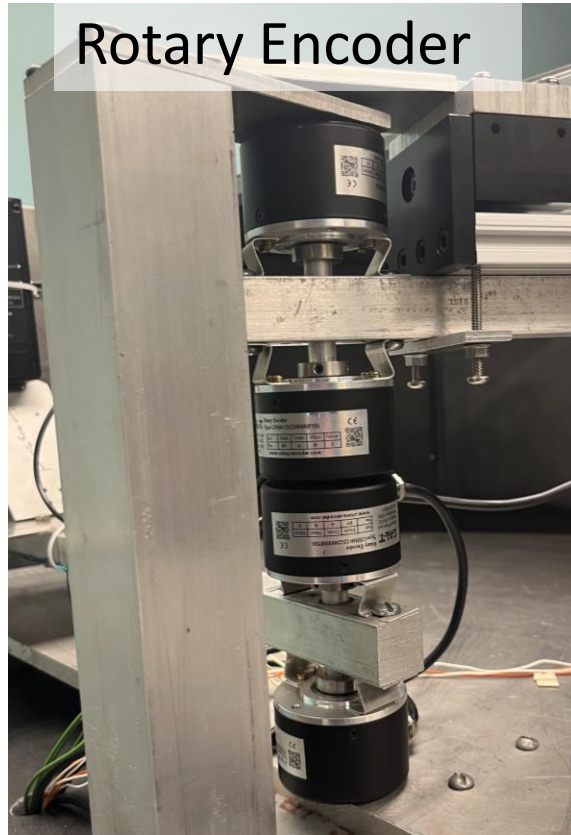
X-Ray Source – Buck Converter Circuit



Electronics



Rotary Encoders, stepper motors, detector



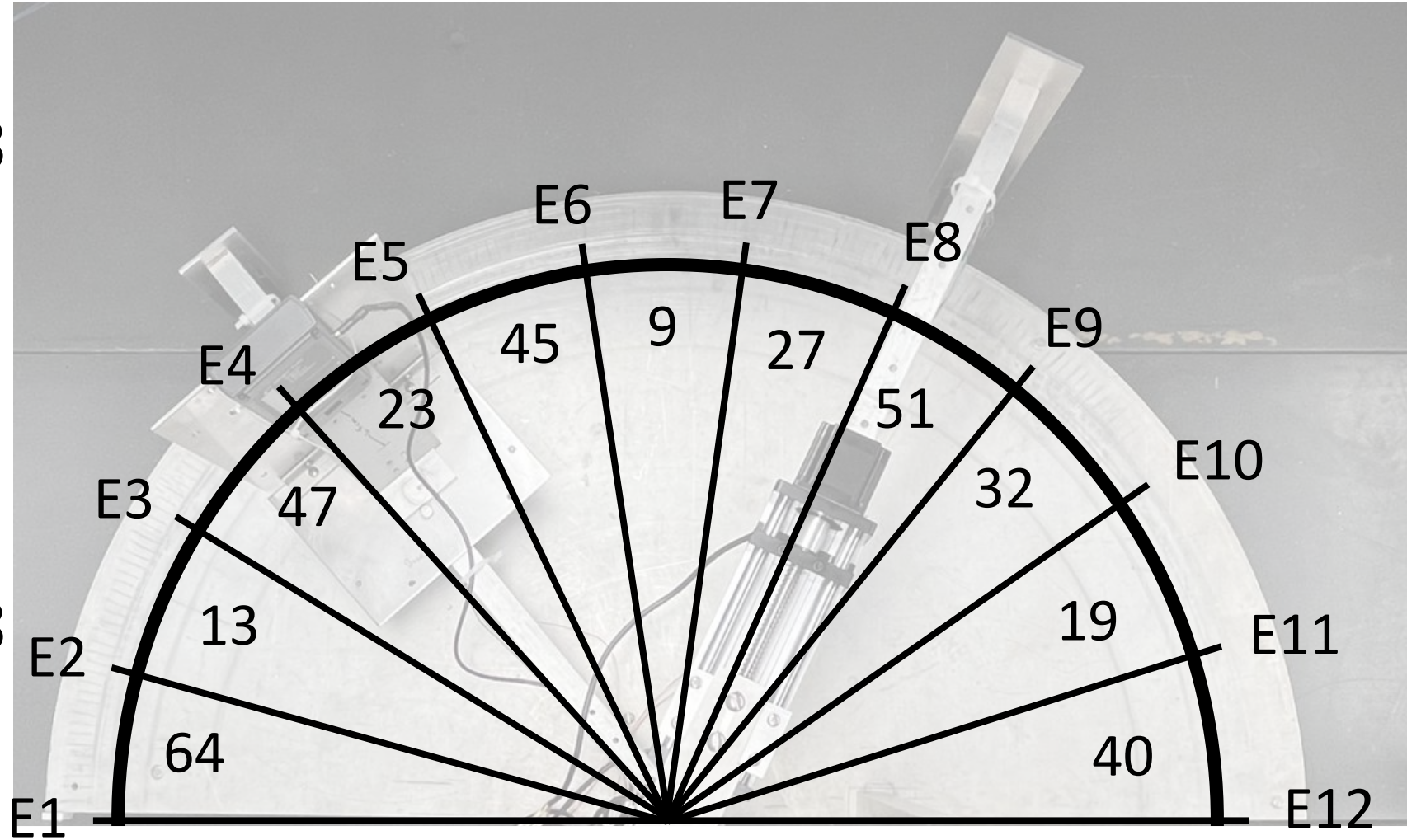
Encoder Array

Theta:

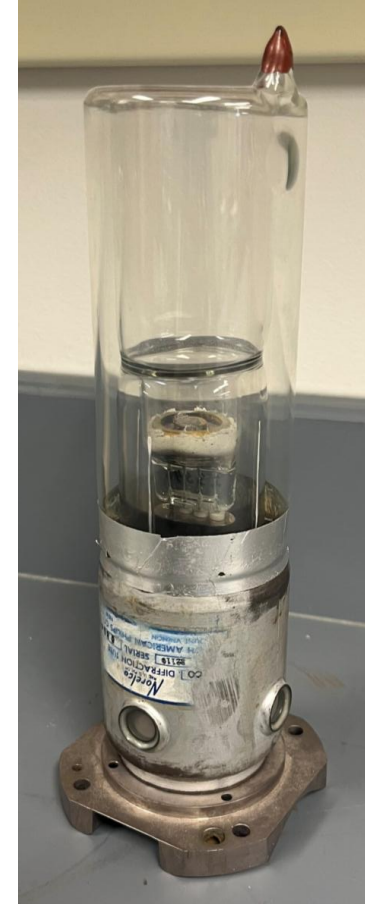
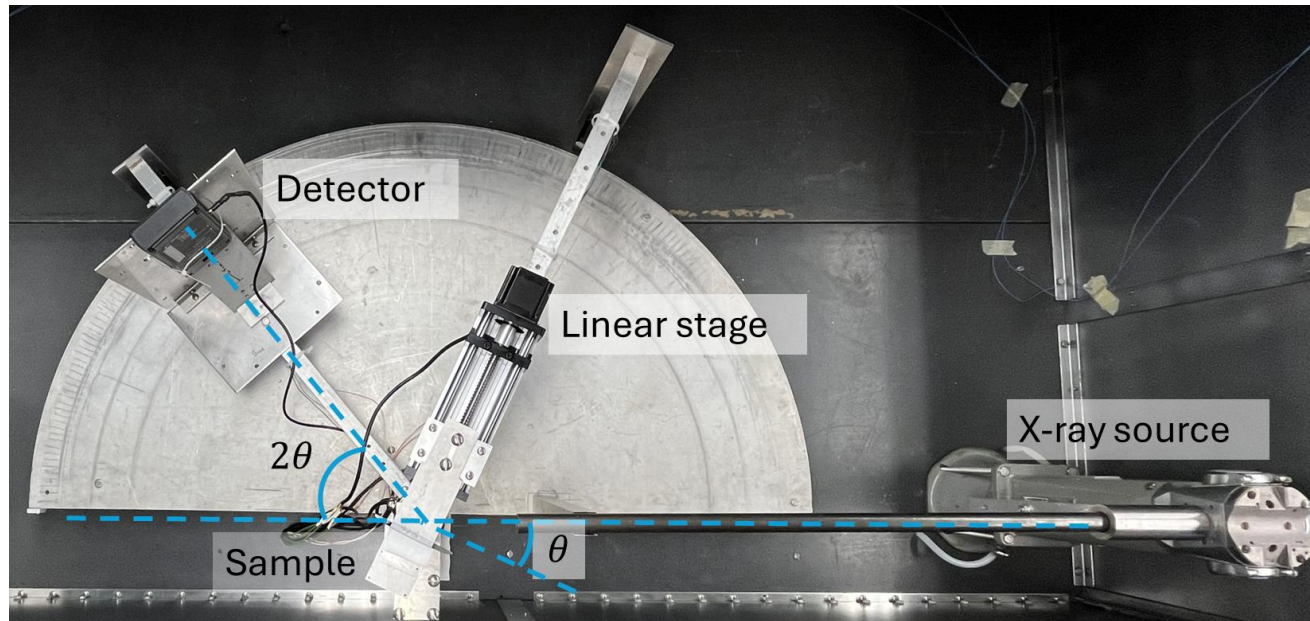
- $\frac{\text{average steps}}{\text{encoder trigger}} = 33$
- $\frac{mdeg}{\text{step}} = 0.68$

Two Theta:

- $\frac{\text{average steps}}{\text{encoder trigger}} = 33$
- $\frac{mdeg}{\text{step}} = 0.69$

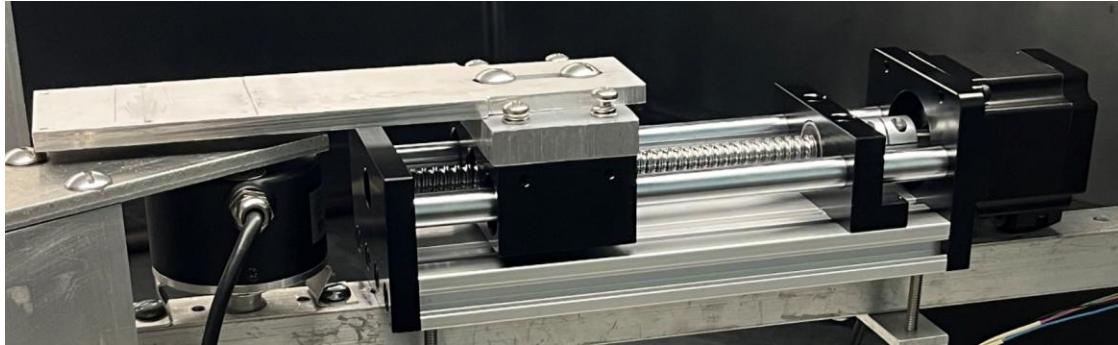


Current Status



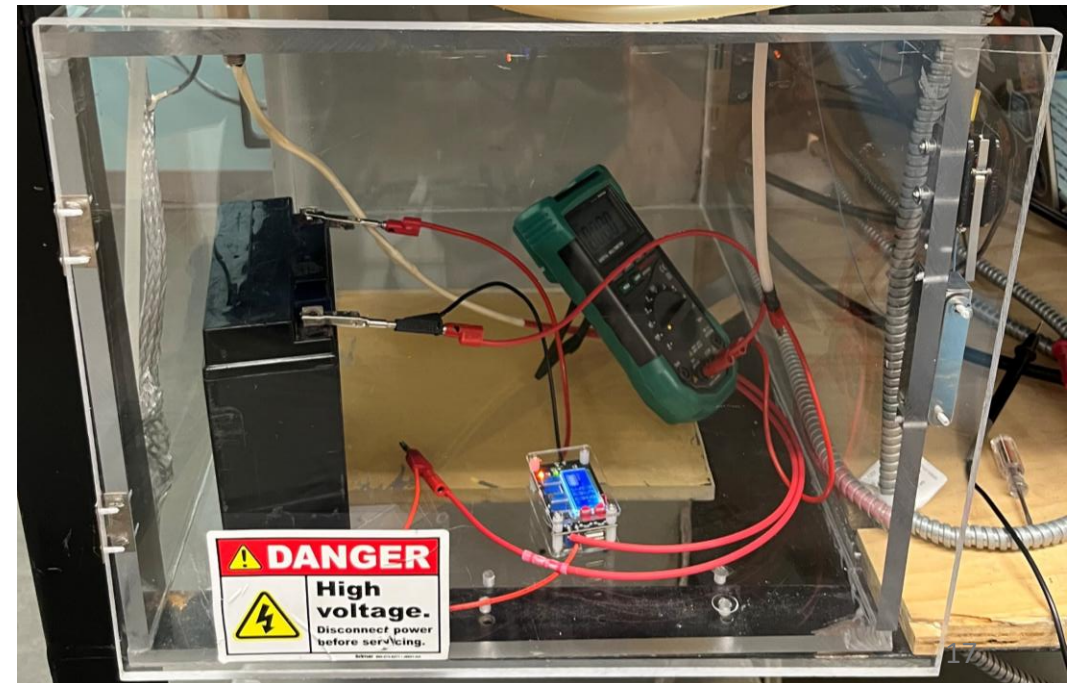
Future Plans

Second sample stage to control x-direction as well as z-direction



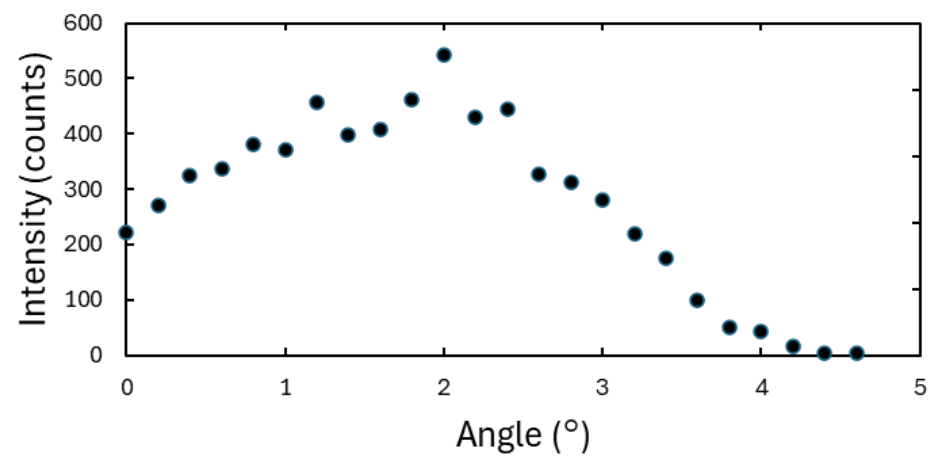
Isolation transformer for power supply instead of floating 12 V battery

Better detector

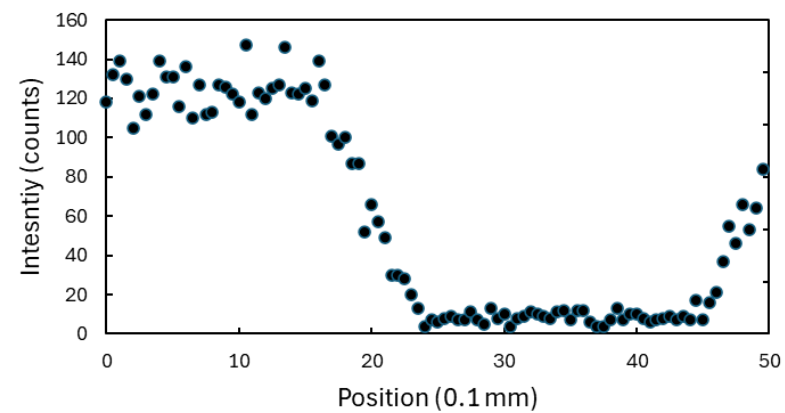


EXTRA SLIDES

Theta Align



Z-Align



Theta Align

