

THE DESIGN AND CONSTRUCTION OF AN X-RAY DIFFRACTOMETER FOR THE STUDY OF THIN METAL FILMS

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Physics Department

Outline

□ Introduction

□ Design

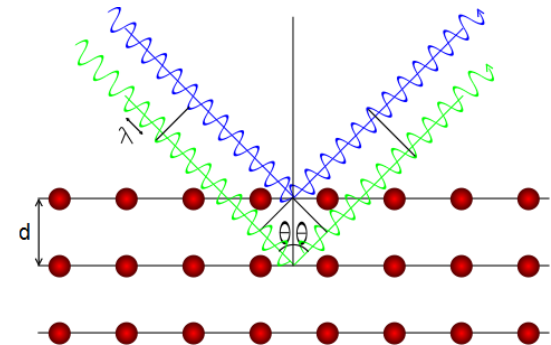
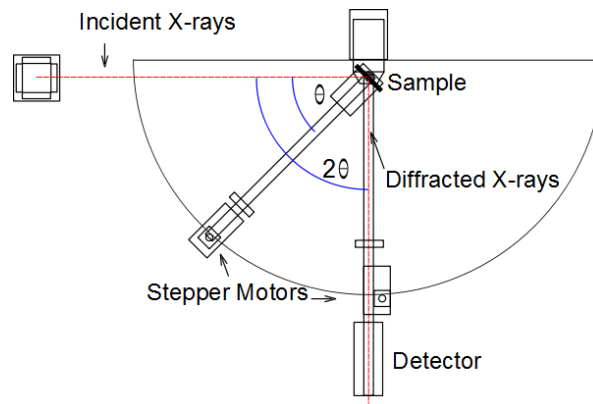
□ Results



<http://en.wikipedia.org/wiki/File:Roentgen2.jpg>

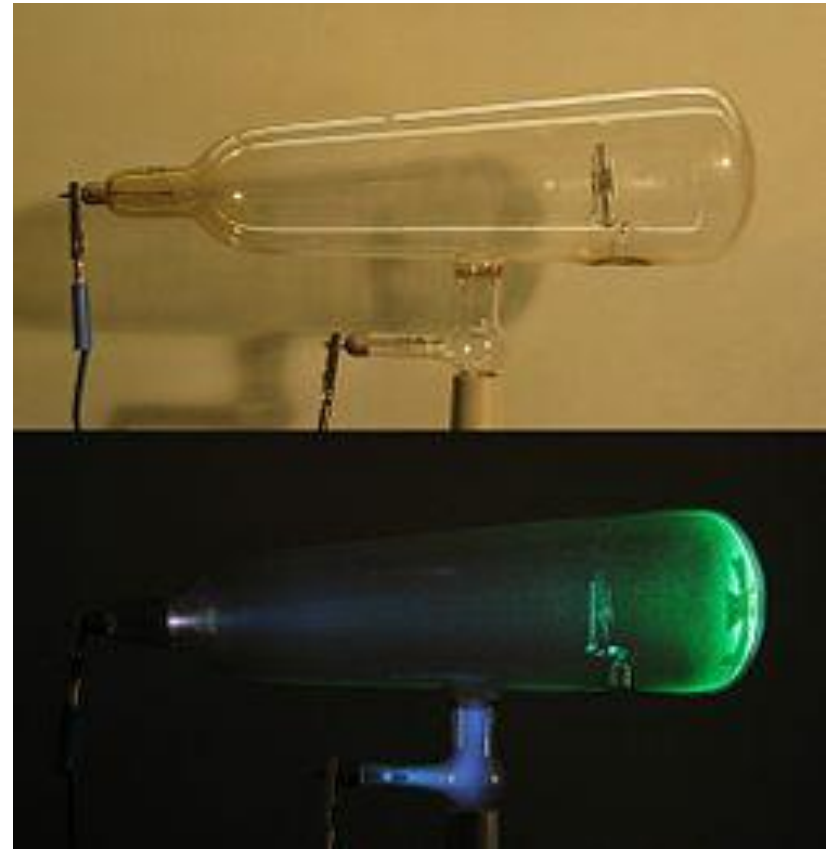


http://en.wikipedia.org/wiki/File:Bundesarchiv_Bild_183-U0205-502_Max_von_Laue.jpg



History

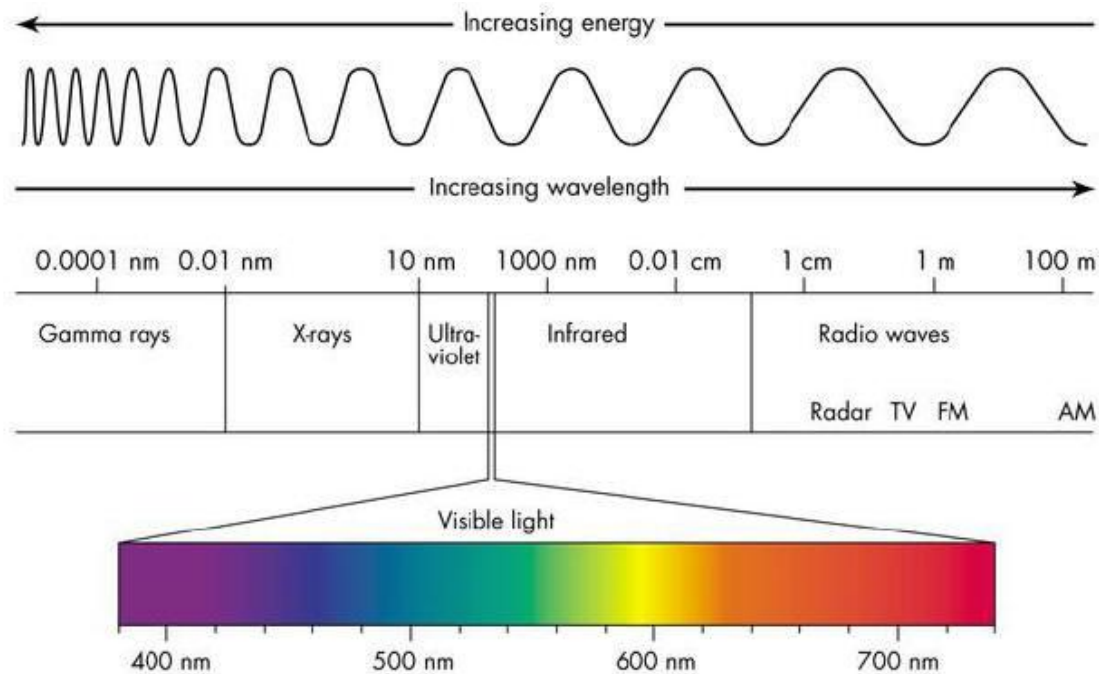
- The Discovery of X-rays
 - ▣ Crookes Tubes
 - ▣ Wilhelm Röntgen
- The Discovery of X-ray Diffraction
 - ▣ Paul Peter Ewald
 - ▣ Max von Laue



http://en.wikipedia.org/wiki/File:Crookes_tube_two_views.jpg

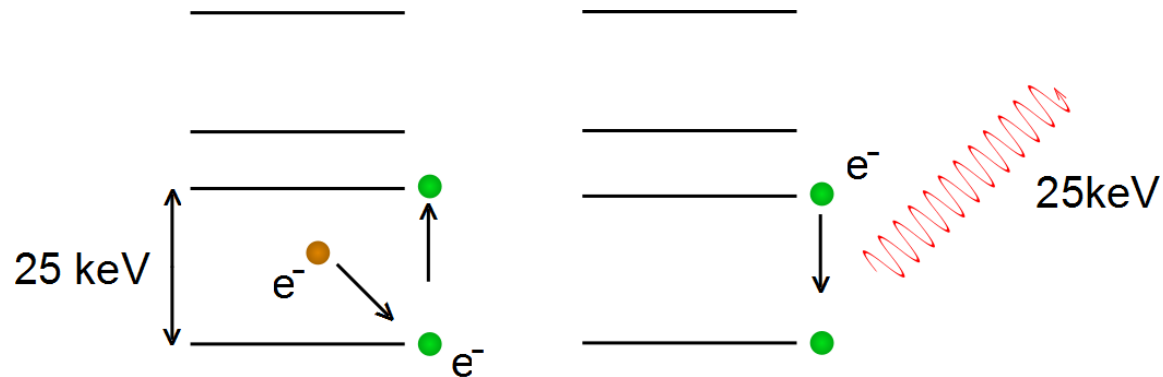
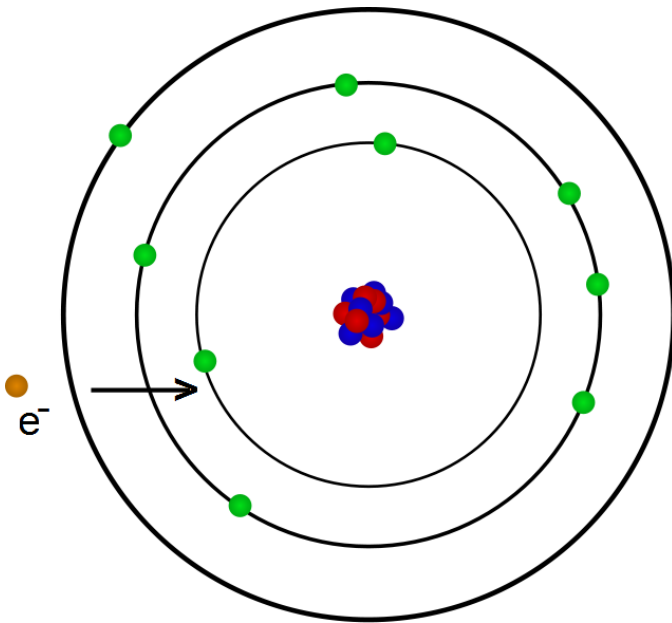
Introduction: The Basics

- What are x-rays?
 - ▣ Photons
 - ▣ Produced from atomic transitions (Fluorescence)



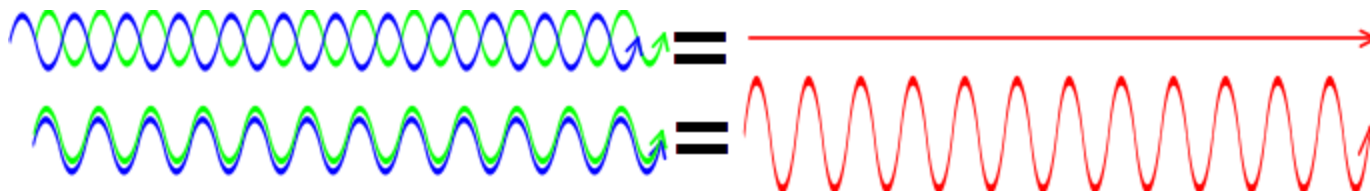
The Basics: Fluorescence

- Excitation and subsequent de-excitation of electrons



The Basics: What is a diffractometer?

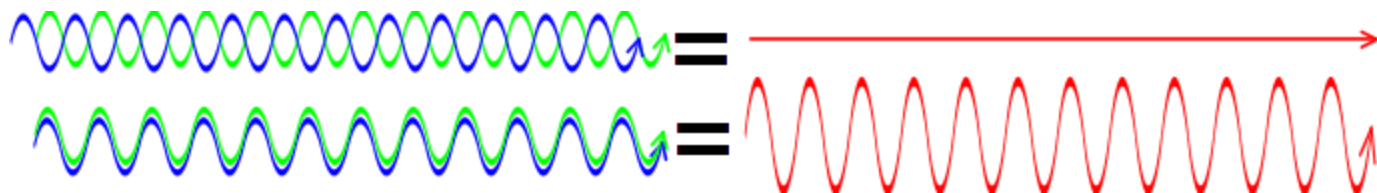
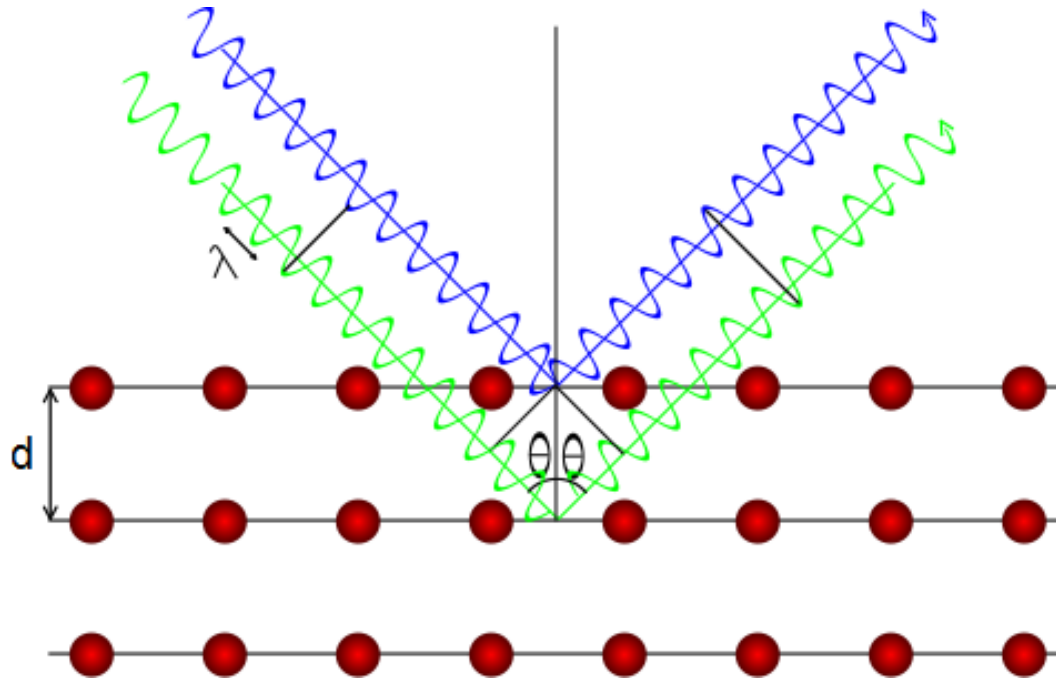
□ Optical Diffraction



<http://en.wikipedia.org/wiki/File:Interference-colors.jpg>

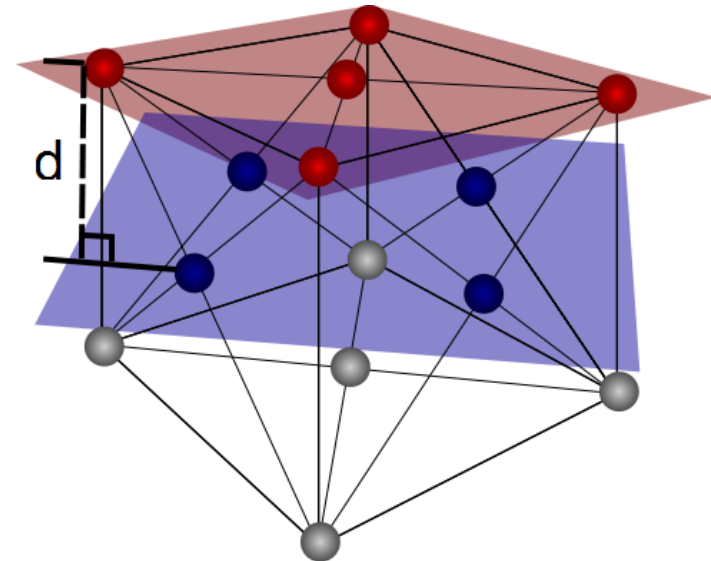
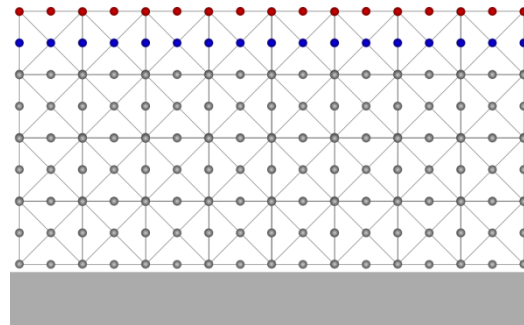
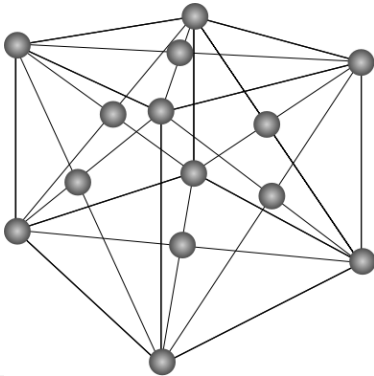
The Basics: Bragg's Law

□ $n\lambda = 2d\sin\theta$



Introduction: What is a diffractometer?

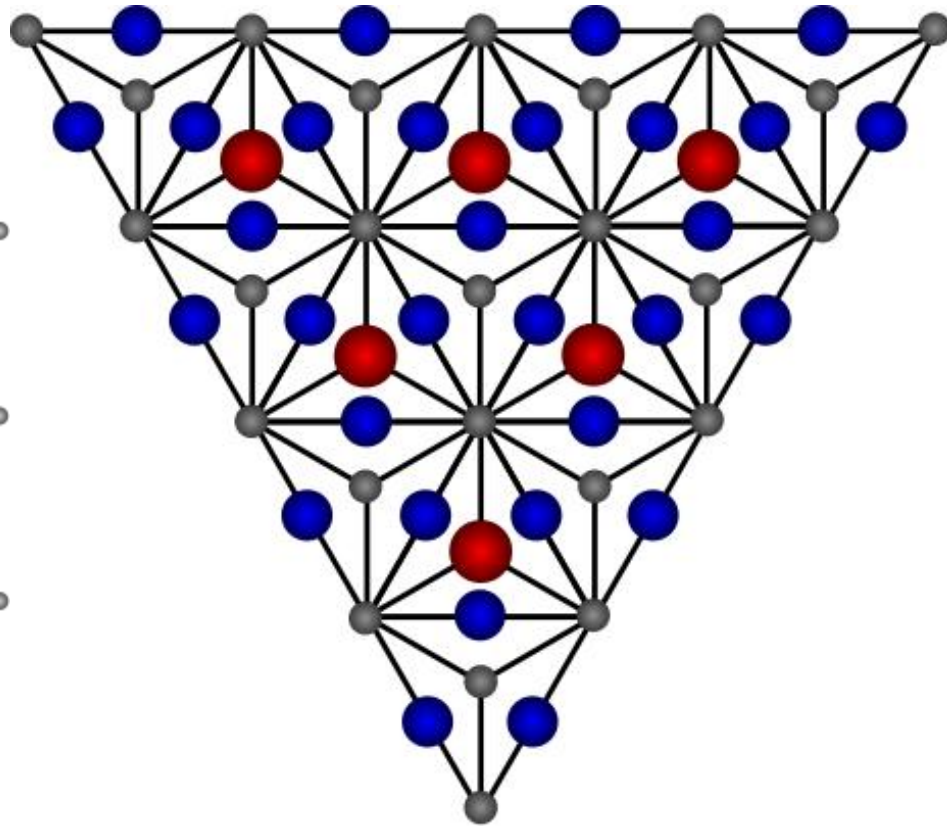
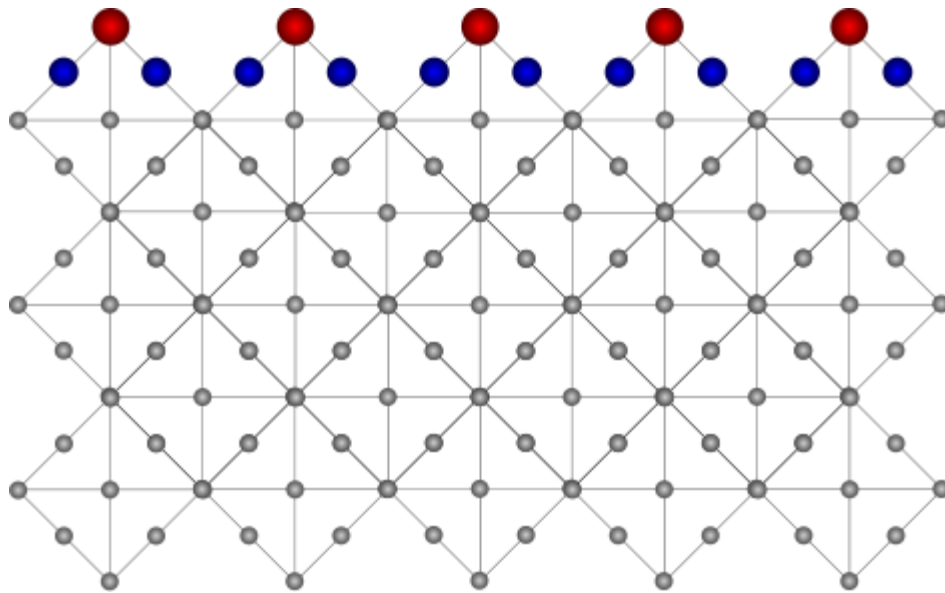
- X-ray Diffraction (in Silver)
 - Measurement of atomic lattice plane spacing
 - 200 Crystals



Introduction: What is a diffractometer?

□ X-ray Diffraction (in Silver)

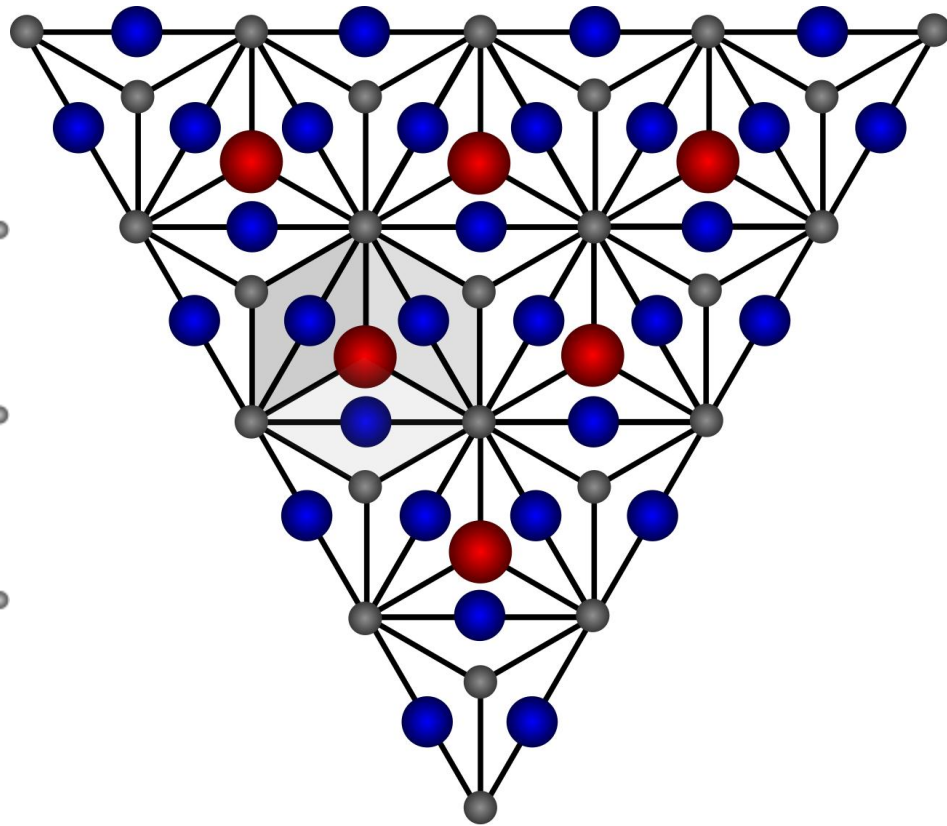
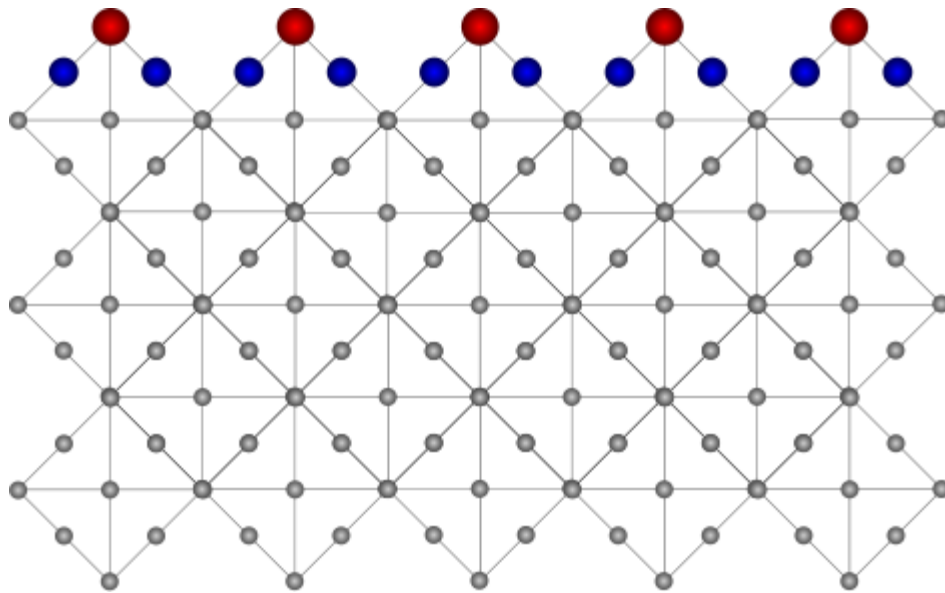
▣ 111 Crystals:



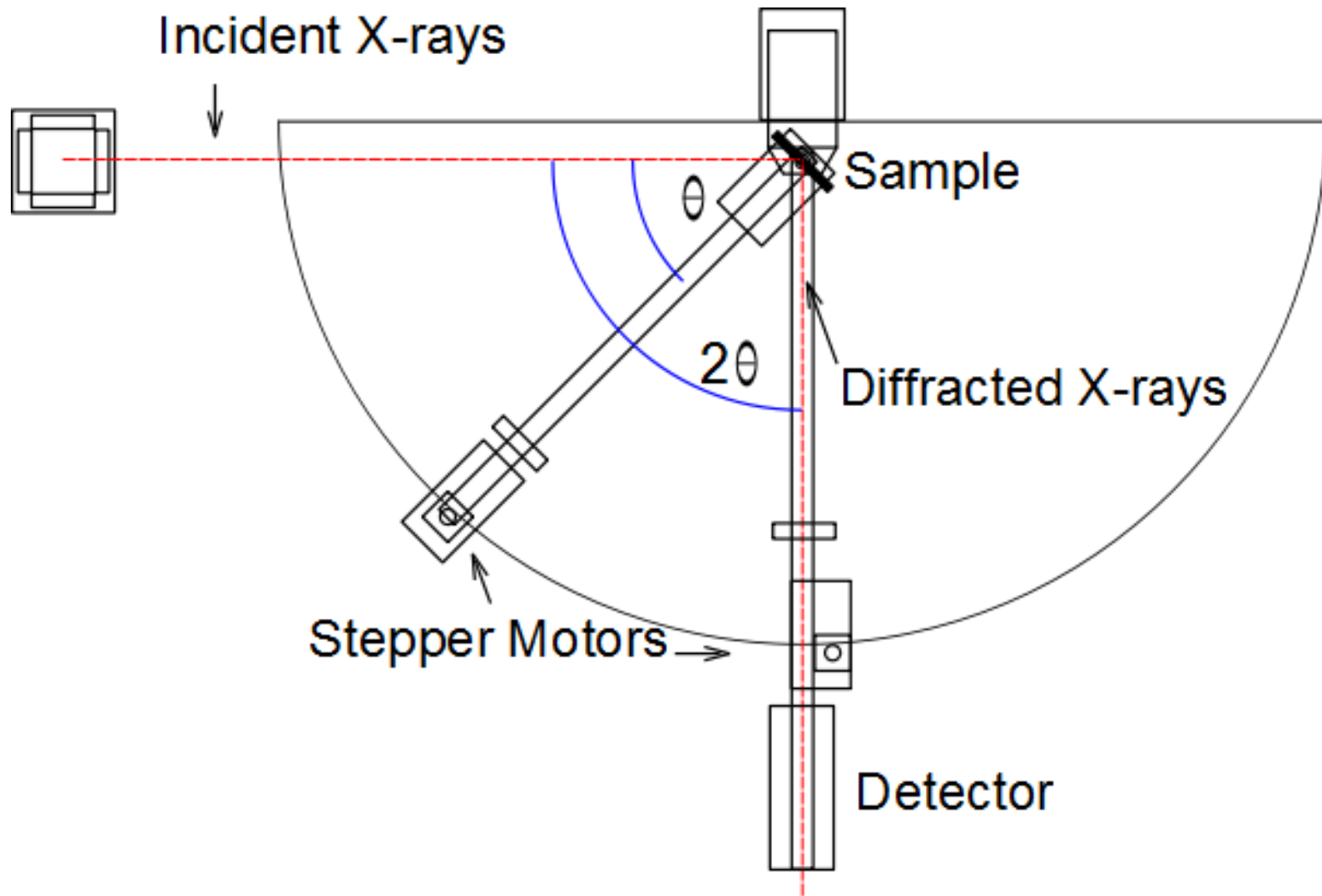
Introduction: What is a diffractometer?

□ X-ray Diffraction (in Silver)

▣ 111 Crystals:



Design: A Bragg-Brentano Diffrac.

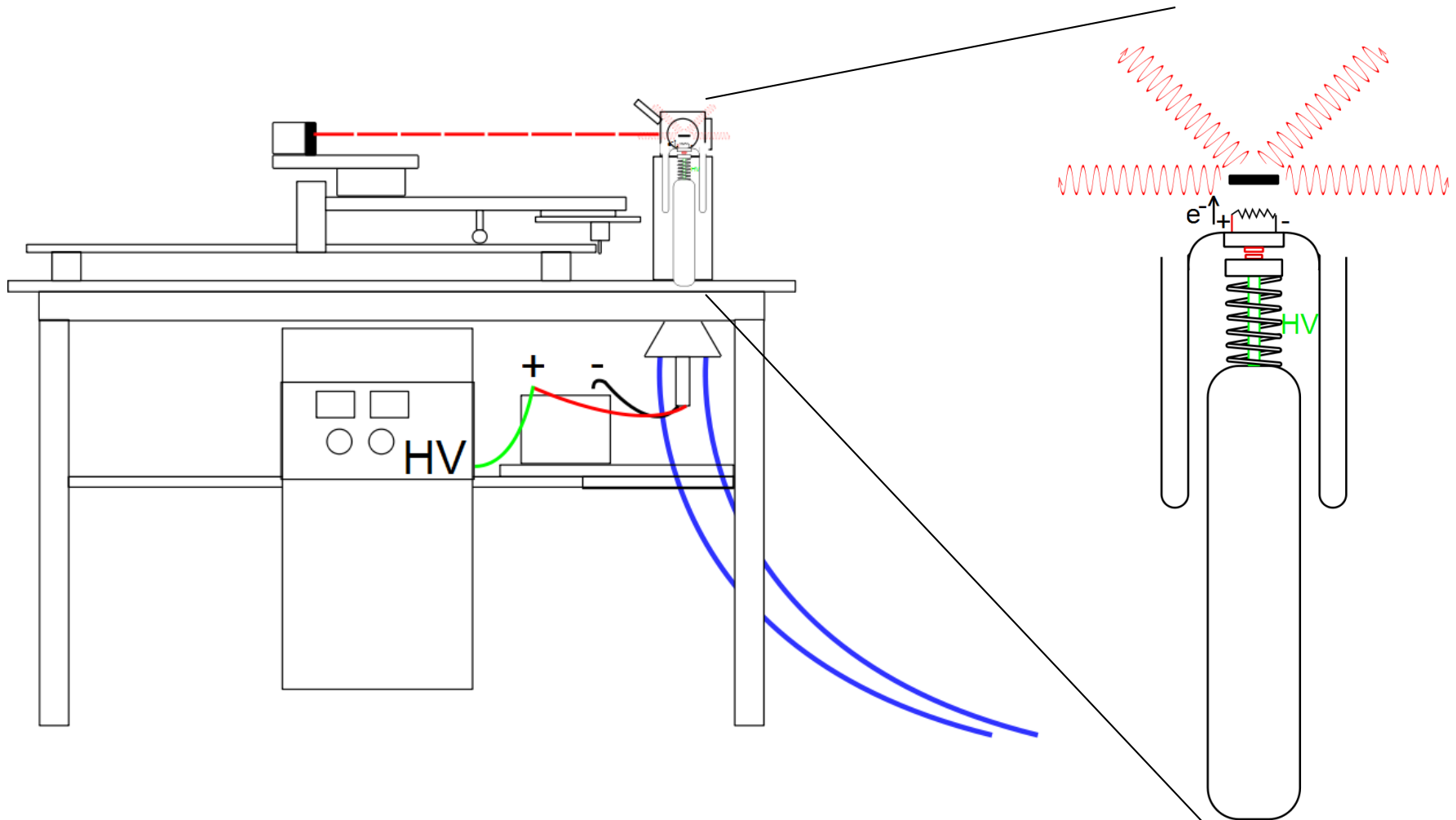


Construction: X-ray Generation

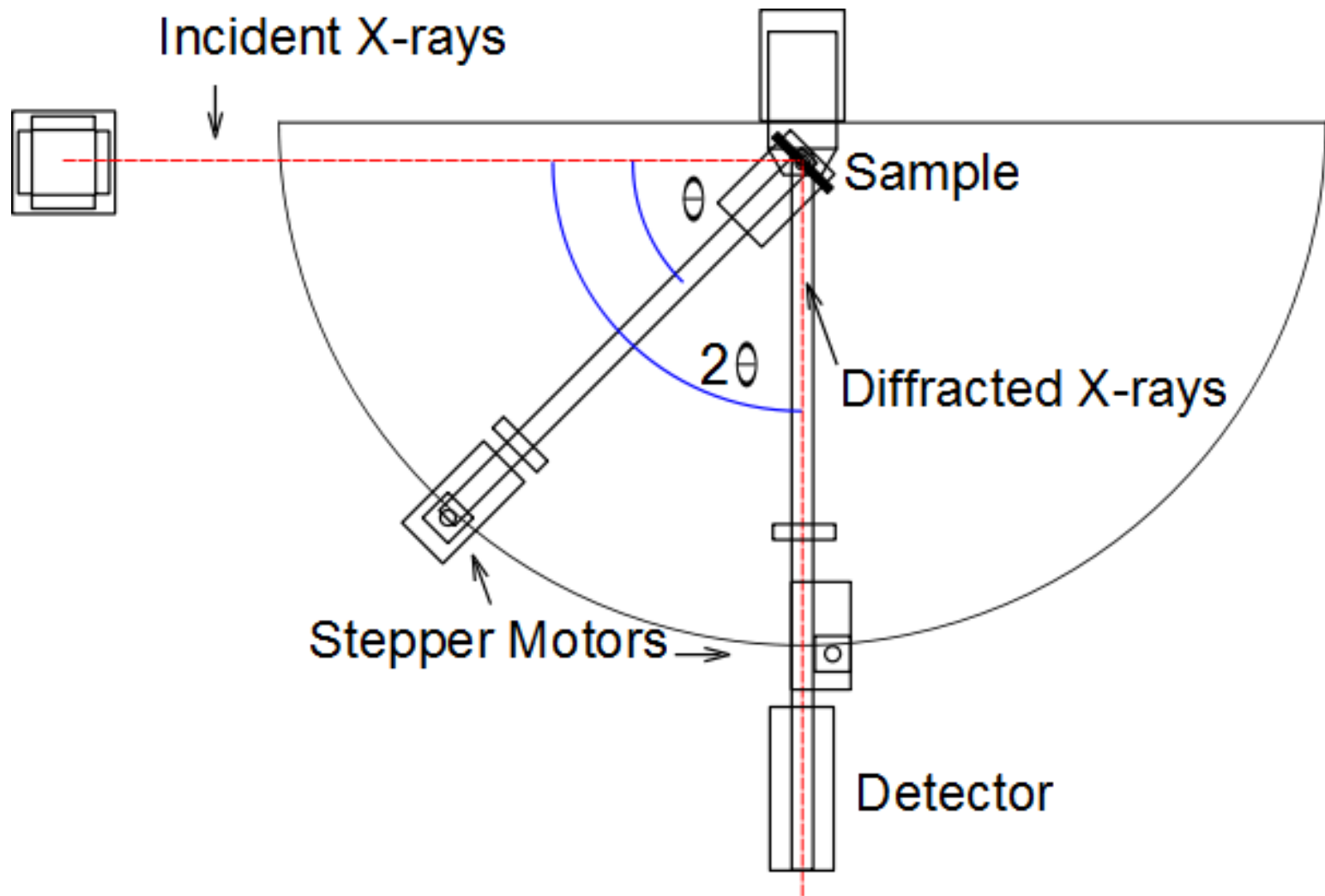
□ Old X-ray System



Construction: X-ray Generation

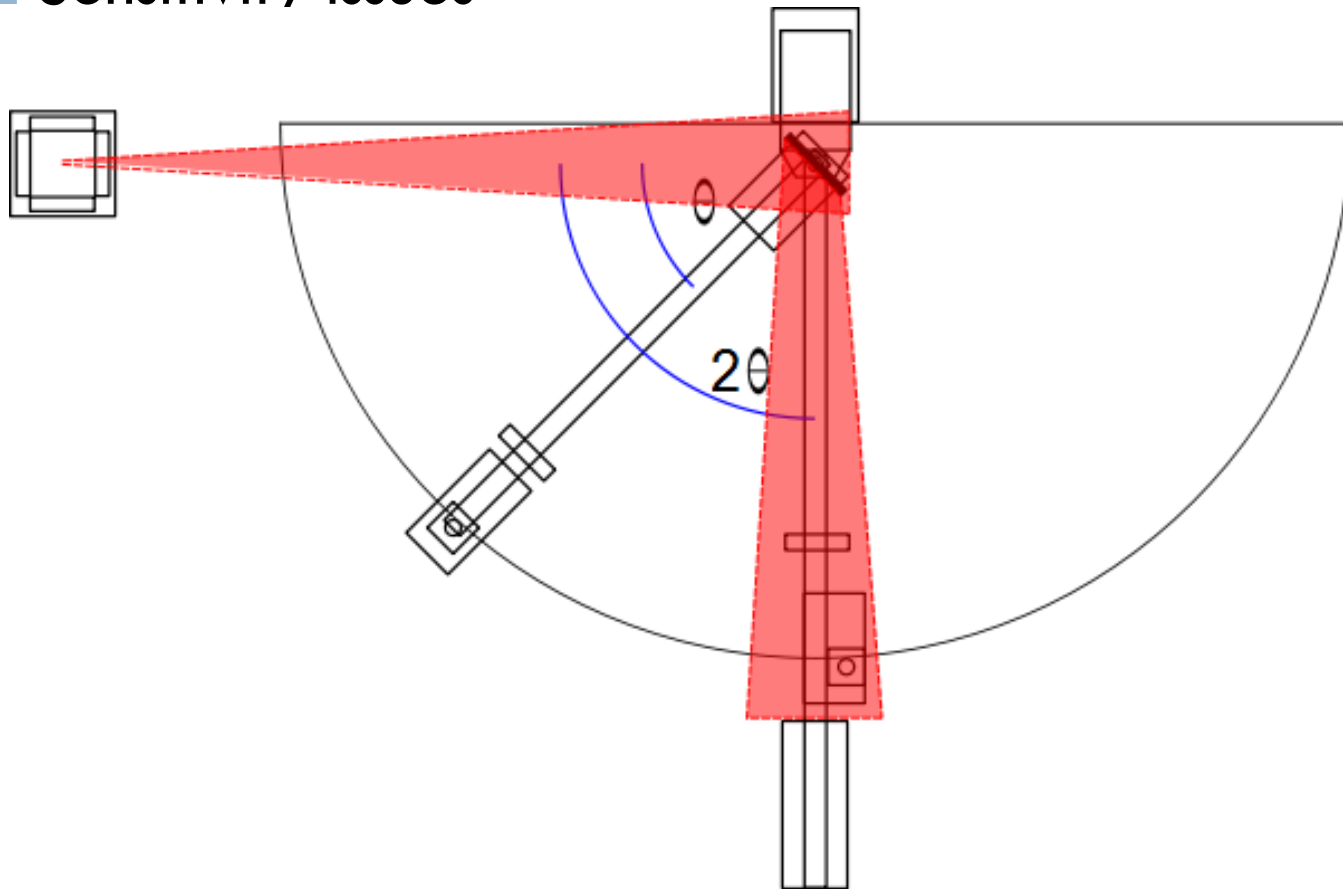


Construction: Mechanical System



Construction: Detection System

- Vernier Student Radiation Monitor
 - ▣ Sensitivity issues

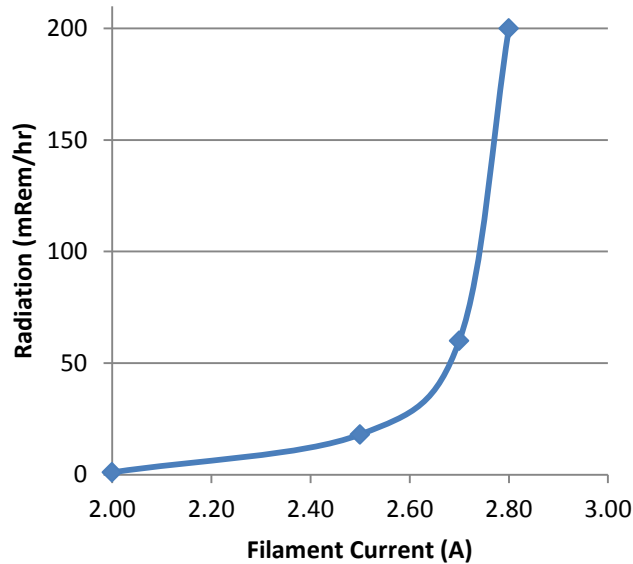


Construction: Electronic System

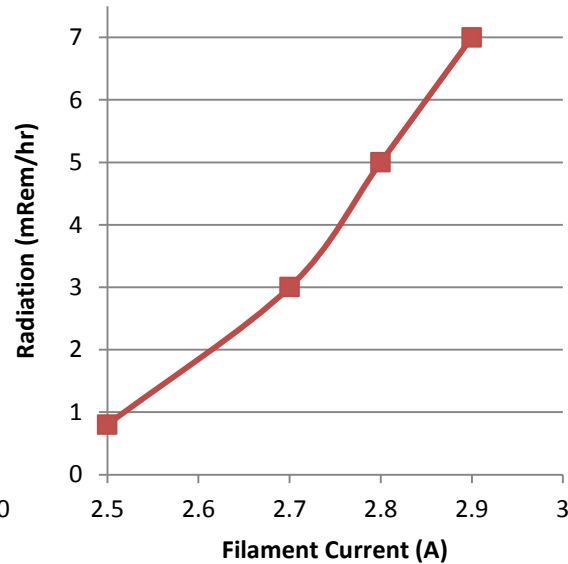
- LabView
 - ▣ Stepper Motor Control
 - ▣ Eventual System Control
- Logger Pro
 - ▣ Water System Temperature
 - ▣ Radiation Detection

Results: X-Ray Generation

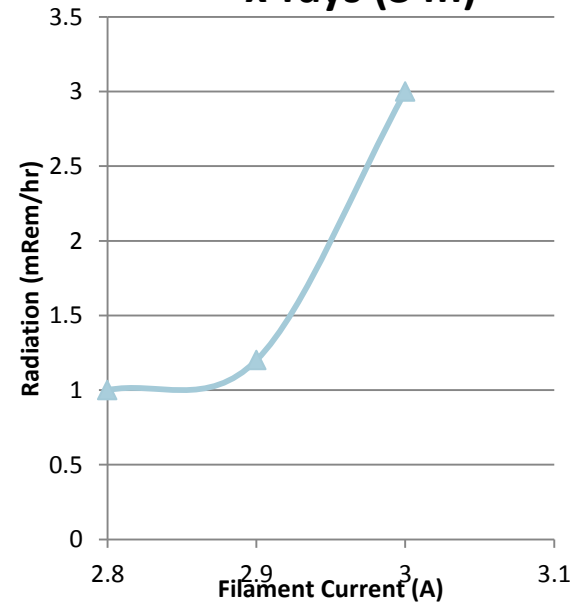
□ X-ray Production x-rays (0.2 m)



x-rays (2.5 m)



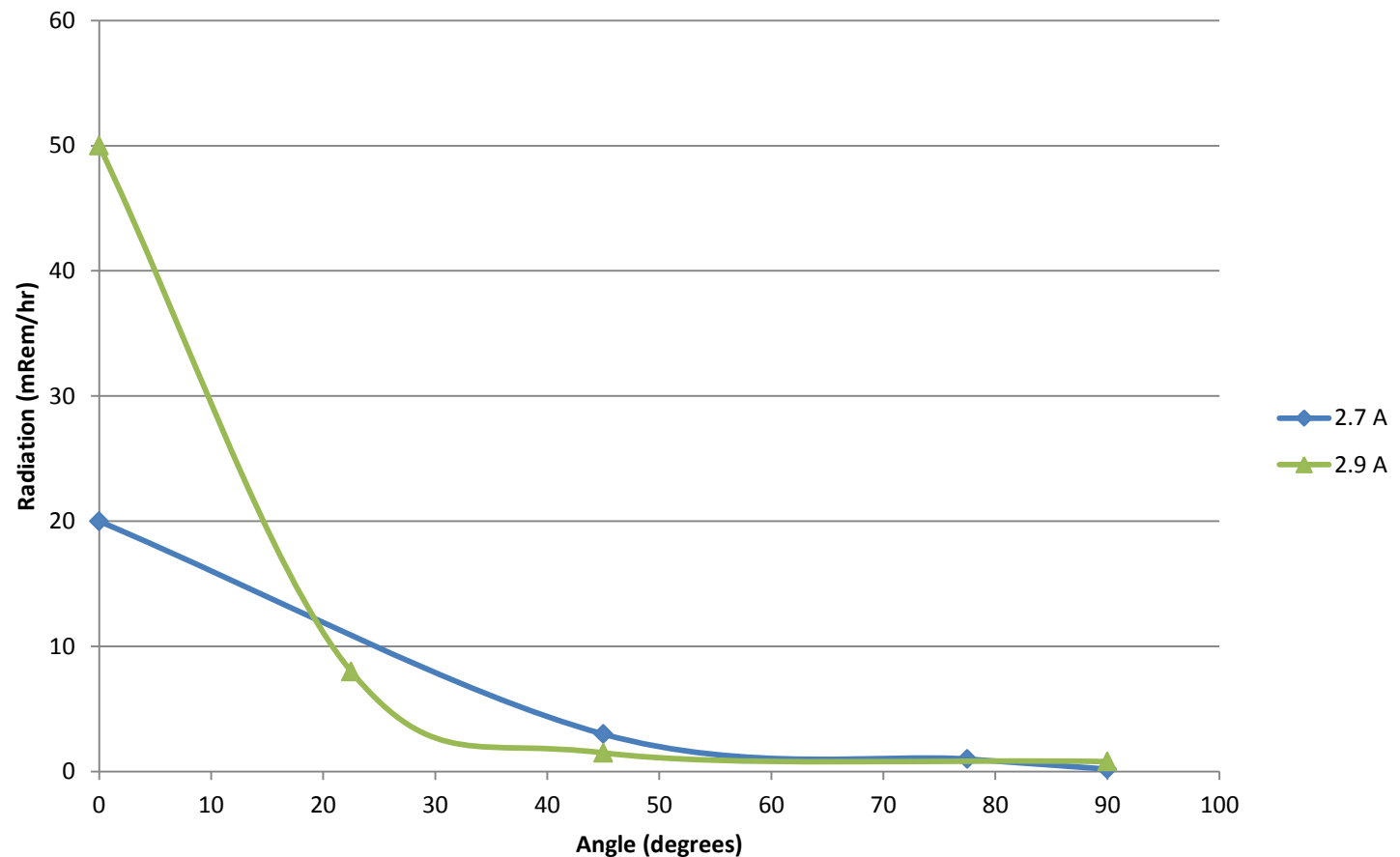
x-rays (3 m)



Results: X-Ray Generation

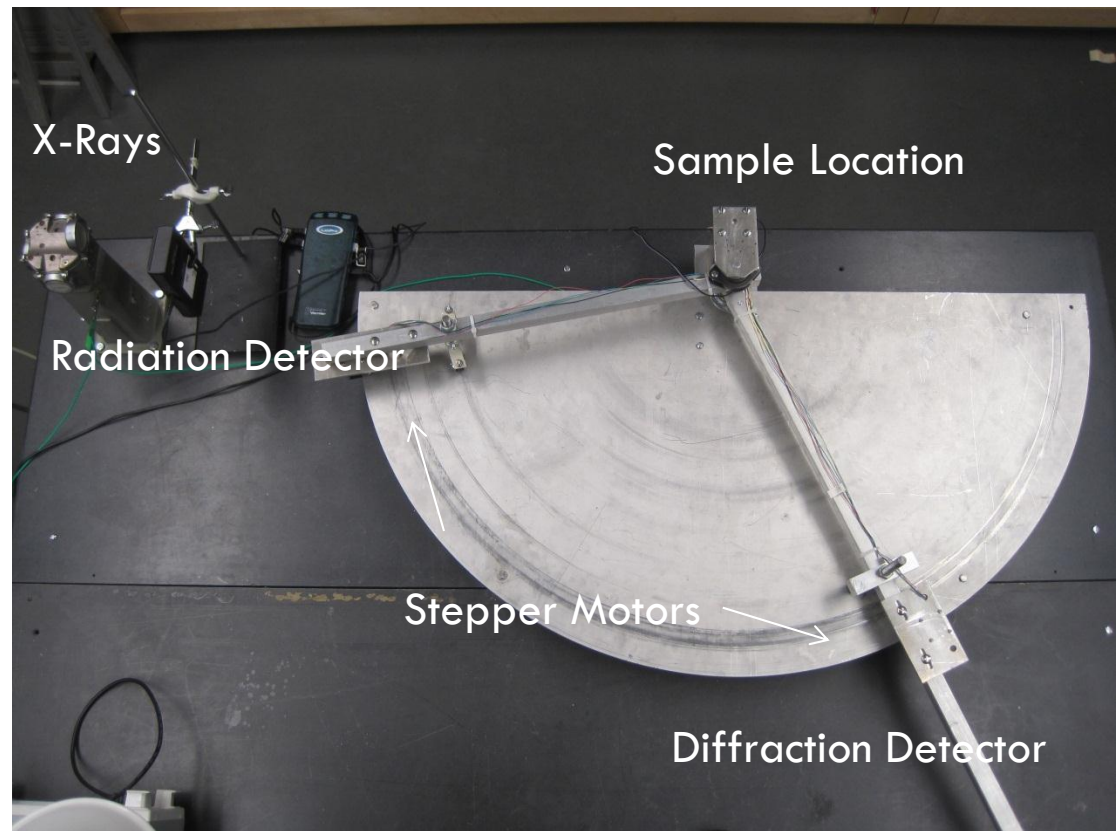
□ X-ray Production

Radiation vs. Angle



Results: Mechanical System

- Motors and Arms
 - ▣ Done
- Sample Holder
- Shielding
 - ▣ Beam
 - ▣ Detector
 - ▣ People
- Detector Mount

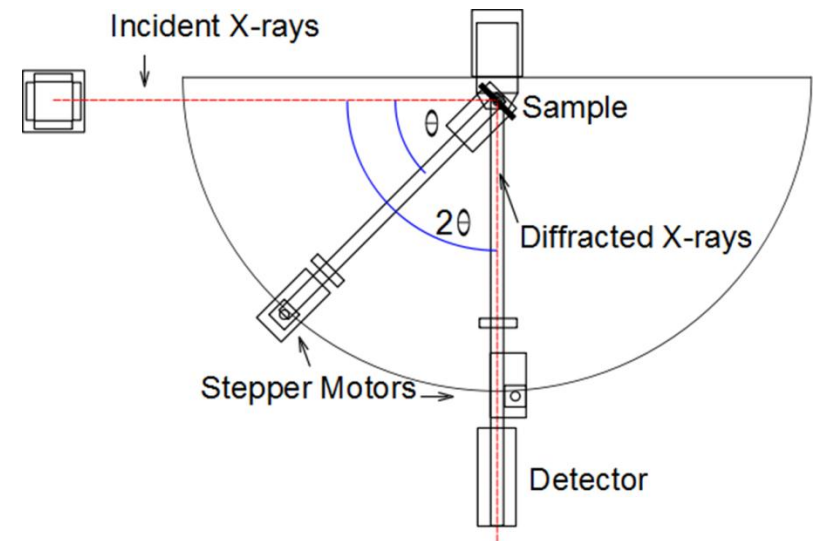


Results: Electronic System

- LabView Motor Control Program
 - ▣ Variable speed and distance
- Logger Pro
 - ▣ Cooling system
 - ▣ Radiation Monitors

Conclusion: Where We'd Like to Go

- X-Ray System
 - ▣ Higher output power supply
 - ▣ Energy spectrum measurement
- Mechanical System
 - ▣ Sample Holder
- Detection System
 - ▣ Adjustable X-ray shielding
- Electronic System
 - ▣ More LabView control



Questions?

