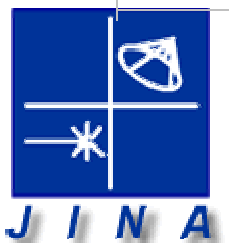
# PIXE PAN 2007
# Introduction

# Schedule

| | Mon | Tue | Wed | Thur | Fri |
|---|---|---|---|---|---|
| | 6/18/2007 | 6/19/2007 | 6/20/2007 | 6/21/2007 | 6/22/2007 |
| 9:00 | Intro (Mary) | PIXE INTRO | Lab 1/2 Intro | Lab 3/4 Intro | Lab 5 Intro |
| 9:30 | NSL Intro | | | | Lab 5 |
| 10:00 | and Tour | PIXE | Lab 1/2 | Lab 3 /4 | Lab Review/Makeup |
| 11:00 | Jordan Intro and Tour | | | | |
| 12:00 | Lunch at | Lunch | Lunch | Lunch | Lunch |
| 13:00 | SDH | | Lab 2/1 Intro | Lab 4/3 Intro | Classroom Transfer |
| 13:30 | Rad Safety | | | | (NSH 184) |
| 14:00 | Hands on Lab | PIXE | Lab 2/1 | Lab 4/3 Intro | Introduction to Nuclear Physics |
| 15:00 | Introduction (JHS) | | | | Tony Hyder (NSH 184) |
| 16:00 | PIXE applications talk | | | | Review/ Plan |
| 16:30 | NSL Conference Rm | | Recap/Q&A | | for Student Week |
| 17:00 | (Larry Lamm) | | | | |
| | | | | | |
| | | | | | |
| | 6/25/2007 | 6/26/2007 | 6/27/2007 | 6/28/2007 | 6/29/2007 |
| 9:00 | Intro (Mary) | Lab 1 Intro | Lab 3 Intro | Lab 5 Intro | PIXE Applications (Lamm) (NSL) |
| 9:30 | NSL Intro | | | | Analysis |
| 10:00 | and Tour | Lab 1 | Lab 3 | Lab 5 | Presentation |
| 11:00 | Jordan Hall Intro/Tour | | | | Prep |
| 12:00 | Lunch at | Lunch | Lunch | Lunch | Lunch |
| 13:00 | SDH | Lab2 Intro | Lab 4 Intro | | Student Presentations |
| 13:30 | Rad Safety | | | Analysis | 184 NSH |
| 14:00 | Hands on Lab | Lab 2 | Lab 4 | Presentation Preparation | Each group of 3 students, 15 minutes each. |
| 14:30 | Introduction | | | | Tour of the Labs for parents by students. |
| 15:00 | (JHS) | | | Lab Make up | |
| 16:00 | Introduction to JINA | | | | Digital Visualization Theater Presentation |
| 16:30 | Science (NSL Conf) | | Recap/Q&A | | Stellar Evolution and Supernovae |
| 17:00 | (Michael Wiescher) | | | | Dr. Philip Sakimoto, Public Welcome |



# General Comments

- Emphasis is not on getting the correct answer, but rather understanding the experimental methods used and physical concepts involved.

- All participants are encouraged to ask questions.

# Photons

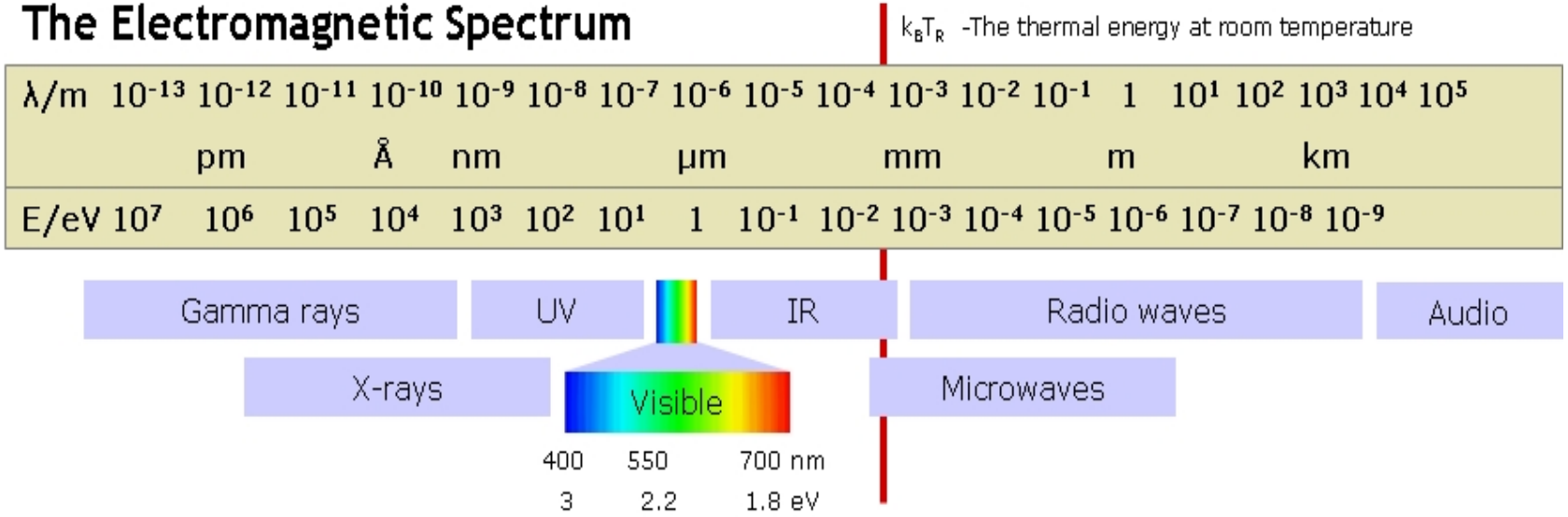
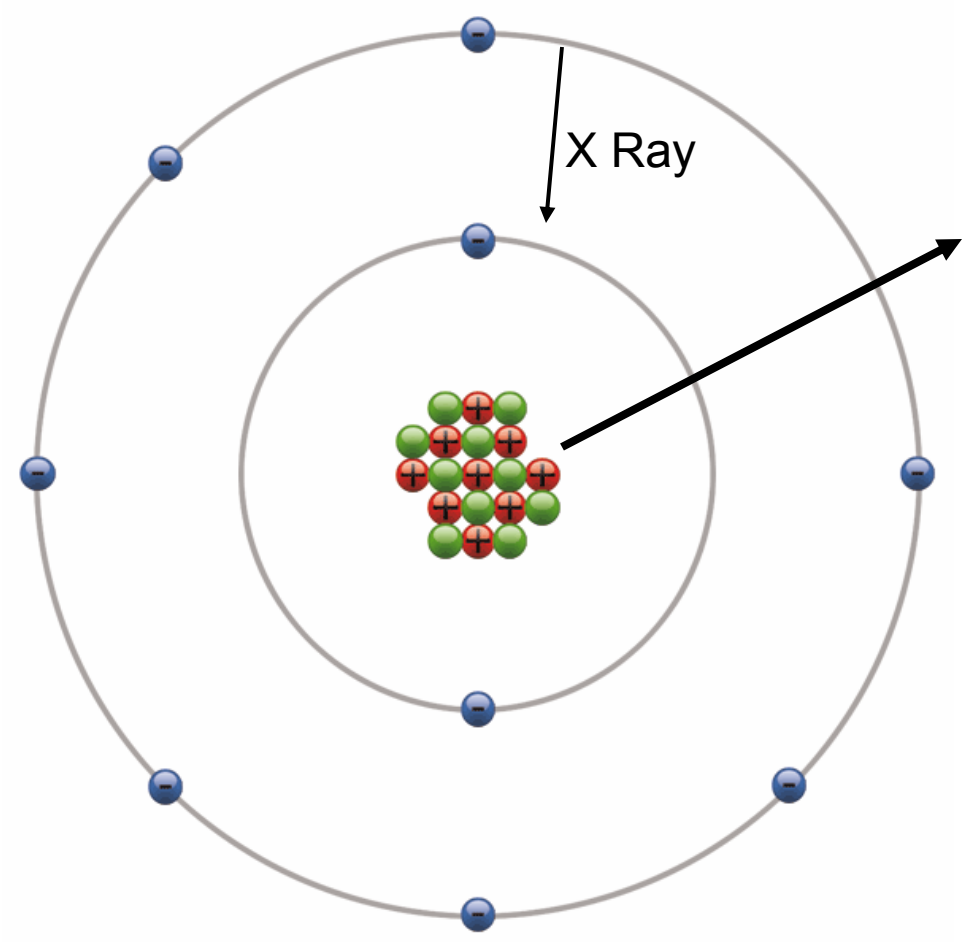


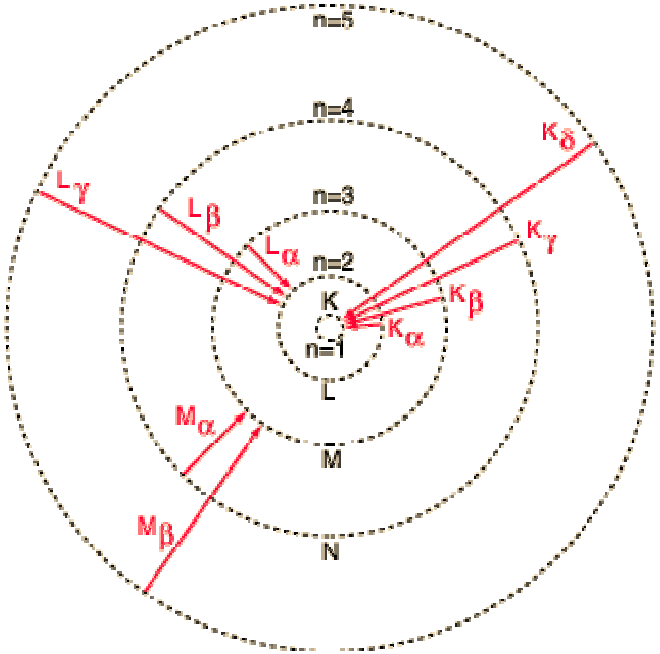

*Illustration from Opensource Handbook of Nanoscience and Nanoechnology

# X and Gamma Ray Origins

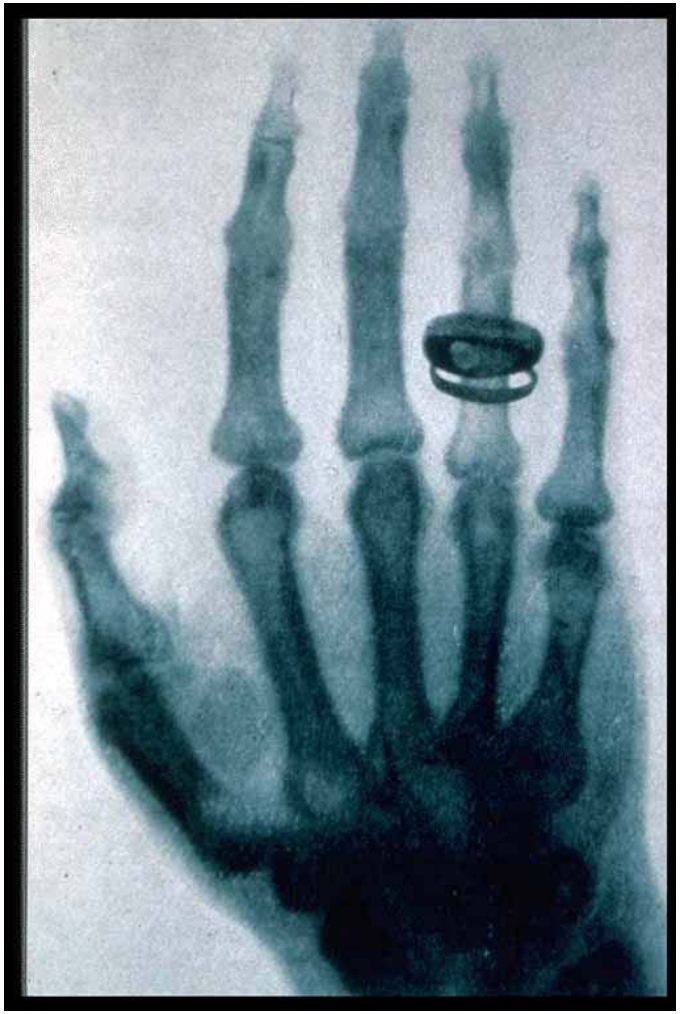


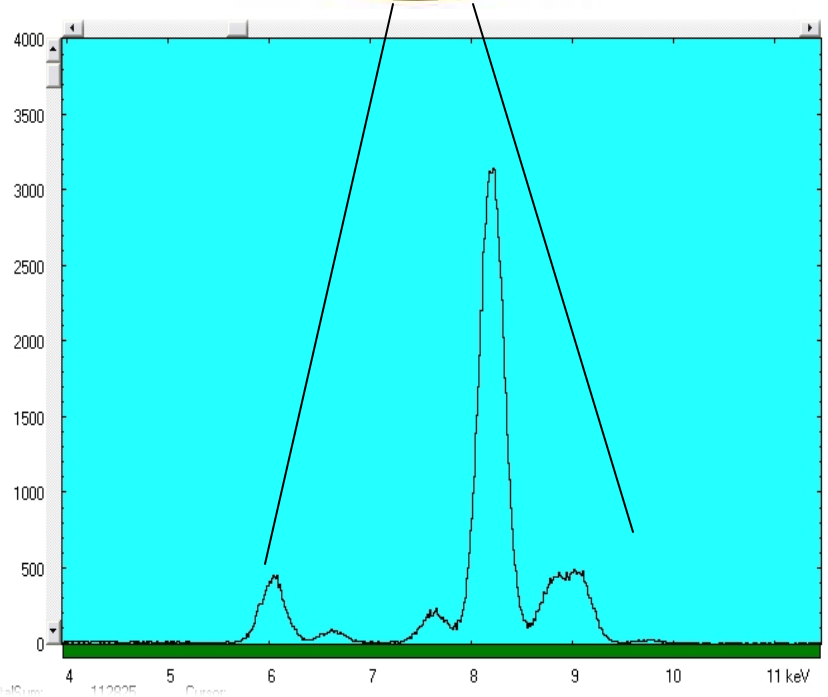
# Some X Ray Nomenclature

- The orbits (or shells) are most often referred to by a letter rather than the principle quantum number (n=1 is the K shell, n=2 is the L shell, etc.)
- Transitions are labeled $K_\alpha$, $K_\beta$, etc. as shown.

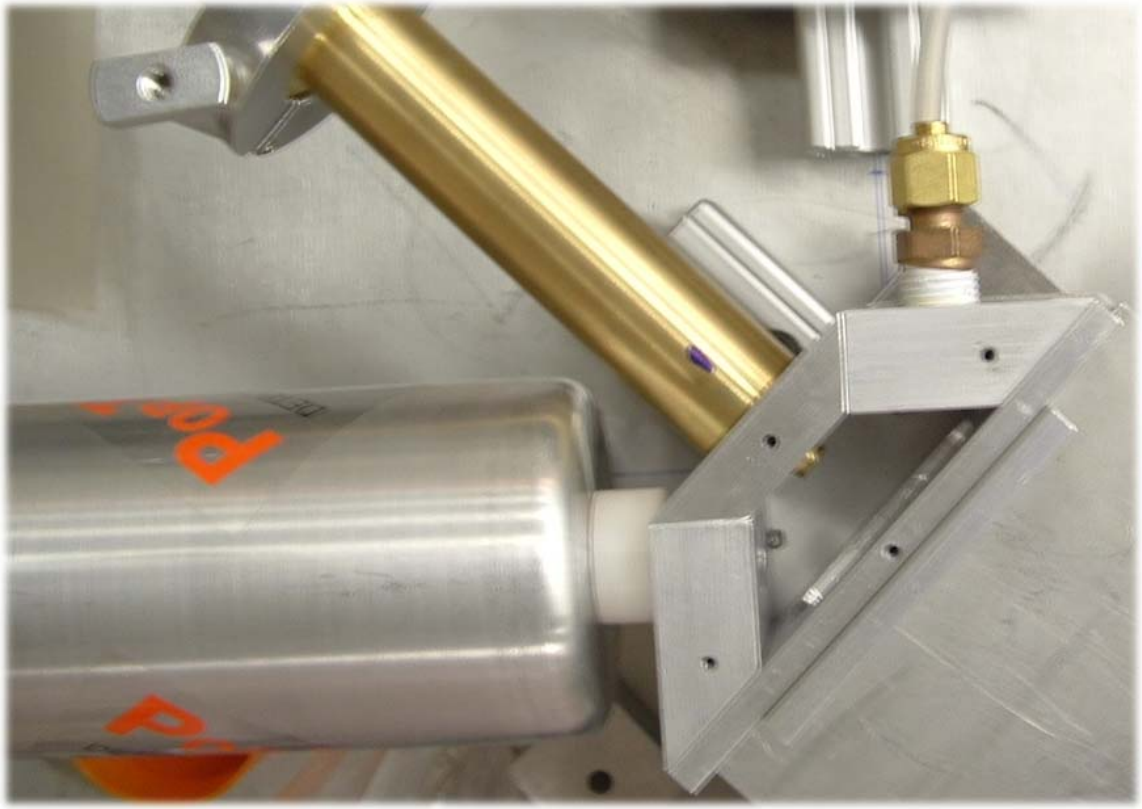


# Information from X-rays



# Experiment I PIXE



- Use a proton beam from the NSL's FN accelerator to excite a variety of targets
- Use the characteristic X Ray Energies to identify the elemental composition of the materials.
- Use the small beamspot (1-2mm diameter) to investigate spatial distributions.

# Experiment II XRF

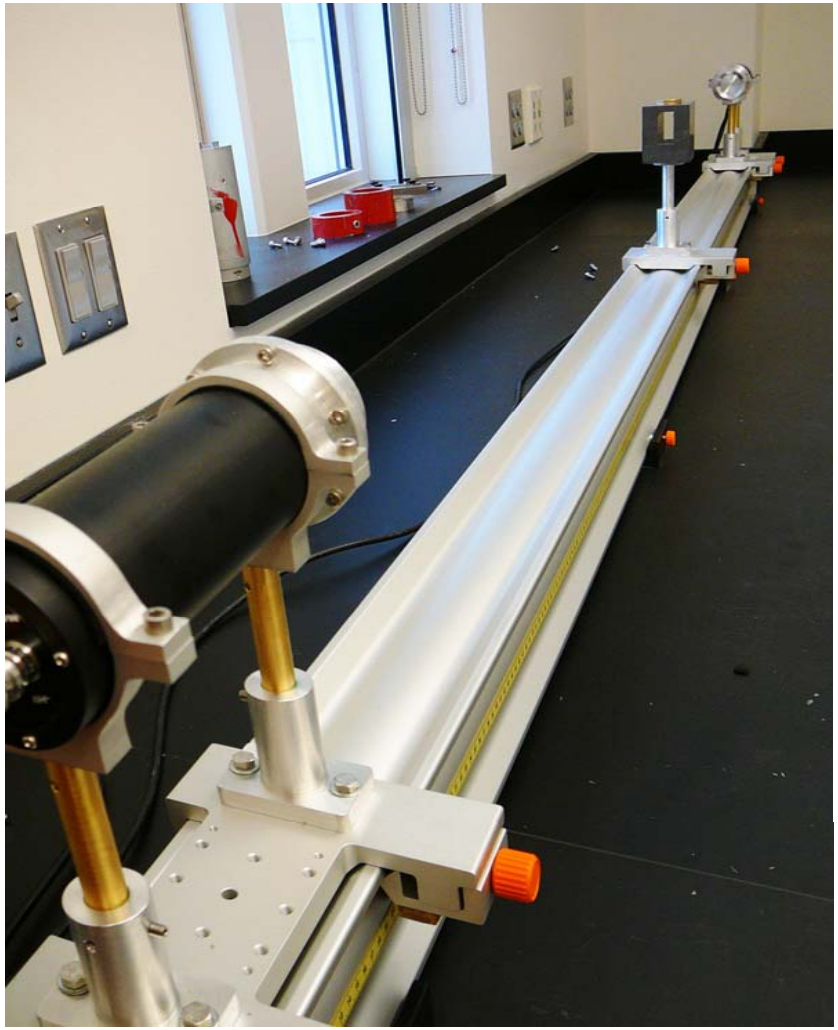
- X Ray Fluorescence – Use an X-Ray source to excite atoms in the target instead of the proton beam.
- Measure a variety of objects.
- Test Moseley's Law relating X-ray Energy to atomic number.

# Experiment III  Speed of Light

•Use Electronic modules as the stopwatch to time how long it takes a 511 keV photon to travel a distance of a meter or so.

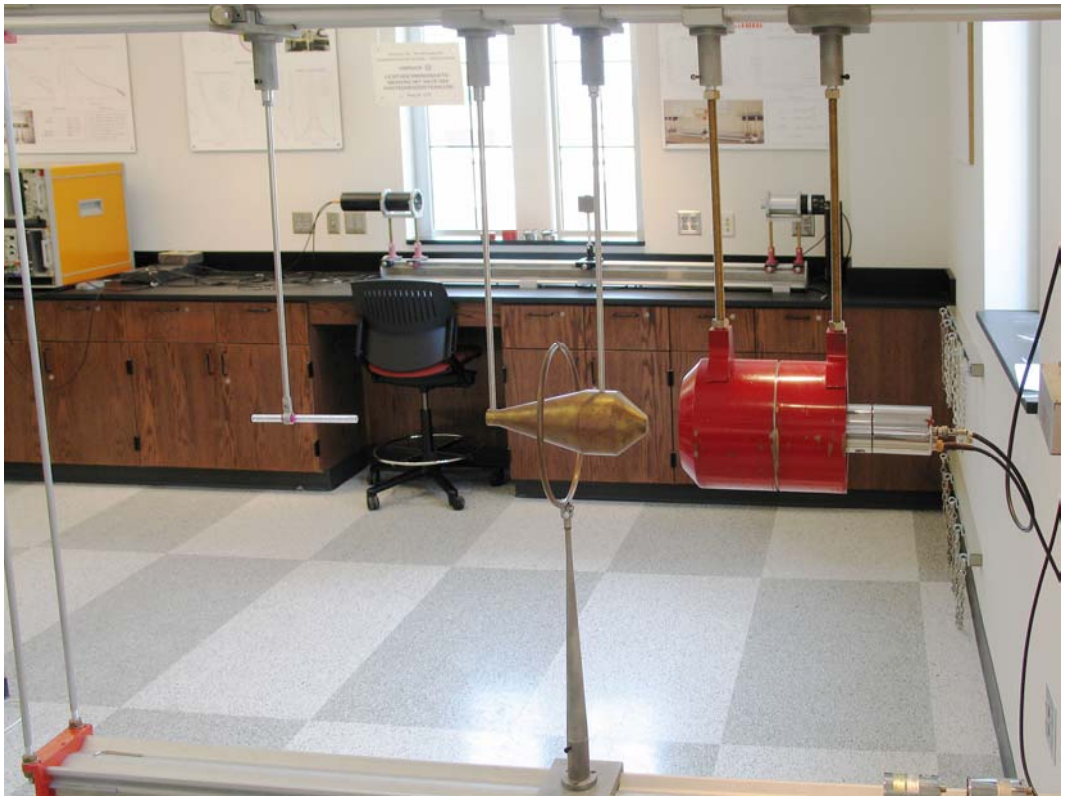
•Use this information and a simple analysis to measure directly the speed of light.

•Photon source is the positron-electron annihilation from $^{22}Na$.



# Experiment IV Compton Effect

•An example of the particle nature of light by measuring the change in energy of photons scattered through different angles.



# Experiment V e/m measurement

- See the effect of magnetic and electric fields on a motion of an electron
- Determine the electrons charge to mass ratio

JINA