22.01 - Recitation #9

- Please grab a snack, get up off the sofa, look at something that isn't a screen for 5 mins!
- Please turn on your video (if possible) and mute yourself.
- These slides are at: *bit.ly/2201Rec9*

Outline + Intended Learning Outcomes (ILOs)

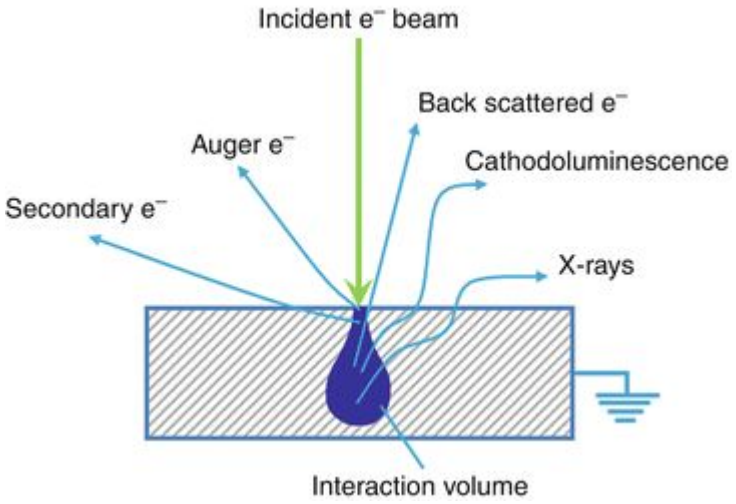
- Electronic stopping Power
- Backscattered electrons
- Photons vs. Protons
- Radiative stopping power
- EDX spectra

- Remember charged particle interactions?
- Understand what happens in an SEM...

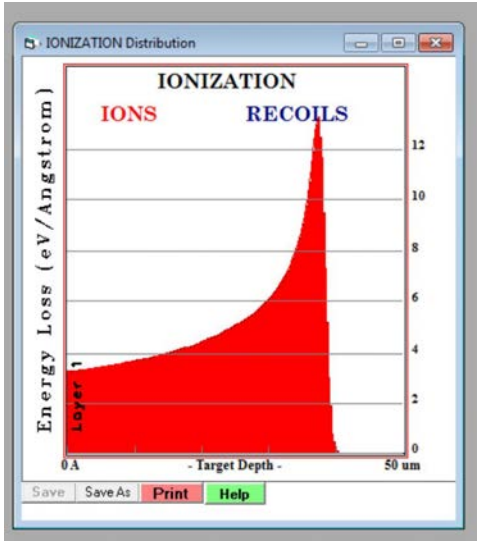
Electronic stopping power of charged particles

$$-\frac{dT}{dx} = \frac{4\pi k_0^2 N Z_1^2 Z_2 e_c^4}{m_e v^2} ln\left(\frac{2m_e v^2}{\bar{I}}\right)$$

Scanning Electron Microscope (SEM)



Photons vs. Protons



$$I = I_0 e^{-\left(\frac{\mu}{\rho}\right)\rho x}$$

Stopping power of protons

$$\frac{dE}{dx}_{elec} = \frac{4\pi N_{Pb} k_0^2 z_{ion}^2 Z_{Pb} e^4}{2T_i} \left(\frac{m_{ion}}{m_{e^-}}\right) ln\left(\frac{\gamma_{e^-} T_i}{\bar{I}_{Pb}}\right)$$

Ratio of radiative to electronic stopping

$$\left(\frac{\left(\frac{dT}{dx}\right)_{rad}}{\left(\frac{dT}{dx}\right)_{ioniz}} \right) = Z \left(\frac{m_e}{M_{ion}} \right)^2 \left(\frac{T}{1400 m_e c^2} \right)$$

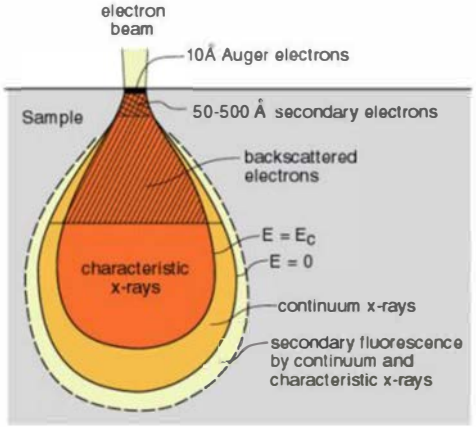
$$\left(\frac{dT}{dx}\right)_{rad} =$$

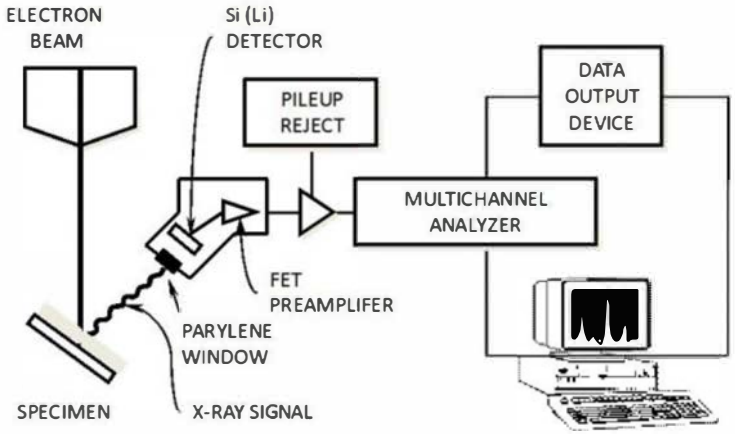
Create your own spectrum! ...

1. **(15 points) Develop and graph a theoretically predicted photon emission spectrum when operating this SEM, in other words, what you expect to see shown on the screen. Here, consider the x-ray spectrum produced at the *characteristic x-ray* interaction region.**

Create your own spectrum (2)

2. **(15 points) Using the *observed* spectrum below, work backwards to determine what the *real* spectrum would have been (not what is shown on the screen, but what is actually emitted from the sample). Compare your answer to part (1) above, specifically calculating your *calculated* elemental distribution compared to the real one. Hint: Use the Web Plot Digitizer to "steal" the data from the spectrum in this image.**





22.01 - Recitation #9 - October 30th 2020

Office Hours 8.15-9am Monday

Office Hours **3-4pm** Monday

Questions?

Please grab a snack, get up off the sofa, look at something that isn't a screen for ~X mins!

22.01 Introduction to Nuclear Engineering and Ionizing Radiation

Spring 2024