PHYS 570-001

Fall 2013

HW #02

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1. Knowing that the photoelectric absorption of an element scales as the inverse of the energy cubed, calculate

a. the absorption coefficient at 10keV for copper when the value at 5keV is 1698.3 cm^{-1}.

b. The actual absorption coefficient of copper at 10keV is 1942.1 cm^{-1}, why is this so different than your calculated value?

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2. A 30cm long, ionization chamber, filled with 80% helium and 20% nitrogen gases at 1 atmosphere, is being used to measure the photon rate (photons/sec) in a synchrotron beamline at 12keV. If a current of 10 nA is measured, what is the photon flux entering the ionization chamber?

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3. A 5cm deep ionization chamber is used to measure the fluorescence from a sample containing arsenic (As). Using any noble gases or nitrogen, determine a gas fill (at 1 atmosphere) for this chamber which absorbs at least 60% of the incident photons. How does this change if you are measuring the fluorescence from ruthenium (Ru)?

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4. Calculate the characteristic angle of reflection of 10keV and 30keV x-rays for:

a. A slab of glass (SiO_2)

b. A thick chromium mirror;

c. A thick platinum mirror.

d. If the incident x-ray beam is 2mm high, what length of mirror is required to reflect the entire beam for each material?

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5. Calculate the fraction of silver (Ag) fluorescence x-rays which are absorbed in a 1~mm thick silicon (Si) detector and the charge pulse expected for each absorbed photon. Repeat the calculation for a 1~mm thick germanium (Ge) detector.