

PHYS 570-001

Spring 2015

HW #02

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 critical 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.