Intrumentation for Characterization of Nanomaterials (v11)

2. Scattering and Diffraction

Problems

2.1. Find the solid angle Ω (in sr) subtended by a solid arc of surface area $A = 8.0\,\text{cm}^2$ with radius of curvature $R = 72$ cm.

2.2. The interference pattern at small angles from two narrow slits using a parallel electron beam of wavelength $\lambda = 0.77$ nm shows an angular splitting between fringes of $\Delta\theta = 5.9$ mrad.
Find the slit separation *d* (in nm). (Note that this is not an application of Bragg's law.)

2.3. A beam of electrons (with unspecified energy) is partially transmitted through a thin Cr foil.
a) From a reliable source, find the mass density (at room temp.) and molar mass of Cr.
Calculate the density of atoms n (in atoms/cm^3, or just cm^{-3}).
b) For a foil of thickness $T = 56$ nm, the transmitted electron beam has 72% of the incident-beam intensity. Determine the mean free path length Λ (in nm) for scattering in In (at this energy).
c) Determine the total atomic scattering cross section σ_0 for an atom at this energy. Use appropriate units.