1. Exercise to the lecture „Röntgenphysik – Streuung und Abbildung" SS 2013

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These exercises are based on the 2nd lecture (slides 10-21).

1. Refraction:

i) An x-ray beam of 0.1mm height hits the following objects (δ=1e-05; β = 0.0):
a) a triangle of height (perpendicular to beam) 0.1mm, length (along beam) 0.1mm
b) a triangle of height 0.1mm, length 1.0mm
c) a triangle of height 0.1mm, length 10.0mm
d) a triangle of height 0.1mm, length 100.0mm
What happens to the beam at a distance of 10m after the sample?
ii) What is the angle of total reflection for a material with a δ=1e-05? You entering the material from a vacuum side (n=1!).

2. Fraunhofer pattern:

The scattered intensity is the product of the scattering amplitudes. Calculate the scattered intensity for a) one square slit, b) a round slit and c) an equilateral triangular slit. Describe the resulting intensity distributions (an image would be nice).

3) Coherent properties of PETRA III:

PETRA III is the new 3rd generation synchrotron source at Hamburg. The electron beam can be configured for each individual beamline in a high or low beta configuration. This results in source sizes of a) 14x330 μm^2 (high beta) and b) 14x84 μm^2 (low beta).
i) Calculate the transverse coherence length at a distance of 90m and at x-ray energies of 1, 2, 4, 8, 16 and 32keV.
ii) What is the longitudinal coherence length after Silicon (111) monochromator with an energy bandwidth of 1e-04 and after a 5m long undulator with 170 magnet structures with a period of 29mm (X-ray energy: 8keV; 1st undulator harmonic)?