PHYS3038 Fall 2015
Homework #9
Due date: 17 Nov 2015

Problems:

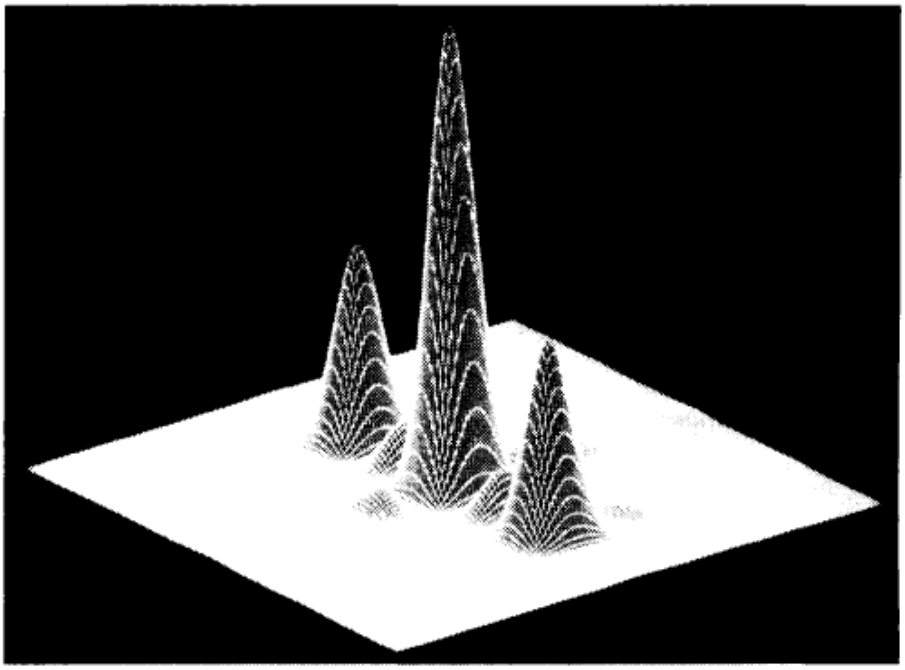
10.7* A single slit in an opaque screen 0.10 mm wide is illuminated (in air) by plane waves from a krypton ion laser ($\lambda_0 = 461.9$ nm). If the observing screen is 1.0 m away, determine whether or not the resulting diffraction pattern will be of the far-field variety and then compute the angular width of the central maximum.

10.8* A narrow single slit (in air) in an opaque screen is illuminated by infrared from a He–Ne laser at 1152.2 nm, and it is found that the center of the tenth dark band in the Fraunhofer pattern lies at an angle of 6.2° off the central axis. Please determine the width of the slit. At what angle will the tenth minimum appear if the entire arrangement is immersed in water ($n_w = 1.33$) rather than air ($n_a = 1.000\,29$)?

10.11* Two long slits 0.10 mm wide, separated by 0.20 mm, in an opaque screen are illuminated by light with a wavelength of 500 nm. If the plane of observation is 2.5 m away, will the pattern correspond to Fraunhofer or Fresnel diffraction? How many Young's fringes will be seen within the central bright band?

10.17 Figure P.10.17 is the irradiance distribution in the far field for a configuration of elongated rectangular apertures. Describe the arrangement of holes that would give rise to such a pattern and give your reasoning in detail.

Figure P.10.17 (Photo courtesy R. G. Wilson, Illinois Wesleyan University.)



10.23 No lens can focus light down to a perfect point because there will always be some diffraction. Estimate the size of the minimum spot of light that can be expected at the focus of a lens. Discuss the relationship among the focal length, the lens diameter, and the spot size. Take the *f-number* of the lens to be roughly 0.8 or 0.9, which is just about what you can expect for a fast lens.