Exercises Astronomical Observing Techniques, Set 10

Exercise 1

a) WYFFOS is the multi-object, wide-field, fibre spectrograph working at the Prime focus of the 4.2m WHT telescope. At a wavelength of 500 nm the resolving power is (R) is 2200. Calculate the spectral resolution element $(\Delta\lambda)$ for this instrument.

b) How many pixels should be used (along the spectral axis) to properly sample this spectrum from 450 to 550 nm?

Exercise 2

Give a short description of the (i) Gaussian, (ii) Lorentzian, and (iii) Voight line profiles.

Exercise 3

a) A square grating of 5 cm has 40 groves per mm. Calculate the maximum resolving power obtainable at at a wavelength of 500 nm, using the second order (m=2).

b) Calculate the wavelengths for constructive interference, using an incidence (i) and diffraction (i') angle of 30° and $-30°$ respectively.

c) In order to increase the efficiency at a specific order a blazed grating is used (having the same properties described above, except those mentioned below). The angle of incidence and diffraction (i and i'), are both 30° which is also equal to the blaze angle (θ_B). Calculate the blaze wavelength (λ_b) associated with the order $m = 50$.

Exercise 4

a) Calculate the spectral radiance (at the zenith) of the sky background in the L band (3.4μm), the optical depth $\tau = 0.15$ (you can assume $\tau << 1$, use wavelength units). The average temperature of the atmosphere is $\bar{T} = 250$ K.

b) Calculate the sky brightness in mag arcsec^{-2}, use that for mag$_L = 0$, the spectral irradiance is 8.1×10^{-11} W m^{-2} μm^{-1}.