

Astronomical Observing Techniques 2019:
Exercises on Spectroscopy
(Due on 14 May 2019 at 13:30)

May 7, 2019

1 Multi-Object Spectrograph

1. WYFFOS is a multi-object, wide-field, fiber spectrograph working at the prime focus of the 4.2m WHT telescope. At a wavelength of 500 nm the resolving power R is 2200. Calculate the spectral resolution element $\Delta\lambda$ in nm for this instrument.
2. How many pixels should be used (along the spectral axis) to properly sample this spectrum from 450 to 550 nm?

2 Grating Performance

1. A square grating of 5 cm has 40 grooves per mm. Calculate the maximum resolving power obtainable at a wavelength of 500 nm, using the second order ($m=2$).
2. Calculate the wavelengths for constructive interference using an incidence (i) and diffraction (i') angle of 30° and -30° , respectively. Hint: use the grating equation.
3. To increase the efficiency at a specific order a blazed grating is used (having the same properties described above, except for 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 $m = 50$.

3 Which spectrograph do I use?

- a) We are studying star formation in molecular clouds in nearby galaxies. We want to study the kinematics and distribution of the hydrogen gas by studying its H-alpha emission. What type of spectrograph would you use for this observation and why?
- b) We have observed a candidate exoplanet in a transit survey. To confirm that this is indeed an exoplanet, we need a follow-up observation. We decide that we are going to observe the radial velocity signal of the exoplanet to obtain its mass and derive its density. What type of spectrograph would you use for this observation and why?
- c) We want to study the dark matter distribution in a nearby spiral galaxy. For this we look at the rotation curve from that galaxy. What type of spectrograph would you use for this observation and why?