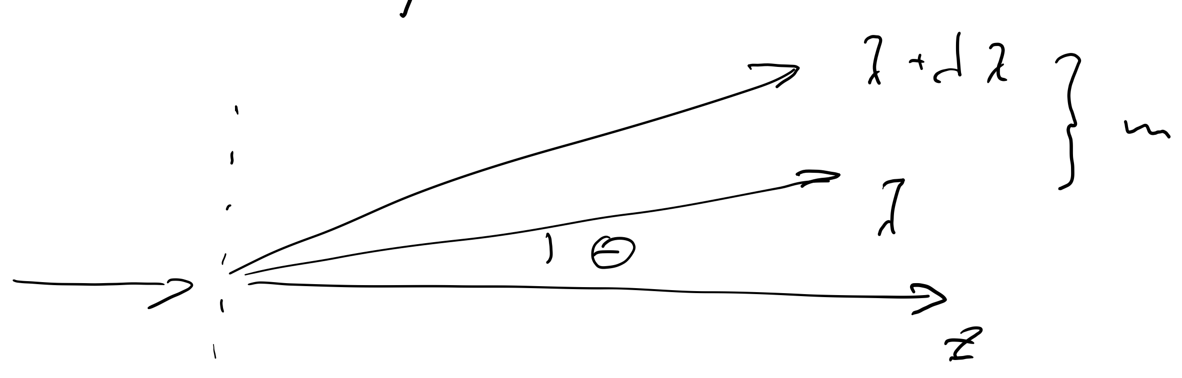
Here we will discuss the possibility of spectral expansion through diffraction, i.e. to perform spectroscopy.

Conditions for main maxima

$$d \sin\theta = m\lambda$$

θ is dependent on λ



Let's characterize spectroscopic properties of the grating.

① Angular dispersion

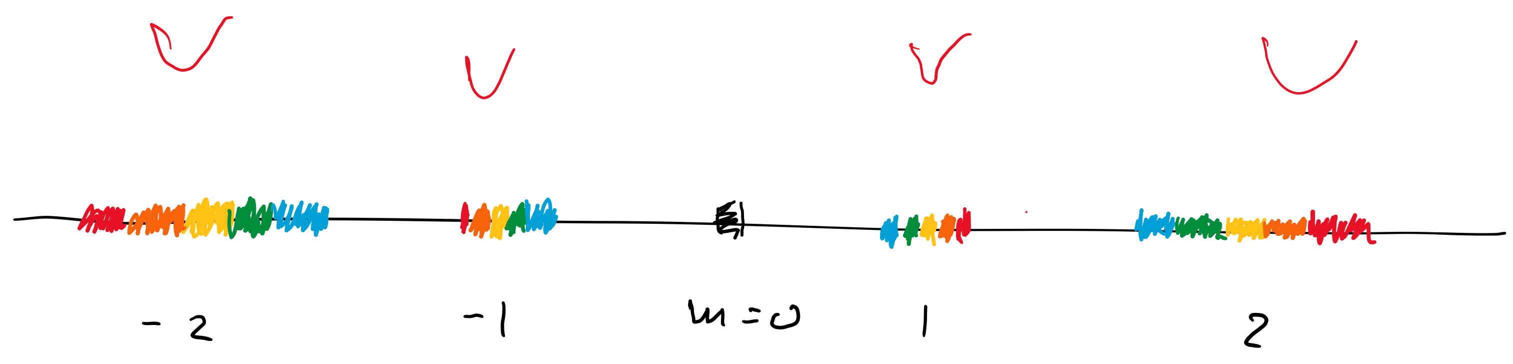
$$D = \frac{d\theta}{d\lambda}$$

$d \sin\theta = m\lambda$ $\qquad$ $d\cos\theta \, d\theta = m \, d\lambda$

$$D = \frac{d\theta}{d\lambda} = \frac{m}{d\cos\theta} = \frac{\tan\theta}{\lambda}$$

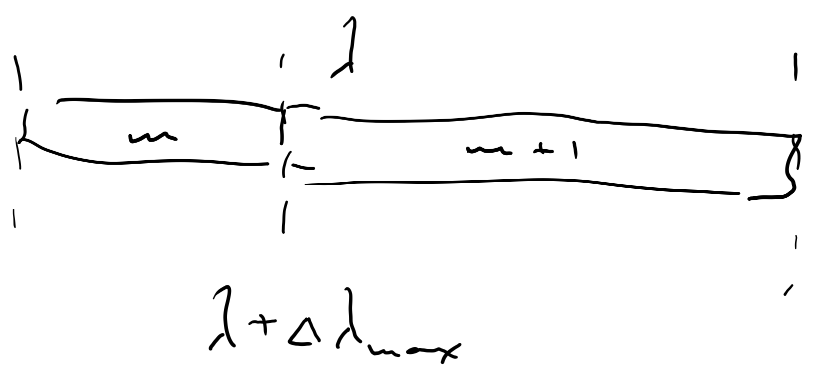
The greater diffraction angle θ, the greater the angular dispersion.

What does it mean?



② Area of free dispersion

This is area where different orders do not overlap.



$$(\lambda + \Delta\lambda_{max}) m = (m+1)\lambda$$

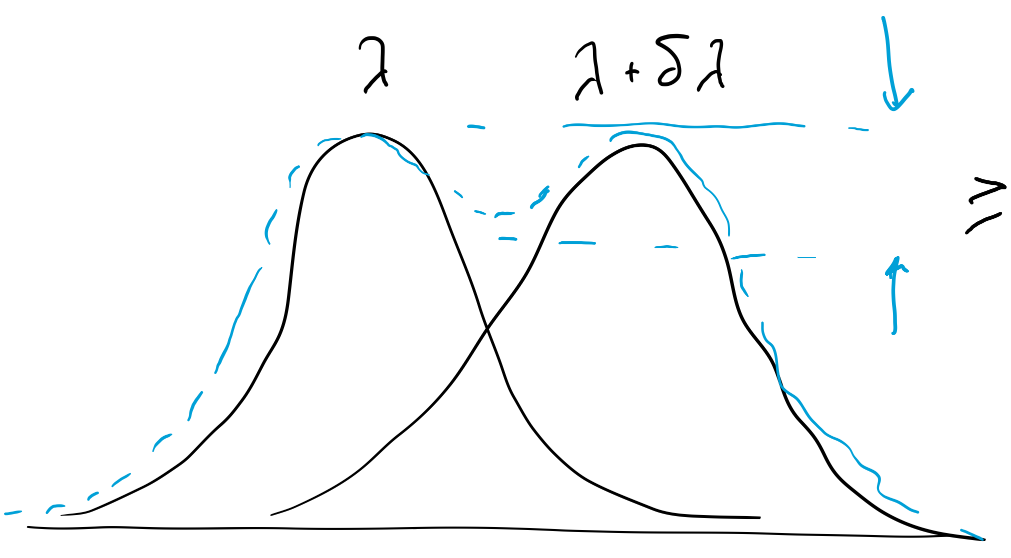
$$m \Delta\lambda_{max} = \lambda$$

$$\Delta\lambda_{max} = \frac{\lambda}{m} \Rightarrow \Delta\lambda_{max} \sim \frac{1}{m}$$

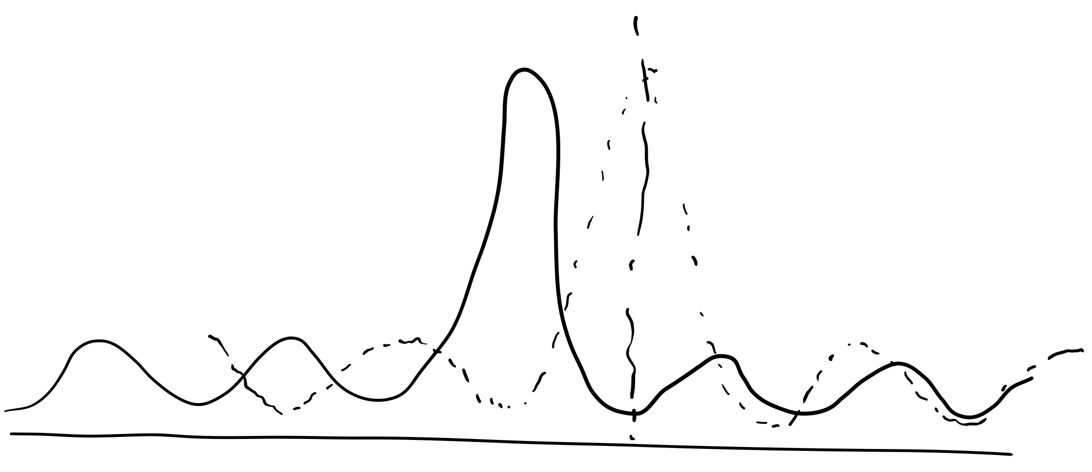
③ Resolution power

$$R = \frac{\lambda}{\delta\lambda_{min}}$$

$\delta\lambda_{min}$ is the smallest difference in λ that we can observe separately.



Where this criterion comes from?



When additional minimum corresponds to main maximum in this case the valley will be 20%.

Additional min λ_1 $\quad d\sin\theta = \left(m + \frac{1}{N}\right)\lambda_1$

Main max λ_2 $\quad d\sin\theta = m\lambda_2$

$$R = \frac{\lambda}{\delta\lambda_{min}} = mN$$