Diffraction for spectroscopic expansion

In this chapter, we will discuss the possibility of spectroscopic expansion through diffraction, i.e., to perform spectroscopy.

Consider the case where

\( \Delta = \frac{2 \pi}{\lambda} \),

where \( \Delta \) is the spatial frequency and \( \lambda \) is the wavelength.

Let's derive the diffraction properties of the grating.

1. **Young's equation**

   \( \frac{\sin \phi}{\lambda} = \frac{1}{d} \)

   where \( \phi \) is the degree of diffraction and \( d \) is the spacing of the grating.

2. **The grating condition**

   \( d \sin \phi = m \lambda \)

   where \( m \) is an integer.

3. **The angular dispersion**

   \( \phi \) is the greater the grating, the greater the angular dispersion.

What does it mean?

4. **Line of the dispersion**

   This is a curve where different colors do not overlap.

\[ \lambda = \frac{1}{n \sin \theta} \]

where \( n \) is the refractive index and \( \theta \) is the angle of detection.

5. **Rayleigh criterion**

   When the angle \( \theta \) is such that

\[ n \sin \theta = \frac{1}{\lambda} \]

we can discern two colors.

When do colors come from?

When additional minima correspond to main maxima in the case of visibility will be 20%.

Additional minima \( \Delta \lambda \), where \( \Delta \lambda \) is the Rayleigh criterion.

Main maxima \( \Delta \lambda \), where \( \Delta \lambda = \lambda \),

\[ R = \frac{2 \Delta \lambda}{\Delta \lambda} \]