# Theory and implementation of spectroscopy

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## 1. INTRODUCTION

## 2. THEORY AND ANALYSIS

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### 2.1. Theory

The following equation is known as the grating equation[1]:

$$d(\sin\alpha + \sin\beta) = m\lambda \tag{1}$$

Where: $d$ = spacing between the slits
$\alpha$ = the incident angle
$\beta$ = the diffraction angle
$m$ = the order of the spectrum
$\lambda$ = the wavelength

The angle $\alpha$ is the angle between the incident light and the normal of the grating, and $\beta$ is the angle between the diffracted light and the normal of the grating. Notice the plus sign instead of minus in the equation. The incident angle is measured counter-clockwise from the grating normal and the diffraction angle is measured clockwise from the grating normal. This is a sign convention for transmission gratings. The equation governs the angular locations of the diffracted light of wavelength $\lambda$.

For our research project, transmission gratings are used for a test model as shown in Fig. 1.

To simplify the construction of the testmodel, the incident light beam must be parallel to the grating normal. Hence, defining $\theta = \beta_{-1}$, Eq. 1 reduces to:

$$d\sin\theta = m\lambda \tag{2}$$

This implies that the the camera must be placed at a specific angle so that it can capture the spectrum of the first order ($m = 1$).

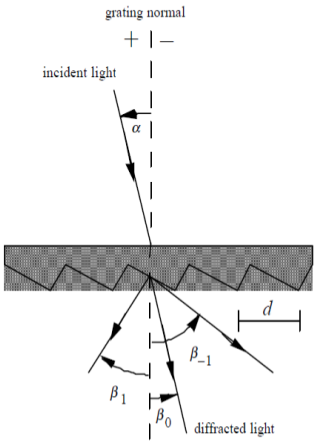


FIG. 1: Diffraction by a plane transmission grating. Adapted from [2].

### 2.2. Analysis

## 3. RESULTS

## 4. DISCUSSION

## 5. CONCLUSION

## 6. BIBLIOGRAPHY NOTES

[1] *The grating equations*, URL https://www.shimadzu.com/opt/guide/diffraction/03.html.
[2] E. L. C. Palmer, *Diffraction Grating Handbook* (Newport Corporation, 2005).