Prof. Vidya Sagar
Department of physics
Raja Singh College, Siwan

Determination of wavelength of Light by diffraction grating.

The usual equation of diffraction grating is

$$(e+d)\sin\theta = n\lambda$$

This is the condition of maximum intensity

It is evident from the above relation that if the grating element $(e+d)$ and the angle of diffraction θ for a particular order n be determined, the wave length λ can be obtained.

Determination of $(e+d)$:— The grating element $(e+d)$ is determined from the number of rulings per inch on the grating. If the number is N', then

$$N'(e+d) = 1 \text{ inch} = 2.54 \text{ cm}$$

$$\therefore (e+d) = \frac{2.54}{N'} \text{ cm}$$

Determination of θ :— This is done with the help of spectrometer. The slit of the spectrometer is illuminated by the given light, and the following adjustments are made.

(I) The eyepiece of the telescope is focussed on the cross-wires.

(II) The collimator and the telescope are adjusted for parallel rays. This is done by Schuster's method using a prism.

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(iii) The grating is adjusted on the prism table such that light from the collimator falls 'normally' on it. To do this the telescope is set in line with the collimator so that the direct image of the slit falls on the intersection of the cross-wires. The position of the telescope is noted. The telescope is turned through 90° from this position and clamped. The axis of the telescope is now perpendicular to that of the collimator. The grating is placed on the prism-table such that its ruled surface lies over the centre of the table and is perpendicular to the joining the the levelling screws A and B in the figure. The prism-table is now rotated till the images of the slit obtained by reflection from the surface of the grating is obtained on the intersection of the cross wire. The levelling screws, A and B are adjusted until the image lies equally above and below the intersection of the cross-wires.

In this position the grating surface is at 45° to incident light. The prism-table is rotated through 45° in the proper direction so that the ruled surface of the grating is normal to the incident light and faces the telescope. The prism-table is clamped in this position.

(iv) The rulings of the grating are adjusted parallel to the axis of the spectrometer. To do this,

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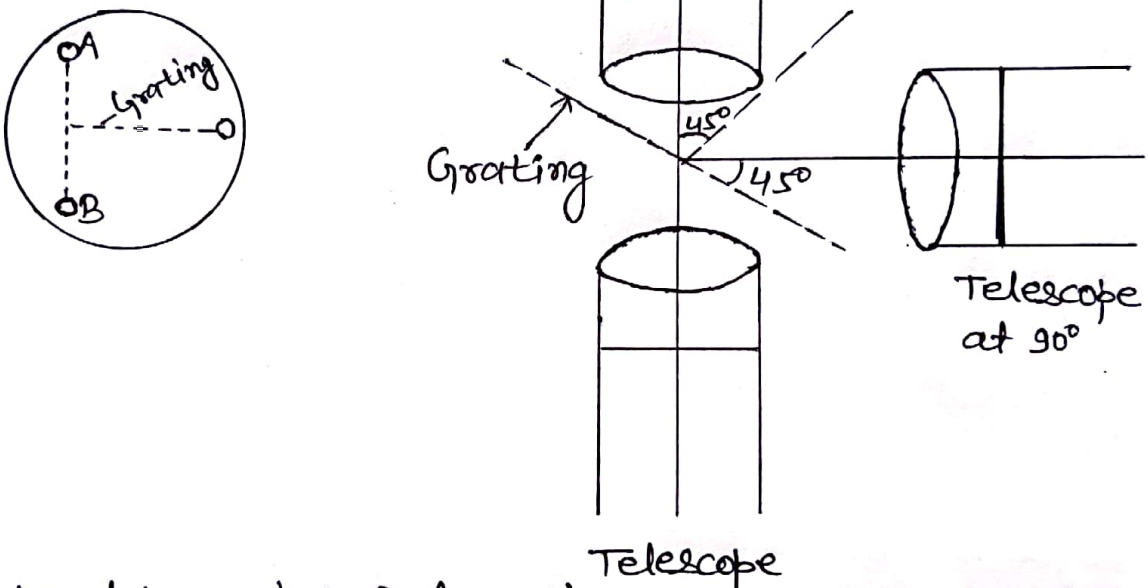
the diffracted images of the slit are observed through the telescope. The screw c is now adjusted until the centres of all the diffracted images lie at the same height in the field of view.

(v) The rulings are adjusted parallel to the slit. To do this, the slit is rotated in its own plane until the diffracted images are as sharp as possible.



Now to determine θ for the line whose wavelength is to be determined the telescope is ~~so adjusted~~ rotated to see the line in the first order on either side of direct image. The telescope is so adjusted that the line falls on the intersection of the cross-wires, and the reading of both the verniers are taken. The telescope is then turned to the other side of the direct image, and the corresponding readings for the same time in the first order are taken. The difference between the two readings of the same verniers gives 2θ for that time, from which θ is found. The process is repeated for the second order.

Hence knowing (e+d), θ and n, λ can be calculated with the help of equation $(e+d)\sin\theta = n\lambda$.

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