

LED spectrum through the transmission grating

Task and equipment

Information for teachers

Additional Information

Because stray light barely affects this measurement, the classroom only needs to be slightly darkened in order to make the interferences on the screen visible. The distances must be measured very precisely because even a small imprecision will lead to large deviations in the result.

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Task

What does an LED spectrum look like through a transmission grating?

The wavelength of light can be determined in a great number of ways. In this experiment you will be introduced to the so-called objective method with transmission grating. The name "transmission grating" means that the light passes through the grating and experiences interference while doing so.

Determine the wavelength of maximum intensity with a transmission grating.



Equipment



Student's Sheet

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Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
3	Slide mount without angle scale	09851-02	1
4	Diaphragm holder, attachable	11604-09	2
5	Lens on slide mount, f = +100mm	09820-02	1
6	Screen, semitransparent, 150x150mm ²	09851-03	1
7	Lens on slide mount, f = +300mm	09820-04	1
8	Grating, 500 lines/mm, in slide frame, glassless	09851-16	1
9	Illumination slit	09851-12	1
10	LED - red, with series resistor and 4 mm plugs	09852-20	1
11	Stray light tube for LED, Di = 8 mm, l = 40 mm	09852-01	1
12	Measuring tape, l = 2 m	09936-00	1
Additional material			
13	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
	Connecting cord, 32 A, 750 mm, red	07362-01	1
	Connecting cord, 32 A, 750 mm, blue	07362-04	1

Set-up and procedure

Set-up

- Corresponding to figure 1-5, fit the stray light tube over the LED and set the components on the mounting rods.
- The illumination slits and the grating are not yet required.



Fig. 1



Fig. 2



Fig. 3



Fig. 4

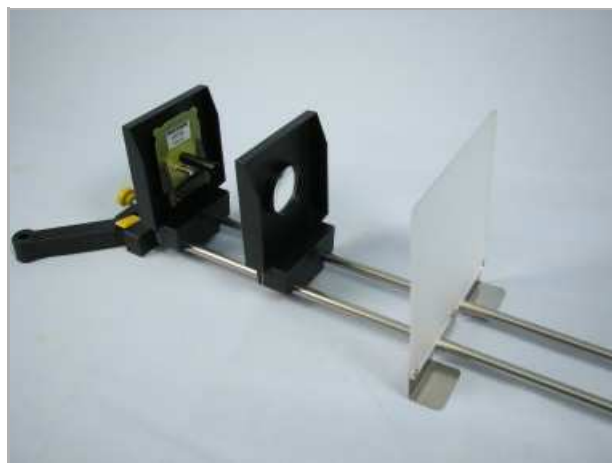
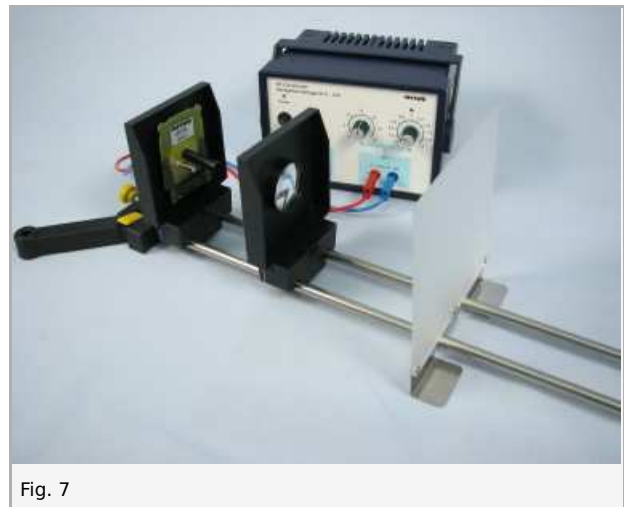
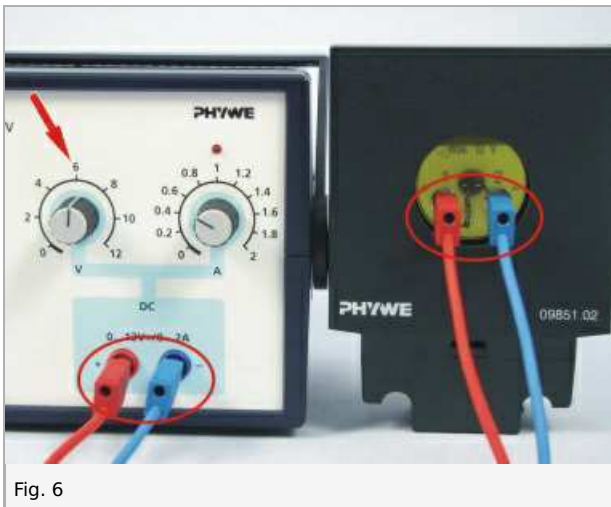


Fig. 5

Student's Sheet

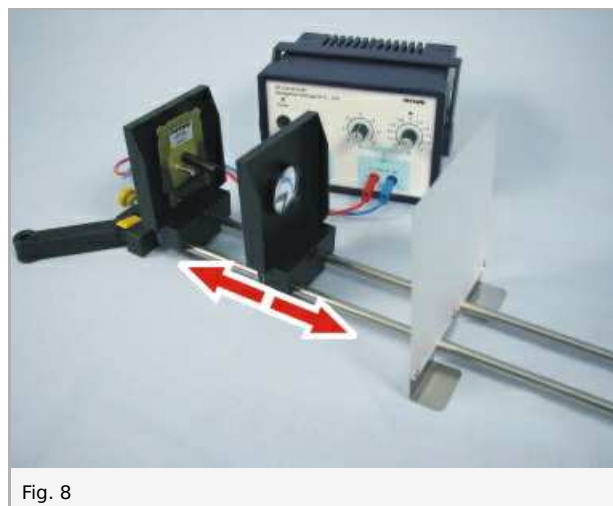
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- The LED is connected to the power supply (observe the correct polarity).
- The power supply is set to 6 V.



Procedure

- The lens is moved forwards and backwards on the mount until a light spot as crisp (and small) as possible occurs on the screen.



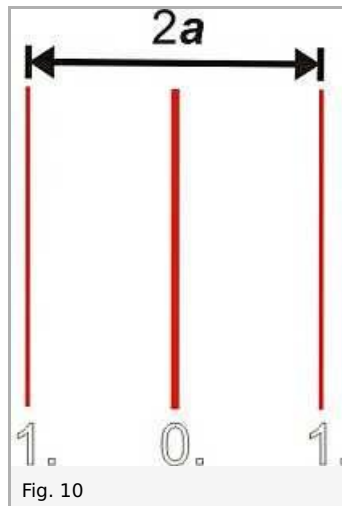
- The illumination slit and the grating are fitted together with an aperture holder onto the slide mount with the lens pointing in the direction of the screen.



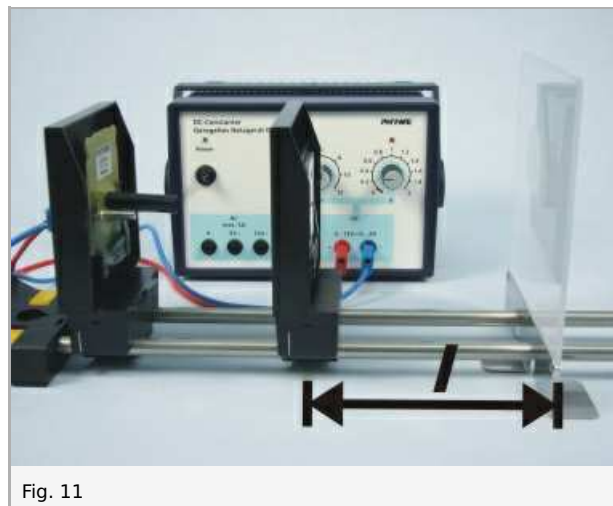
Student's Sheet

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- Now an interference pattern can be seen on the screen. Measure the distance between the two first maxima and record it as $2a$.



- Measure the distance between the grating and the screen. Record this distance as l .



Report: LED spectrum through the transmission grating

Result - Table 1

Supplement the table with your measured values.

a in cm	9.7	1
l in cm	28.5	1

Evaluation - Question 1

For a lattice the formulae below are known: $\sin(\alpha) = \lambda/g$ and $\tan(\alpha) = a/l$, with λ being the wavelength of the light (in this case the wavelength is 632 nm), g is the grating constant, a the distance to the first interference maximum and l the distance between the grating and the screen.

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Evaluation - Question 2

Combine the two equations and solve to find λ . The grating has 500 lines per mm.

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Evaluation - Question 3

Should you have problems with the derivation use the calculation of g the formula below: $\lambda = g \times \sin(\arctan(a/l))$.

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