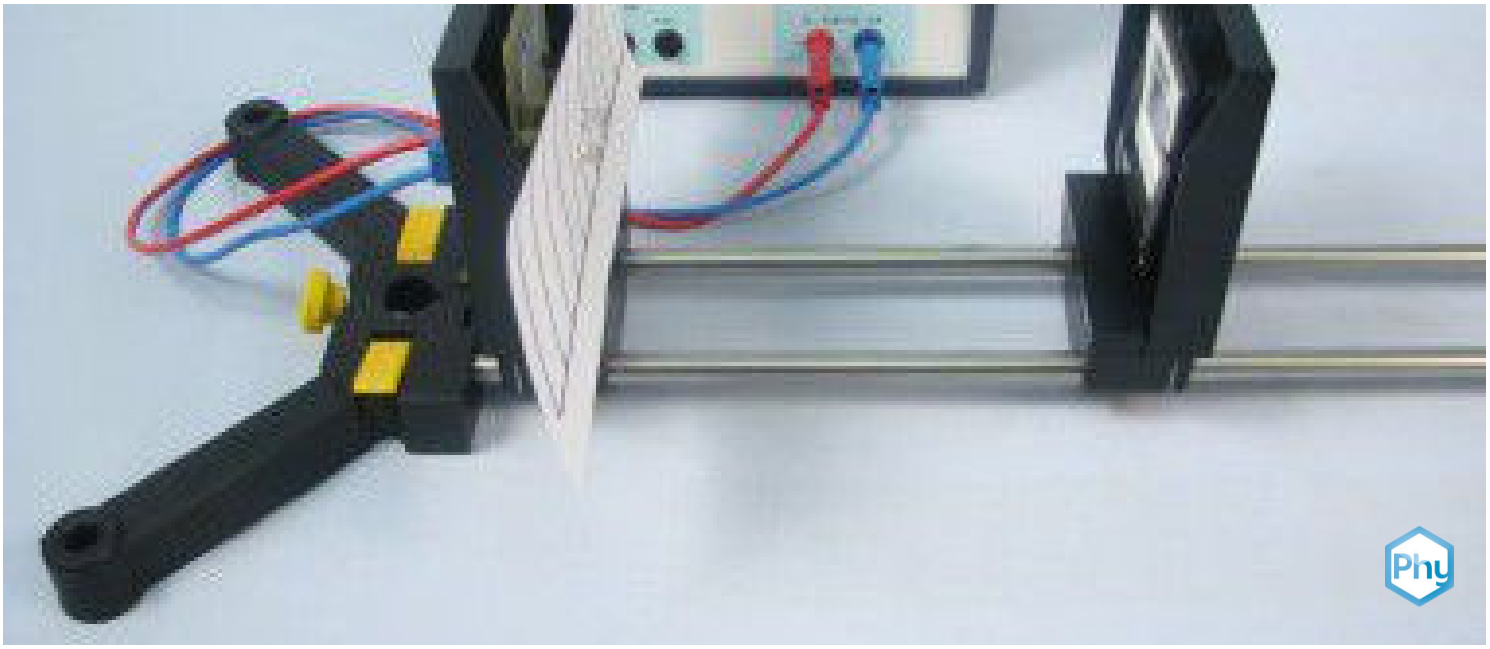
At what wavelength does an LED light up?



Physics > Modern Physics > Solid state physics

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/615c3b5dbd5b06000320c685

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Teacher information

Application

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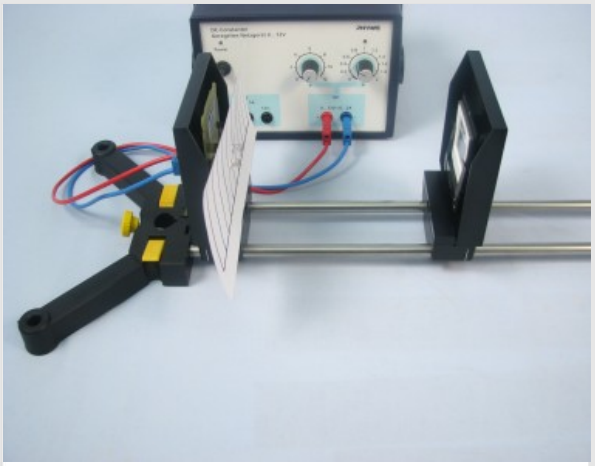

Test setup

The wavelength of light influences the results of many experiments. Thus, by knowing the wavelength of emitted light, much can be said about the nature of different materials.

Determining the wavelength of light is a good way to check the understanding of diffraction at the grating, as this is necessary to determine the wavelength.

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Other teacher information (1/2)

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Previous

Students should be familiar with diffraction at the grating.

Principle

Light rays hit the grating and are diffracted there with different degrees of rigidity according to their wavelength. Thus, the position of the first secondary maximum with a known grating constant depends only on the distance of the grating from the screen and the wavelength of the light used.

Other teacher information (2/2)

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Learning

The aim of this experiment is to consolidate the students' understanding of diffraction at the grating.

Tasks

- Measurement of the first secondary maximum and determination of the wavelength of the light used.

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Student Information

Motivation

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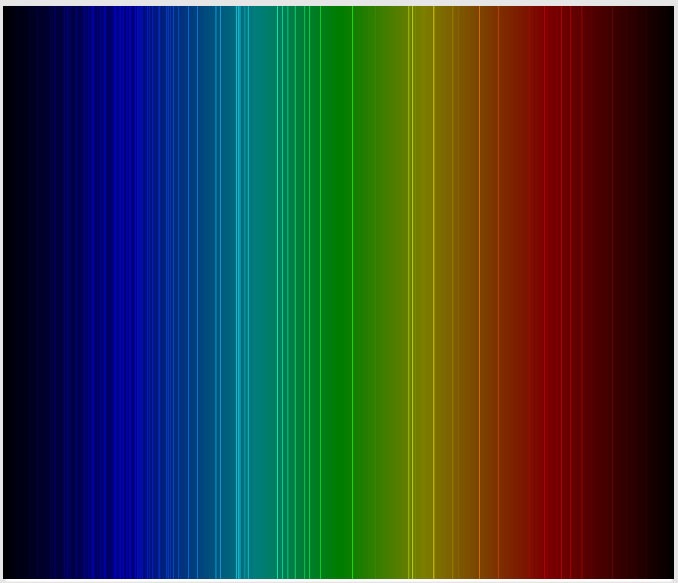
The determination of the wavelength of light is a vast field, which is especially applied in astronomy and materials research.

Whether it is used in spectroscopy to find out what the atmosphere of a distant planet is made of, or to find out how fast a car fell into a speed trap, the determination of the wavelength of the emitted light accompanies many areas of life.



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Equipment

Position	Material	Item No.	Quantity
1	LED - blue, with series resistor and 4 mm plugs	09852-40	1
2	LED - green, with series resistor and 4 mm plugs	09852-30	1
3	LED - red, with series resistor and 4 mm plugs	09852-20	1
4	LED - UV, with series resistor and 4 mm plugs	09852-50	1
5	Grating, 500 lines/mm, in slide frame, glassless	09851-16	1
6	Support base, variable	02001-00	1
7	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
8	Slide mount without angle scale	09851-02	2
9	Diaphragm holder, attachable	11604-09	2
10	Measuring tape, l = 2 m	09936-00	1
11	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
12	Connecting cord, 32 A, 750 mm, red	07362-01	1
13	Connecting cord, 32 A, 750 mm, blue	07362-04	1

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Structure (1/2)

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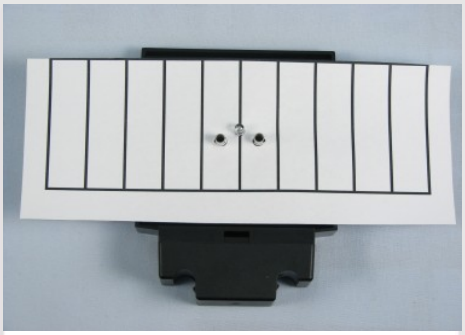
- Note: To perform this experiment, it is advantageous if the room is only slightly darkened and the measurements are not performed directly against daylight.
- Set up the experiment according to steps 1 to 6 in the order LED, measuring scale, grid on the stand material.

Step 1



Step 2

Step 3

Structure (2/2)

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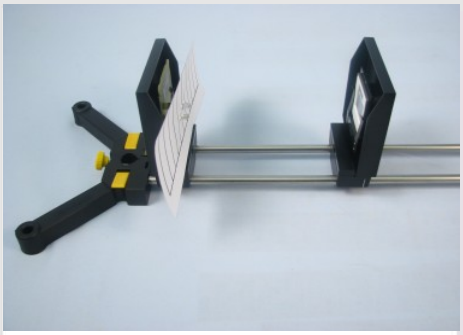
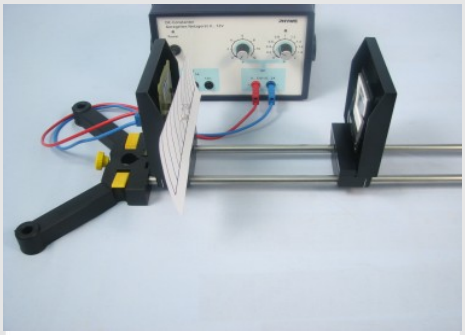
- The prepared measuring scale is plugged onto the diode so that the head of the LED just sticks out. Pay attention to the correct polarity when connecting the LED!



Step 4

Step 5



Step 6

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Procedure (1/2)

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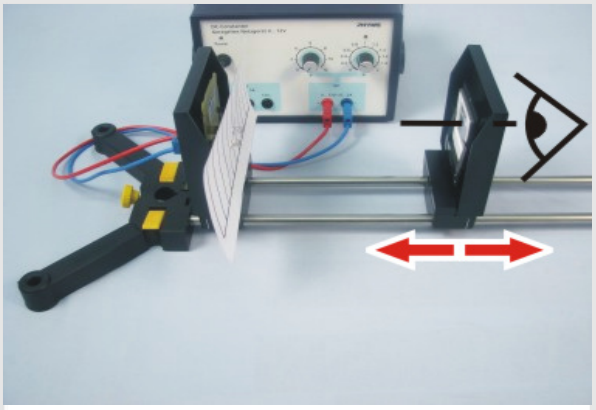
- Select the LEDs with the colors UV, blue, red and green one after the other.
- After connecting an LED, set a voltage of 6 V so that the LED lights up clearly.
- The eye is used to get very close to the grid from behind.
- Move the grid forward/backward until the first maximum is on the middle of a thick line.



The accuracy is increased by setting a distance of 8 or 10 cm for the first maximum.

Procedure (2/2)

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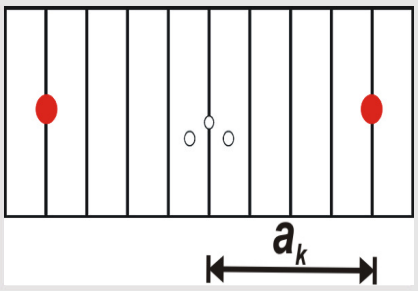
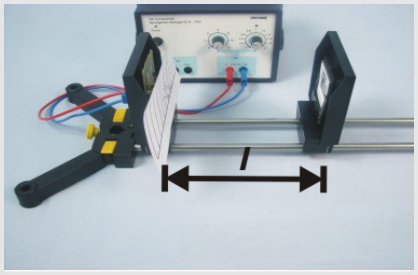
- Note the distance of the first maximum to the center as a_k in Table 1 in the Protocol.
- Measure the distance from the grid to the tip of the LED and note it as distance l in Table 1.
- Repeat the experiment for the other diodes.





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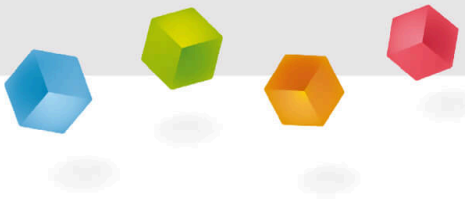

Report

Task 1

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LED color	a_k in cml	in cm λ	in nm
red			
green			
blue			
UV			

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Task 2

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What equations are needed to determine the lattice constant?

- [ ] $\sin(a_k) = k \cdot \lambda / \mathrm{g}$
- [ ] $\tan(a_k) = a_k N$
- [ ] $\cos(a_k) = k \cdot \lambda / \mathrm{g}$

Check

Task 3

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What formula does this give for the lattice constant?

- $\mathrm{g} = k \cdot \sin(a_k N)$
- $\mathrm{g} = k \cdot (\lambda / \cos(\arctan(a_k N)))$
- $\mathrm{g} = k \cdot (\lambda / \sin(\arctan(a_k N)))$

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Slide	Score / Total
Slide 14: Determination of the lattice constant	0/2
Slide 15: Equation 2	0/1

Total score 0 / 3

Show solutions | Repeat | Export text

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