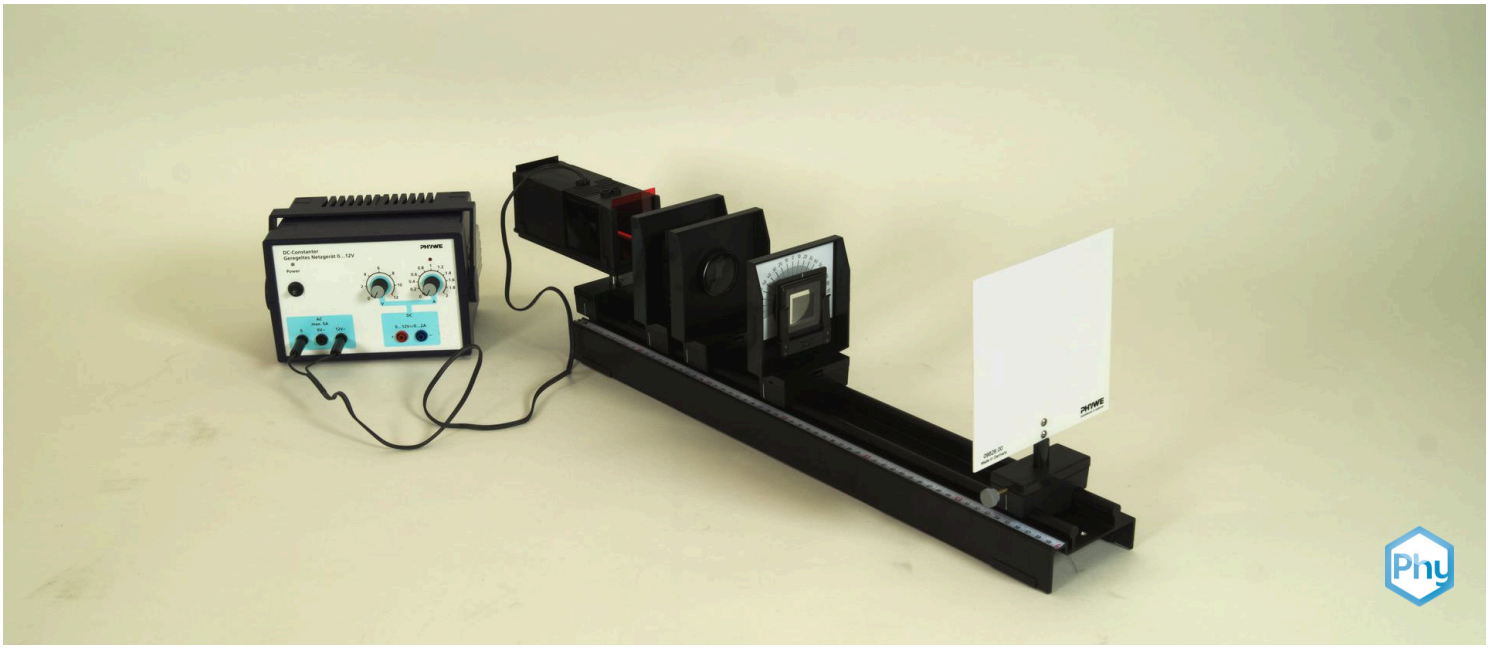
Diffraction at a grid



Physics > Light & Optics > Diffraction & interference

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/62e17d968248420003226ddc

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Teacher information

Application

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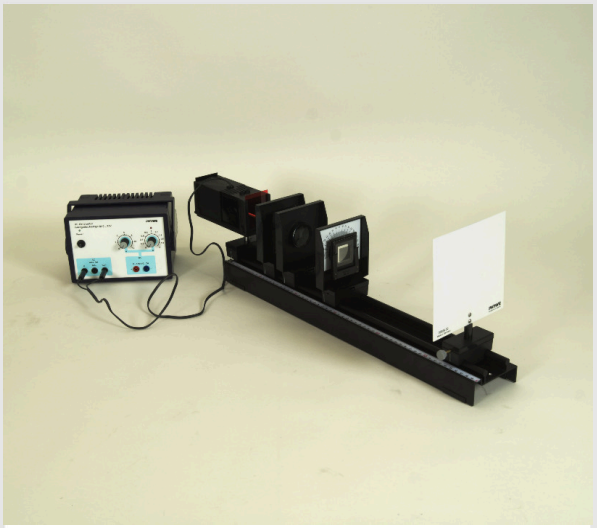

Experimental setup

An optical grating is a periodic structure to diffract incident light. In the process, the spectrum of the incident light becomes visible. Gratings can be used for spectral analysis or also monochromatisation.

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Other teacher information (1/4)

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Principle

The optical grating deflects the incident light at each slit, causing interference behind the grating. A symmetrical interference pattern is created, whereby the light is split into its spectrum.

Learning objective

The students should observe the diffraction effect on the grating and compare it with the dispersion on the prism.

Other teacher information (2/4)

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Task

Students should investigate the phenomena that occur when a beam of light is sent through an optical grating.

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Other teacher information (3/4)

- After recognising in physics lessons that light can be reflected and refracted like water waves, for example, the question must be pursued as to whether light also has wave character. If so, it should be possible to detect interference phenomena in light as well as in water waves.
- The experiment on diffraction at the optical grating provides convincing proof of the interference capability of (visible) light and thus of its wave character.

Other teacher information (4/4)

Notes on set-up and procedure

- The experiment should be carried out in a well-darkened physics room. Then second-order diffraction spectra can still be clearly detected.
- If additional examinations are to be carried out with monochrome light, it is recommended to use filters (from the filter set add. colour mixing, order no. 09807-00), which can be inserted one after the other into the aperture shaft of the lamp.

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Safety instructions

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- The general instructions for safe experimentation in science lessons apply to this experiment.

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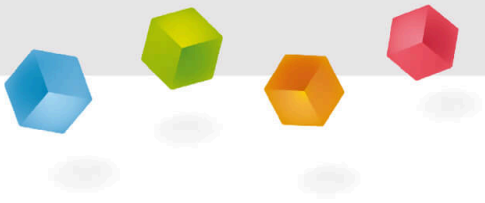

Student information

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Motivation

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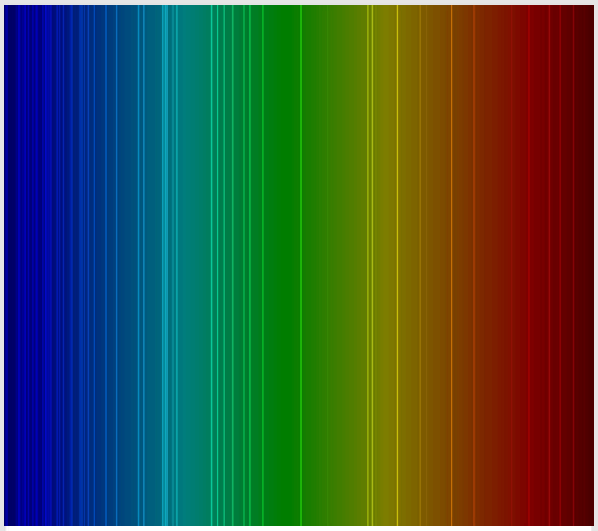

Spectral lines of white light

An optical grating is a periodic structure to diffract incident light. In the process, the spectrum of the incident light becomes visible. Gratings can be used for spectral analysis of materials or also for monochromatisation (isolation of a specific wavelength).

How does an optical grating work?

Tasks

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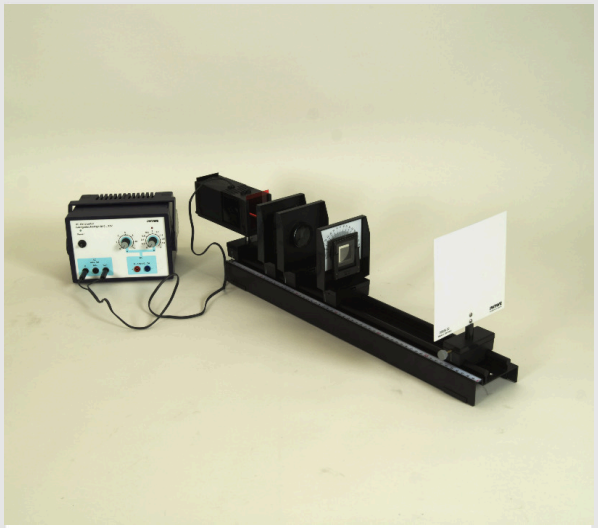

Experimental setup

Investigate the phenomena that occur when a beam of light is sent through an optical grating.

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Equipment

Position	Material	Item No.	Quantity
1	Optical profile-bench for student experiments, l = 600 mm	08376-00	1
2	Light box, halogen 12V/20 W	09801-00	1
3	Bottom with stem for light box	09802-20	1
4	Diaphragm with slit	09816-02	1
5	Lens on slide mount, f=+50mm	09820-01	1
6	Lens on slide mount, f=+100mm	09820-02	1
7	Slide mount for optical bench	09822-00	1
8	Mount with scale on slide mount	09823-00	1
9	Screen, white, 150x150 mm	09826-00	1
10	Diaphragm holder, attachable	11604-09	2
11	Grating, 80 lines/mm	09827-00	1
12	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up (1/2)

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- Assemble the optical bench from the two tripod rods and the variable tripod base.

Set-up (2/2)

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- Place the base with the stem under the light box and clamp it into the left part of the tripod base so that the lens side faces away from the optical bench.

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Procedure (1/3)

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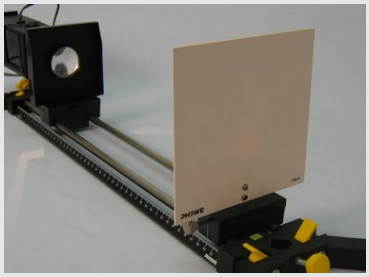

- Connect the lamp to the power supply unit (12 V~).
- Place the screen on the right end of the optical bench and the lens with the $f = +100\,\mathrm{mm}$ near the lamp and move it until the circular light spot on the shade has a diameter that is about the same as the diameter of the lens.

Procedure (2/3)

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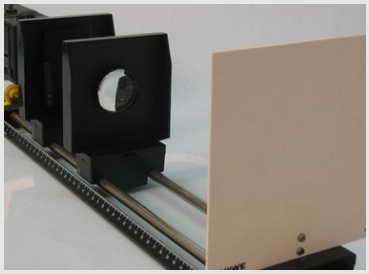

- Slide the aperture with the slit into an aperture holder and place it on the rim of the lens.
- Set the lens with $f = +50\,\mathrm{mm}$ and move them until a sharp image of the slit appears on the screen.

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Procedure (3/3)

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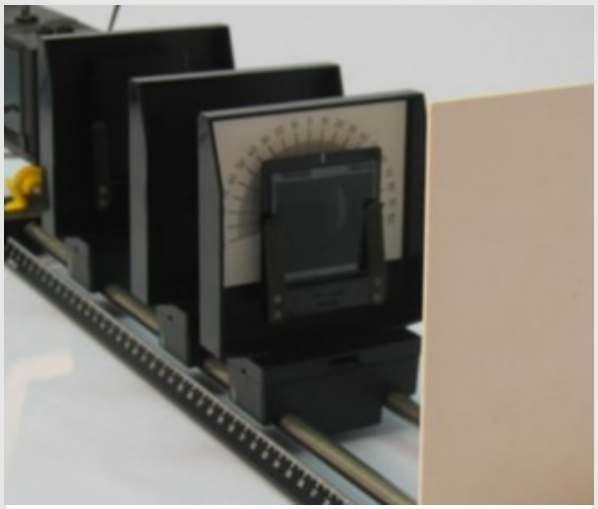

Experimental setup

- Set the frame with scale to the right of the lens (with $f = +50\,\mathrm{mm}$), slide the grating into the second aperture holder and place it on the socket.
- Describe the image on the screen before and after the grating is placed in the beam path in the protocol.
- This phenomenon is called the diffraction spectrum of light. Pay attention to the arrangement of the colours: Light of which colour is diffracted the strongest or weakest? Write down your observations.
- Switch off the power supply unit.

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Report

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Task 1

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How are the different colours inflected?

- [ ] Blue light strongest
- [ ] Blue light weakest
- [ ] yellow light weakest
- [ ] Red light strongest
- [ ] Red light weakest

Check

What appears on the screen after the grating has been placed in the beam path?

- ○ Asymmetrical red and blue stripes are created.
- ○ (Continuous) spectra are produced, symmetrical to the white image of the slit.

Check

Task 2

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What properties must light have in order to explain diffraction phenomena?

- ○ Light must have particle properties.
- ○ Light must have thermal properties.
- ○ Light must have wave properties.

Check

What do you observe when you look through fine fabric, a bird feather or similar towards the sun or another light source (beware of glare!)?

- ○ Distortions and lens effects occur due to diffraction phenomena.
- ○ Coloured patterns appear due to diffraction phenomena.

Check

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Task 3

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When light is refracted through a prism, spectra are also produced that are called dispersion spectra.

Fill in the missing words.

Dispersion spectra: [ ] light is refracted the strongest, [ ] light is refracted the weakest.

Diffraction spectra: [ ] light is refracted the strongest, [ ] light is refracted the weakest.

Check

Slide	Score / Total
Slide 18: Multiple tasks	**0/3**
Slide 19: Multiple tasks	**0/2**
Slide 20: Dispersion vs. diffraction	**0/4**

Total **0 / 9**

Solutions Repeat

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