A CD as reflection lattice

Task and equipment

Information for teachers

Additional Information

The setup of the experiment is uncritical and provides in general good and reliable measured results.

For carrying out the experiment, the room should be relatively dark because the reflected light is not particularly bright. When reading the measured values it must be ensured that the paper is not bent and that it is a uniform distance from the CD.

Additional information to the report

Figure (Evaluation - Question 1):
Schematic drawing of the experimental setup and path of light. The dotted shape is the intensity function of the diffraction pattern. The lateral distance of the first secondary maximum from the beam centre (here the centre of the hole) is a, the distance between the diffraction object and the screen is l.
The light arriving at the lens from the LED is focussed through the lens and concentrated into a light spot on the CD (geometrical optics). At the metal surface of the CD the light beam is reflected abd falls onto the grooves in the CD (grating). Here wavelets (physical optics) are generated according to Huygens' principle. These interfere and in this way generate intensity minima and intensity maxima.

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

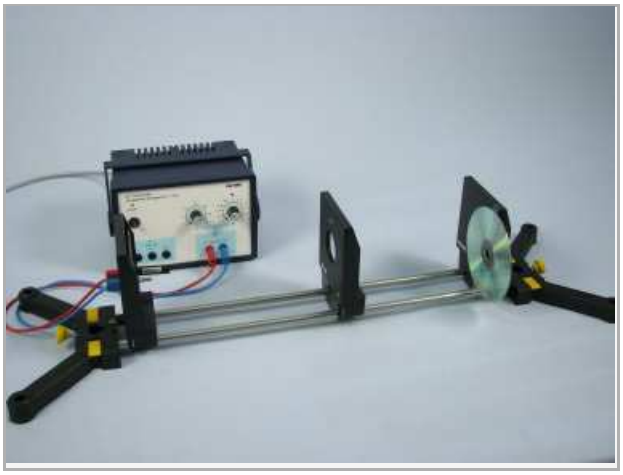
A CD as reflection lattice

Task and equipment

Task

What is the distance between the grooves on a CD?

A CD made with grooves similar to a record. In contrast to the record the distances between the grooves of a CD are so small that they can hardly be seen with the naked eye. In this experiment you will learn about a method to determine the distance between the grooves.



Equipment

Student's Sheet

Printed: 18.04.2017 10:30:20 | P1416201

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	1
5	Lens on slide mount, f=+300mm	09820-04	1
6	Lens on slide mount, f=+100mm	09820-02	1
7	LED - red, with series resistor and 4 mm plugs	09852-20	1
8	Stray light tube for LED, Di = 8 mm, l = 40 mm	09852-01	1
9	Measuring tape, l = 2 m	09936-00	1
Additonal material			
10	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
11	CD		
12	Connecting cord, 32 A, 750 mm, red	07362-01	1
13	Connecting cord, 32 A, 750 mm, blue	07362-04	1
	A4 sheet of paper with a hole (diameter approx. 2 mm)		

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Set-up and procedure

Set-up

- Setup as shown in figure 1.
- Fit the tube over the LED and set the slide mount with the LED as far out as possible on the optical bench.

Fig. 1

Fig. 2

Fig. 3

- Glue the CD to the slide mount in such a way that the light hits the CD as close as possible to the outside diameter (where the grooves are less curved).
- Mount the CD as far as possible at the other end of the optical bench (the sheet of paper is not yet reqiuired).

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Fig. 4

Fig. 5

- Connect the LED to the power supply (8 V).
- Warning: Observe the correct polarity!

Fig. 6

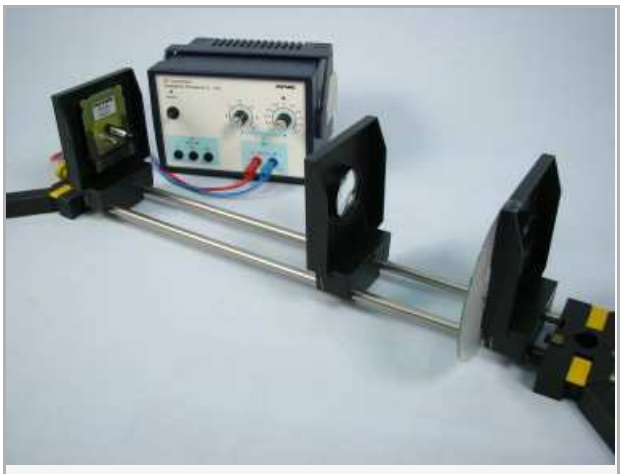


Fig. 7

Procedure

- The lens is moved forwards and backwards on the mount until the sharpest (and smallest) light spot occurs on the CD.

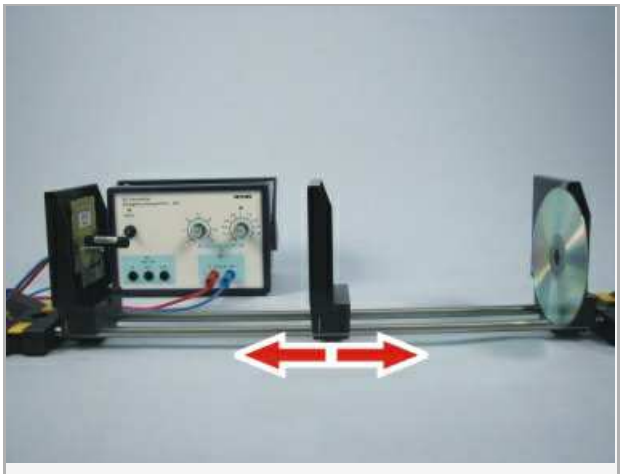


Fig. 8

- The paper is held on the CD side with the hole directly in front of the lens so that the light spot is still visible on the CD. Now on the paper on the right-hand and the left-hand side of the lens reflected light spots can be seen.

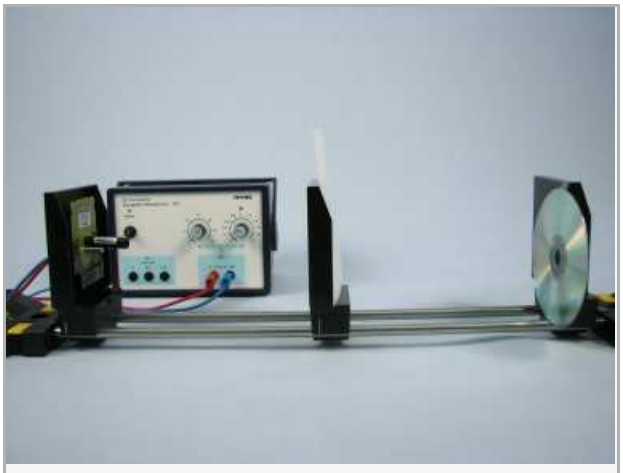


Fig. 9

- Measure the distance between the light spots on the left-hand and the right-hand side of the lens and record it as $2a$ in table 1.

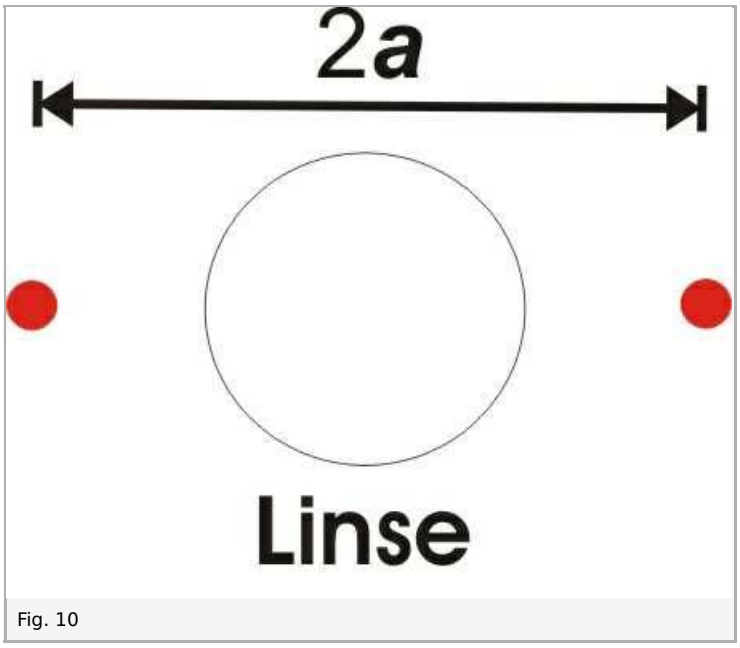


Fig. 10

- Measure the distance between the paper and the CD. Record this distance as l.

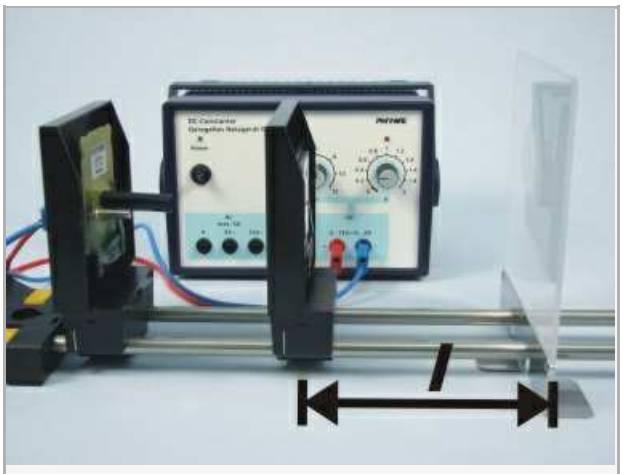


Fig. 11

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Student's Sheet

Printed: 18.04.2017 10:30:20 | P1416201

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com

Report: A CD as reflection lattice

Result - Table 1

Supplement the table with your measured values.

	Measurement #1	Measurement #2	Measurement #3	Mean Value	
$2a$				7.65	1
l				16.5	1

Evaluation - Question 1

Produce a sketch of the experiment and mark the path of the light.

Evaluation - Question 2

Explain the occurrence of the reflected light spots. Note: The cd is here regarded as a reflection grating.

Evaluation - Question 3

Determine the grating constant for the CD: For a grating the formulae below are known: $\sin(\alpha) = \lambda/g$ and $\tan(\alpha) = a/I$, with λ being the wavelength of the light (in this case the wavelength is 631 nm), g is the grating constant, a the distance to the first interference maximum and I the distance between the grating and the screen. In our case the grating constant is equal to the number of grooves per millimetre. Combine the two equations and solve to find g. Calculate the distance between the grooves on the CD.

Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com