HOLOMAKERS PROJECT

Motivating secondary school students towards STEM careers through hologram making and innovative virtual image processing practices with direct links to current research and laboratory practices

Erasmus+ KA2 2017-1-PL01-KA201-038420

Physical Experiment

Calculating the distance of distance between the recording CD/DVD tracks

Co-funded by the Erasmus+ Programme of the European Union

Project description for teachers

The purpose of the experiment is to determine the distance between the recording tracks on a CD/DVD. This is possible due to the fact that the CD/DVD can be treated as a reflective diffraction grating. The period of this grid corresponds to the distance between the tracks with the saved information.

We will need:
- laser pointer emitting a wave of a known length (λ) (usually this value is given on a sticker on the pointer),
- a recorded CD/DVD
- measure tape
- holder for the laser
- screen for observing diffraction orders

After lighting the CD/DVD with a laser beam, you should observe the appearance of additional diffraction orders (see Fig 1). Reflected light is diffracted, thanks to which new directions of beam propagation appear. We can observe them as light spots on the screen.

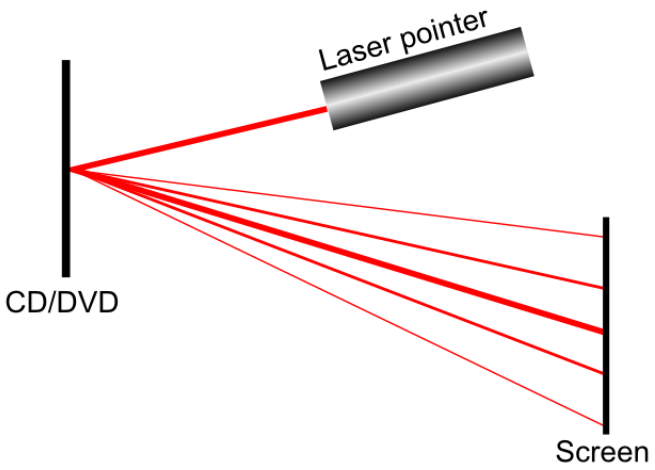

Fig 1 Reflection of light from a CD / DVD

Set your setup in that way that 0^{th} (m=0), and 1^{st}/-1^{st} (m=±1) diffraction order are clearly visible (Fig 2).

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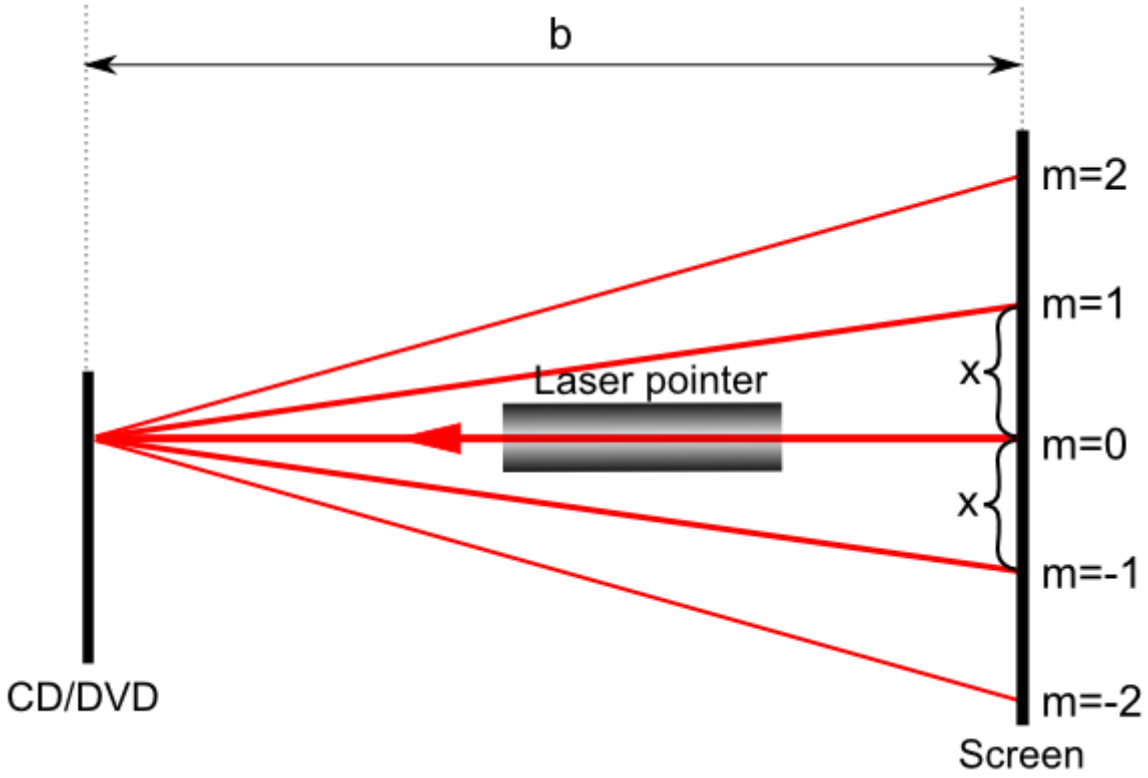

Fig 2 Experimental setup (top view).

For calculations, measure the distance b between the disc and the screen (wall) and the distance x between zero and plus/minus the first order of diffraction. It is best to repeat this action several times in order to validate the results.

To determine the distance d between tracks with recorded information on a CD/DVD (the constant of our grating), use the formula below (if we measure the first diffraction order then m = 1)

$$d = \frac{m\lambda\sqrt{x^2 + b^2}}{x}$$

The values of distance *b* and *x* measured several times should be inserted into the formula. Therefore we obtain several values of the constant *d* which then can be averaged. The calculated values can also be compared with other groups. The actual distance between nearby tracks on a CD is 1.6 µm and on a DVD it is only 0.74 µm.

The group that received the result closest to the expected one can be considered the best.

Let the students ask questions here:
a) What will change in our diffraction image if we bring the laser closer to the disc?
b) What will change in our diffraction image if the screen is brought closer to the disc?

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Declaration

This report has been prepared in the context of the HOLOMAKERS project. Where other published and unpublished source materials have been used, these have been acknowledged.

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