Physical Concepts Understanding with a Help of Multimedia Tools

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Abstract

Contribution deals with the interpretation of selected physical concepts with a help of multimedia tools. Physical phenomenon that students can come across with in everyday life is presented with a help of video tools. The same physical phenomenon can be explored in a physical laboratory through simple, hands-on experiment and this can be followed by exact physical measurement in a microcomputer-based laboratory. Further analysis of the phenomenon can be realized with a help of java applets. In the contribution there is presented a possible combination of all the mentioned ways on several case studies.

Introduction

Students during secondary school have to learn about many different physical phenomena and as the results of research show [1], they have many difficulties in understanding the physical world. They enter and leave the courses with fundamental misunderstandings of the world around them. Their learning of facts about science remains within the classroom and has little effect on their thinking about the larger physical world [2]. That's why there is great effort to use methods and ways of teaching that could make physics more attractive and that could help in deeper understanding of physical phenomena. One of the possible methods how to make teaching more interesting is physical experiment. There are many different ways of its realization from simple hands-on experiment up to experiments aided with computers. The physical phenomenon the students come across with in everyday life can be also presented via multimedia tools as well as by means of short video presentation. In the contribution there is presented a possible combination of all the mentioned ways on the examples of interference and diffraction.

1 Interference and diffraction

Everybody has seen the colours of soap bubbles and oil slicks on wet pavement. These effects are caused by the well-known phenomenon of thin film interference. When an object is placed between a point source of light and a screen it casts an intricate shadow made up of bright and dark regions. This deviation from rectilinear propagation is known as diffraction. The explanation of these phenomena is very important from the point of view of wave nature of light understanding. The explanation can start with presentation of these phenomena in everyday life with a help of video tools that can be followed by non-traditional hands–on experiments and finally there can be realized an exact computer-aided experiment. These experiments can be followed by interactive study of java applets.

2 Video presentation

Video presentation of interference and diffraction can show these effects in everyday life. Such a presentation can have a strong motivational effect on students. We can show them e.g. these situations:

- while using detergent during washing dishes we can see colourful pictures on the detergent surfaces,
- on the thin oil film in a frying pan there can be seen striking colour effects,
- glasses of binoculars seem to be coloured blue in reflected light.

3 Hands-on experiments

After the motivational input we can realize some very simple non-traditional experiments that can be realized by very simple tools. That also makes them easy to do not only for teachers but for students as well who can work with light waves by themselves e.g. at home.

For diffraction of light on diffraction grating we use a diffraction grating and an opaque projector. For the experiment realization we need to cover the surface of the projector by a piece of thick paper. We leave a circular opening of diameter about 3 cm. Then we put a single slit on the opening and we focus the image of the slit. Then we put a diffraction grating close to the projector objective the way that the lines of grating are parallel to the slit. On the wall there can be seen dark and bright shadows representing minima and maxima. The intensity of bright shadows decreases from the centre to the sides.

The experiment that can be easily realized also by students themselves is aimed at Newton's rings demonstration. We use two glasses from spectacles with close dioptre power. They can be e.g. one glass with zero dioptre power and the other one with 0,25 dioptres. We put the convex surface of the 0,25 dioptres lens on the concave surface of the other lens. At the area of their connection Newton's rings can be seen. Two lenses are held in hand and they are turned the way that the sky is

reflected on them. This way the interference on the thin air film can be easily demonstrated.

4 Computer-aided experiment

In a microcomputer based laboratory we can realize the demonstration of diffraction patterns from single slit to many-slits diffraction grating.

For the computer-aided experiment realization we need: laser pointer, optical bench equipped with moving clap, thread, holders, weight (40 g), screen, single slit, diffraction grating, angle position sensor, light sensor, computer equipped with IP COACH system.

In the experiment we use the light sensor for recording the light intensity of diffraction pattern and the angle position sensor for recording the position of the light sensor. The light sensor is mounted on the optical bench the way it can move along it and the angle position sensor is mounted at the end of the optical bench. The light sensor is connected with a thread to the weight through the angle position sensor so when the weight moves it turns the position sensor and makes the light sensor move as well. Behind the optical bench there is a screen mounted perpendicularly to the light waves. During the measurement the laser beam must fall on the light sensor.

When everything is set, we start measuring. We move the light sensor slowly along the diffraction pattern. Computer shows graphs of light intensity as a function of position (fig.1,2).

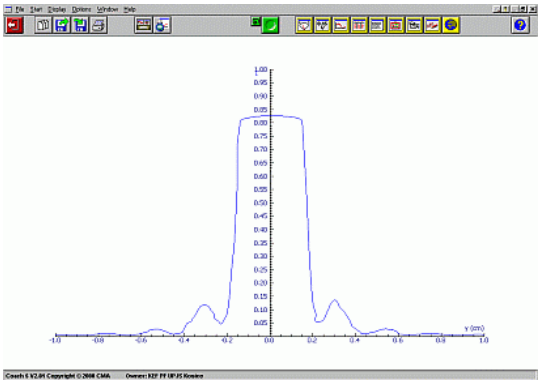

Fig.1 Diffraction pattern of single slit

5 Use of Java Applets

To enhance the understanding of interference and diffraction we can use one of the java applets available in wide range on Internet. They can model the behaviour of diffraction gratings of N slits where the student can set the number of slits, wavelength and the distance from the screen. The applets enable students to explore the diffraction patterns interactively (fig.3) [5]. The similar applets can be found in [6].

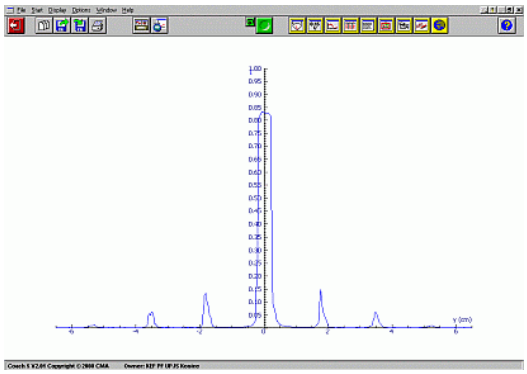

Fig. 2 Diffraction pattern of grating d=0,01mm

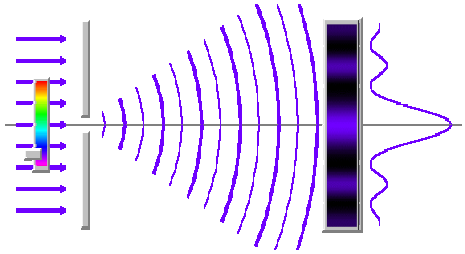

Fig.3 Java applet – Single slit diffraction

Conclusion

In the contribution we tried to show combination of different attitudes to the phenomenon of interference and diffraction explanation. There are several possible ways of multimedia tools presented that should enhance the mentioned phenomena understanding. This attitude can be used in other physical concepts explanation, e.g. boiling of water, free fall, etc but the range of the contribution does not allow to mention them in details.

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