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Research Article

DESIGNING COMPACT DISK AS AN ALTERNATIVE DIFFRACTION GRATING EXPERIMENT

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ABSTRACT

Simple diffraction grating experiments can be made using a compact disk as a diffraction grating. This diffraction grating can be used as an alternative to standard diffraction gratings in physics experiments. The diffraction grater is made up of a narrow gap that is adjacent to each other in large quantities. A beam of coherent light is passed through a diffraction grating it will produce a diffraction pattern on the screen. This diffraction grating experiment is used to determine the magnitude of the diffraction grating constants (d) and the capacity of the compact disk data. Variations of diffraction gratings are used using compact disk and Digital Versatile Disk. Coherent light from a laser with a wavelength of 365 nm is transmitted through a compact disk and Digital Versatile Disk. With variations of the grating distance to the screen (y) a bright dark pattern is generated on the screen. The light dark pattern is a diffraction phenomenon. the analysis of the calculation of diffraction grating laser pointer gained wide or CD lattice constants of (2800.1 ± 8.81) nm with a relative error 8.81%, while the width of the grid or DVD lattice constants of (1921.4 ± 1.76) nm with a relative error of 1.76%. the capacity of CD earned as much as 226 Mb CD and capacity DVD earned as much as 480 Mb. Therefore, DVDs and CDs can be used as a diffraction grating. Through experiments laser diffraction grating can be calculated capacity of CD/DVD.

INTRODUCTION

One of the obstacles the learning process in schools are often found is the lack of supporting facilities, including the media learning and practical tools. Schools in large cities generally have teaching and laboratory facilities more adequate than schools that are in remote areas. Implementation of learning physics ineffective usually caused by lack of availability of practical tools. This is due to the price of expensive lab instruments spectroscope as a practical example of light diffraction.

Spectroscope is a tool to see the light spectrum. Light other than material nature as well as a wave having a frequency, wavelength, and speed. Sunlight is a mixture of all colors by adjusting the intensity of black body radiation pattern. The diffraction grating serves decipher mixed light into a rainbow.

Diffraction can occur when a wave or a beam of light passing through a slit or more with a width equivalent to the wavelength of the incident light. This is in accordance with the general equation of diffraction:

$$d \sin \theta = m\lambda \quad (1)$$

d is the distance between each slit in the grating,
θ (theta) discharge angle of light,
λ(Lambda) wavelengths.

The coefficient m is an integer that indicates the order of diffraction. If m is equal to zero, meaning there is no deflection of light and m is equal to one means the first pattern and so on.

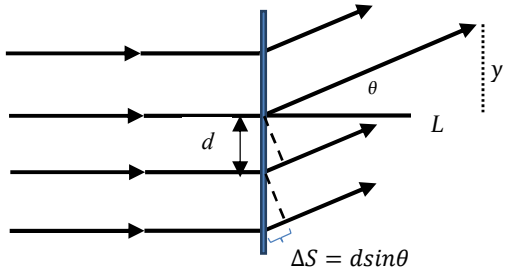

Figure 1 Deflection Light On Diffraction Grating

The diffraction grating is a thin layer that consists of a lot of loopholes, so that when viewed with the naked eye will not be visible. The cracks on the grid have the same distance from each other. If a light beam through a small gap in the

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diffraction grating will occur. Maximum diffraction pattern on a screen will appear in the form of a bright line called the maximum interference generated by the many loopholes. This occurs when different optical path of the diffracted light is a multiple of the wavelength of light that isΔSequal to λ, 2 λ, 3λ. For a small angle, the tangent of an angle equal to the sine of the angle, so that the sine values obtained in equation (2).

$$sin\theta \approx tan\theta = \frac{y}{L} \quad (2)$$

With,
L = distance gap to screen
y= Distance n the light of all of the bright center
Based on the equation (1) and (2) can be determined width or constant diffraction grating with Equation (3).

$$y = \frac{m\lambda}{d}L \quad (3)$$

Compact Disc(CD) and Digital Versatile Disk (DVD) is a digital information storage media. On the CD / DVD are very small pits and included a range of wavelengths of visible light. The pits are arranged in a spiral from the center of the disc and the track size of the data on the storage media can be estimated by using a laser beam and acts as a diffraction grating. With a number of innovations, DVDs and CDs can be used to diffracting visible light waves.

Purpose

The study aims to show that the CD or DVD can be used as a practical tool in learning the physics of diffraction grating. The lab can be seen from the data capacity for each CD or DVD.

METHOD

The method used by the researchers is to create a model and then test the model. The steps are as follows, namely experimental tools laser light source, a diffraction grating using CD and DVD, display, rulers, paper board and the light source. The experiment tools was designed as shown in Figure 2.

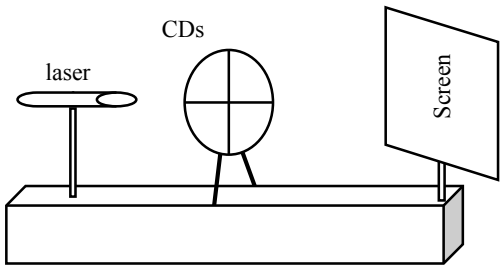

Figure 2 Illustration of practical tools diffraction grating using a CD or DVD

The laser beam is turned on with a pointer directed at the center of the grid and set the distance L to form an interference pattern on the screen. Measure and record the distance L, measure and record the value of Y, which is within the center of the light pattern to one of the first light, which is located on the right or left of center light. Changing the price of L and Y as much as 5 times.

Calculation of diffraction laser pointer on a CD / DVD and analyzed by repeated measurement result value:

$$d = \bar{d} \pm \Delta d$$

With,

$$\bar{d} = \frac{d_1 + d_2 + \cdots + d_n}{n}$$

$$\Delta d = \frac{1}{n}\sqrt{\frac{n\sum d^2{}_i - (\sum d_i)^2}{n-1}}$$

Relative error: $\frac{\Delta d}{\bar{d}} \times 100\%$

The number of pits in the CD / DVD can be seen by comparing extensive CD / DVD and extensive pitnya using the equation:

$$jumlah\ pit = \frac{Luas\ CD}{Luas\ Pit}$$

The data capacity of a CD / DVD can be found using the equation:

$$1\ byte = \frac{1}{8} jumlah\ pit \quad (4)$$

Error value = $\frac{[literatur - percobaan]}{literatur} \times 100\%$

RESULT

The measurement results with λ = 365 nm and m = 1 for CDs are presented in Table 1, while DVD is presented in Table 2.

Table 1. Results of the diffraction grating light on CD

No.	$\lambda = 365\ nm$		d (nm)
	Y (cm)	L (cm)	
1.	1.3	10	2807.7
2.	1.9	15	2881.6
3.	2	20	3650
4.	4.2	25	2172.6
5.	4.4	30	2488.6
			$\bar{d}$=2800.1

Table 2. Results of the diffraction grating light on DVD

No.	$\lambda = 365\ nm$		d (nm)
	Y (cm)	L (cm)	
1.	1.8	10	2027.8
2.	2.9	15	1887.9
3.	3.7	20	1972.9
4.	4.9	25	1862.2
5.	5.9	30	1855.9
			$\bar{d}$=1921.4

From the analysis of the calculation of diffraction grating laser pointer gained wide or CD lattice constants of (2800.1± 8.81) nm with a relative error 8.81%, while the width of the grid or DVD lattice constants of (1921.4± 1.76) nm with a relative error of 1.76%.

DISCUSSION AND CONCLUSION

The capacity of data that can be stored in a CD and DVD can be estimated using laser diffraction. If there is a light that has a certain wavelength passes through a narrow gap with the long wave light rays coming, there will be a deflection or spreading the light. On the surface layer of CDs and DVDs that can be read, there is a pit with a gap that can be entered by the wave that has looked. The distance between the pits and pit width should allow the diffracted light wave diffraction on the grating.

The analysis was performed by determining the magnitude d of the data that have been obtained using equation (3). Furthermore, comparing the area of a CD / DVD with the area of the pit to look for the number of pits in one CD / DVD. Using equation (4), the data capacity of a CD / DVD can be known.

Of the five result on the CD in getting the value of d is 2.8 × 10-2 m with extensive CD 1.11 × 10-2 m and spacious pit CD 6.15 × 10-6m. Thus, the number of pit CD earned as much as 181 000, and 226 Mb CD capacity by 67.7% error value.

Of the five result on DVD in getting the value of d is 1.9 × 10-2 m with extensive DVD 1.11 × 10-2 m and spacious pit DVD 2.9 × 10-6m. Thus, obtained as a DVD pit number 384 000, and 480 Mb DVD capacity by 89.7% error value. DVDs and CDs can be used as a simple spectroscope and a diffraction grating. Through experiments laser diffraction grating can be calculated width of the grid.

Because DVDs and CDs easily available and inexpensive valuable and can be designed very simple to experiment a diffraction grating, the researchers suggested that the diffraction grating DVDs and CDs can be used as a practical tool in schools. Besides, it still needs further research why the diffraction grating on the DVD is denser than CDs.

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