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Study of Solar energy dependent determination of wavelength using LASER source

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ABSTRACT
The study of Sun light i. e. solar energy utilized to convert it into electrical energy by means of using solar panel at small scale. The Sun is naturally a source of heat energy by using the fission process inside it, enabling it to generate vast amounts of heat energy. We used the solar panel or photovoltaic (PV) panels on which surface the sun light falls after successfully falling on its surface the solar (Photon) energy converts into electrical energy i.e., photon conversion into electrical energy. The generated electricity can be stored in batteries or it can be utilized directly. We reported the wavelength of LASER light using solar energy conversion into electrical energy. We planned this investigation to be further designed for large scale production of solar energy by designing large sized solar panels or photovoltaic panels.
Keywords: Solar energy, LASER source, Wavelength, Photons, photovoltaic panels.

I. INTRODUCTION

The supply and demand of energy determine the course of global development in every sphere of human activity. Sufficient supplies of clean energy are intimately linked with global stability, economic prosperity, and quality of life.

Our primary source of clean, abundant energy is the sun. Solar energy is radiant light generated from the Sun that is harnessed utilizing a wide range of technologies including solar power to generate electricity [1],solar water heating, solar architecture [2]. The rotation of the sun is made evident by the sunspots that cross the solar disk in about two weeks, then disappear, and then reappear at the opposite limb (or curved edge) two weeks later. Observations of the sun reveal that different parts of the Sun rotate at different speeds. For example, the equatorial rotational period is 25.38 days, but at latitude 35°, the period is 27 days. Sunspots aren't seen at higher latitudes, but use of the Doppler effect for light observed at latitude 75° reveals a longer period of 33 days [3-6]. This differential rotation reveals that the Sun is not solid, but is gaseous or liquid.

The total energy emission of the sun, or luminosity, is 4×10^{26} watts. This is found by measurement of the solar constant, the energy received per square meter (1,360 watts/m ^{2}) by a surface perpendicular to the direction of the Sun at a distance of 1 astronomical unit and multiplying by the surface area of a sphere of radius 1 AU. The term *solar constant* implies a belief in a constant luminosity output for the Sun, but this may not be completely correct. The Maunder minimum, an era of very few detectable sunspots in the century after their discovery in 1610, suggests the solar sunspot cycle was not in operation at this time. Other evidence suggests the presence or lack of a solar cycle is related to changes in the solar luminosity output. Past ice ages of the Earth could be the result of a diminished solar luminosity output. Monitoring of the solar constant in the last decade from spacecraft suggests there are variations on the order of one-half percent. Thus, our Sun perhaps is not as constant a source of energy as was once believed [7].

The temperature of the solar "surface" (the photosphere) can be defined in several ways. Application of the Stefan-Boltzman Law (energy emitted per second per unit area = σT^4) yields a value of 5,800 K. Wien's law, which relates the peak intensity in the spectrum to the temperature of the emitting material yields T = 6,350 K. This discrepancy between the two values results for two reasons. First, the emitted light comes from different depths in the photosphere and thus is a mixture of emission characteristics of a range of temperatures; thus, the solar spectrum is not an ideal black body spectrum. Second, absorption features significantly alter the spectrum from the shape of a black body spectrum.

The strongest absorption features were first studied by Fraunhofer (1814) and are called **Fraunhofer lines**. Absorption lines from over 60 elements have been identified in the solar spectrum. Analysis of their strengths gives temperatures at different depths in the photosphere and chemical abundance ratios [8-10].

II. EXPERIMENTAL METHOD

Figure 1: Experimental setup Solar energy dependent determination of wavelength using LASER source with optical bench.

The optical bench is used to assemble the experimental setup solar energy dependent determination of wavelength using LASER source[11-14]

The above experiment was performed by our B.Sc. Second year Physics (optional) student in the department of physics. The solar cells (rechargeable) were fully charged by means of putting solar panel in sunlight as shown in figure 2.

Figure 2. Production of LASER beam using Solar energy or cell for determination of wavelength.

After putting the solar panel approximately two hours in the vicinity of sunlight the solar cells fully charged. We connected the solar energy assembled kit as shown in fig.2.The LASER light is illuminated as shown in fig.2.

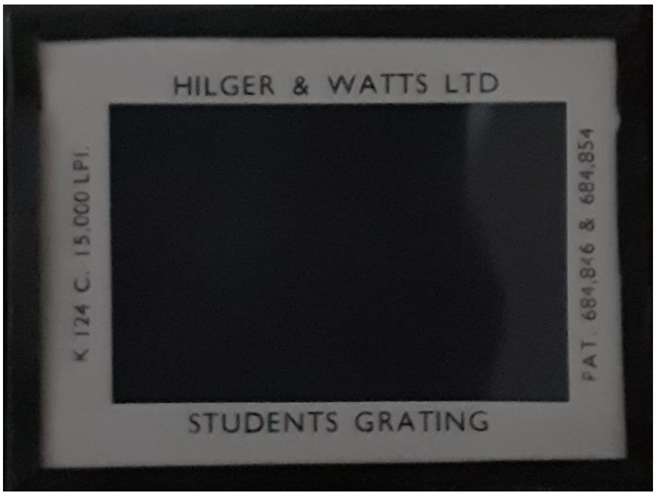

Figure 3. The grating with 15000 LPI, LASER beam fall grating to calculate its wavelength.

Figure 4. LASER beam falls on grating, it is generated from a Solar unit for determination of wavelength.

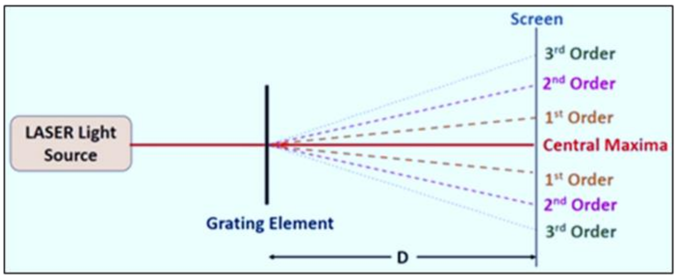

Figure 5. Schematic diagram of LASER diffraction by plane diffraction grating.

The figure 5 shows the schematic diagram of LASER diffraction by plane diffraction grating with its various components including laser source, grating screen. Apparatus used are plane diffraction grating, laser source, scale and prism table.

Figure 6. Order of LASER beam spots when diffraction taking place from plane diffraction grating.

The figure 6 indicates the spots of LASER beam obtained by plane diffraction on screen.

III. RESULT AND DISCUSSION

Properties of the Sun

The energy that we receive from the Sun dictates the environment on Earth that is so important to humanity's existence. But to astronomers, the Sun is the only star that can be studied in great detail; thus, studying the sun is vital to the understanding of stars as a whole. In turn, the study of stars shows us that our Sun is merely an average star, neither exceptionally bright nor exceptionally faint. Evidence from other stars has also revealed their life histories, allowing us a better understanding of the part and future of our particular star [15-20].

The solar diameter equals 109 Earth diameters, or 1,390,000 kilometers. What we see when we look at the sun, however, is not a solid, luminous surface, but a spherical layer, called the photosphere, from which the bulk of the solar light comes (see Figure 4). Above the photosphere the solar atmosphere is transparent, allowing light to escape. Below the photosphere, the physical conditions of the material of the solar interior prevent light from escaping. As a result, we cannot observe this interior region from the outside. The solar mass is equivalent to 330,000 earth masses, or 2×10^{30} kg, for a mean or average density (mass/volume) of 1.4 g/cm ^{3}[20-26].

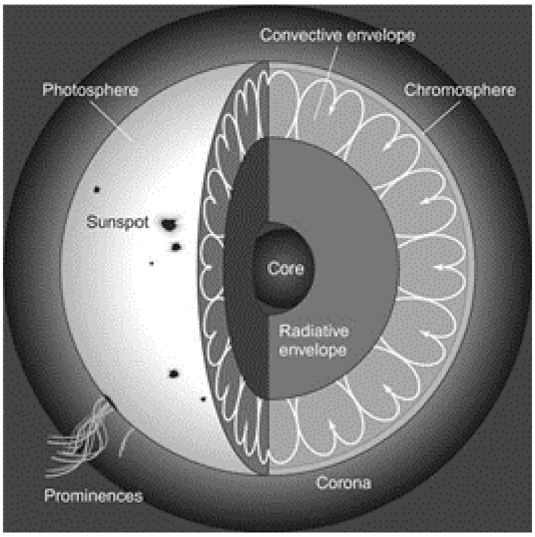

Figure 6. The cross section of the Sun.

Figure 6. shows the cross section of the sun with its internal view.

The formula used to calculate wavelength of LASER beam using diffraction grating is calculated from the Bragg's diffraction equation

$$\lambda = \frac{2.54 \, sin\theta}{n \, N}$$

Where λ =LASER wavelength

θ=Diffraction angle

n=Diffraction order

N=Number of parallel lines per inch in grating element =15000 $N = \frac{15000}{2.54} \, cm$

D=14 for first and second order LASER spot observed on the screen

Table 1. Experimental data obtained from LASER source.

Diffraction order	Distance (Left) D_1 cm	Distance (Right) D_2 cm	Mean distance $Dm = \frac{D_1 + D_2}{2}$ cm	$sin\,\theta = \frac{Dm}{\sqrt{(D_m^2 + D^2)}}$	$\lambda = \frac{2 \cdot 54\, sin\, sin\, \theta}{n \cdot N}$ (cm)
1	5	5	5	0.371	6208
2	12	11	11.5	0.677	5731
				Average	6009 A.U.

IV. CONCLUSION

We used the solar panel or photovoltaic (PV) panels on which surface the sun light falls after successfully falling on its surface the solar (Photon) energy converts into electrical energy i.e., photon conversion into electrical energy. The generated electricity can be stored in batteries or it can be utilized directly. We successfully reported the wavelength of LASER light using solar energy conversion into electrical energy. This investigation can be further designed for large scale production of solar energy by designing large sized solar panels or photovoltaic panels.

We successfully determined the wavelength of LASER light determined using plane diffraction grating by means of supplying solar energy to illuminate LASER light.

The most common theoretical value wavelength of laser pointers red is 11905 A.U.

Our reported value of laser wavelength is 6009 A.U. as shown in table 1.

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