PHY F214 PHYSICS LAB-6 REPORT SEM-1 2017-2018

EXP NO. =8   EXP NAME =LASER CHARACTERISTICS

NAME-UTKARSH SINGH

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AIM-

1. **To verify the profile of a laser beam is Gaussian.**
2. **To determine the spot size and beam divergence.**

Apparatus used:

Laser,photodetector on translation stage,amplifier,knife edge with mount.

Principle used:

The beams intensity is recorded with the help of a photodetector and the voltage across it is measured the greater the voltage the greater the intensity at a particular point . The laser is an almost perfectly coherent light source and it's intensity varies as a Gaussian function. The shape of the beam is like a cone.They are produced by stimulated emission.

Procedure and observation:

First all of we align the beam horizontally ,parallel to the bed of the bench.the photovoltage is measured through a multimeter and the readings of the distance moved and the voltage measured is noted down .The photocurrent is expected to vary as Gaussian function of the position of the detector from the center of the beam. Then the spot sizes at two locations are measured and from this the divergence of the beam is calculated.

Distance from laser source is 40cm.

distance (cm)	voltage(V)

|	
0	0.07
0.02	0.112
0.04	0.135
0.06	0.209
0.08	0.33
0.1	0.599
0.12	1.056
0.14	2.111
0.16	3.206
0.17	4.38
0.18	5.45
0.19	7
0.2	8.53
0.206	9.43
0.212	10.33
0.216	11.12
0.22	11.97
0.224	12.41
0.228	12.76
0.232	12.8
0.238	12.82
0.242	12.61
0.246	12.2
0.252	11.13
0.256	10.3
0.26	9.59
0.27	8.88
0.28	7.18
0.29	5.4
0.3	4.15
0.31	3.09
0.32	2.24
0.33	1.58
0.34	1.14
0.36	0.49
0.38	0.209
0.39	1.06
0.4	0.07
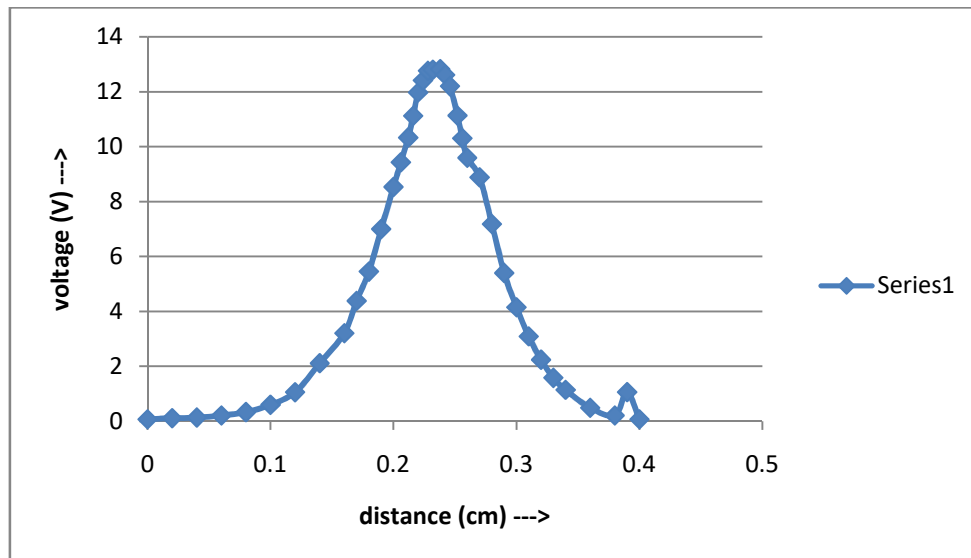
Graph of voltage vs distance

Here we can see that the voltage varies as a Gaussian function and as voltage is proportional to the intensity of a laser beam hence the intensity of the laser beam also varies as a Gaussian function.There are slight displacements from the ideal condition at some points due to human errors and the effect of the voltage that is produced by the outside light other than the laser.because photodetector measures a slight voltage even when the laser beam is off.

For the distance of 80 cm

distance (cm)	volatge (V)
0	
0.01	0.08
0.02	0.108
0.03	0.152
0.04	0.237
0.044	0.372
0.048	0.389
0.052	0.414
0.056	0.48
0.066	0.578
0.086	0.76
0.094	1.54
0.104	1.941
0.114	2.32
0.122	2.573
0.126	2.611

|	
0.13	2.666
0.134	2.711
0.138	2.738
0.142	2.718
0.154	2.697
0.164	2.678
0.172	2.58
0.182	2.33
0.192	1.93
0.232	1.57
0.242	0.95
0.252	0.63
0.262	0.509
0.272	0.301
0.292	0.28
	0.16
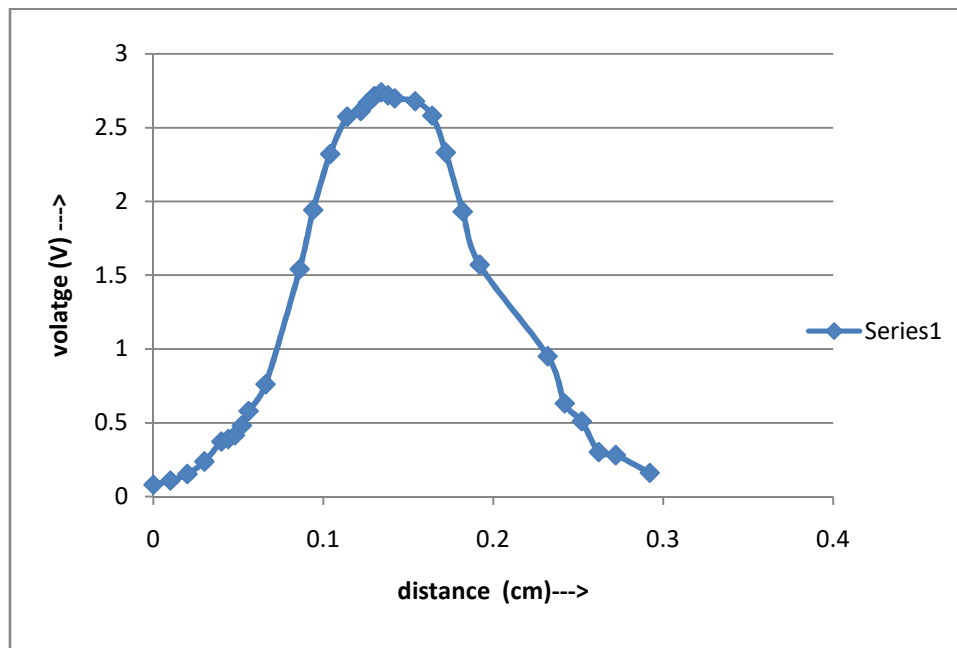
Graph of voltage across photodetector vs distance moved

Here we can see that the voltage varies as a Gaussian function and as voltage is proportional to the intensity of a laser beam hence the intensity of the laser beam also varies as a Gaussian function.There is deflection from the ideal curve due to various errors such as the manual errors in reading the multimeter as the voltage keeps fluctuating many a times and there may be some backlash error that gets generated when we move the screw gauge.

Then we had put two converging lenses of focal lengths f1=5cm and f2=20cm in between the laser and the photodetector which were kept at 80 cm distance and the beam was converged keeping f1 and f2 at 25 cm distance.

distance (cm)	voltage(V)
0	0.073
0.04	0.107
0.08	0.254
0.09	0.302
0.1	0.35
0.11	0.404
0.12	0.465
0.13	0.56
0.14	0.657
0.15	0.762
0.16	0.835
0.17	0.863
0.18	0.916
0.19	0.95
0.2	0.965
0.22	0.954
0.23	0.93
0.24	0.896
0.26	0.806
0.27	0.748
0.28	0.68
0.3	0.553
0.31	0.48
0.32	0.39
0.33	0.34
0.34	0.286
0.36	0.194
0.4	0.078
0.42	0.04
0.44	0.012
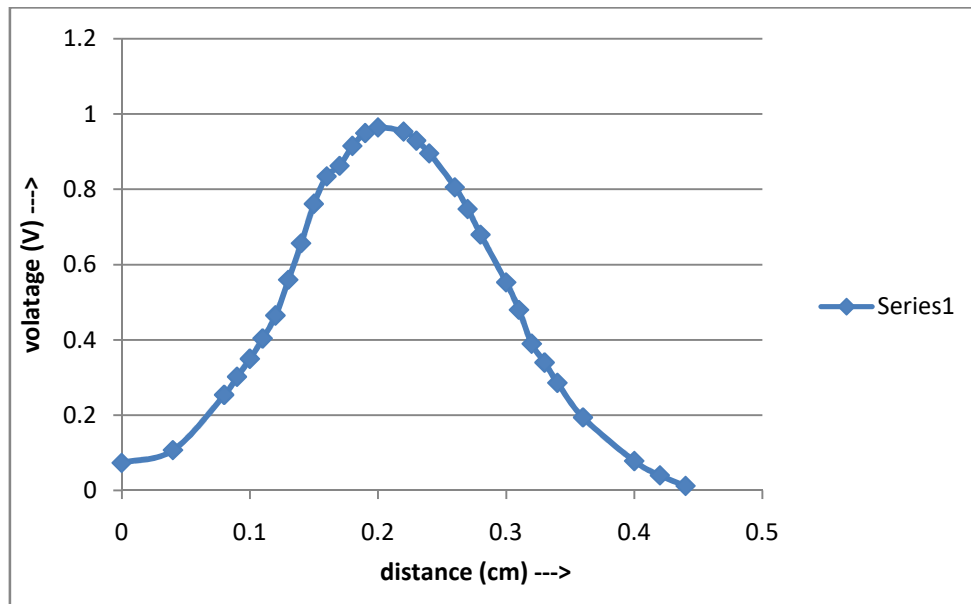
Graph of voltage across photoresistor vs distance measured

Here we can see that the voltage varies as a Gaussian function and as voltage is proportional to the intensity of a laser beam hence the intensity of the laser beam also varies as a Gaussian function.There are slight displacements from the ideal condition at some points due to human errors and the effect of the voltage that is produced by the outside light other than the laser.because photodetector measures a slight voltage even when the laser beam is off.

Here we are trying to see whether after apllying the converging lenses does the spot size of the laser beam decreases or not as compared to the spot size at 80 cm distance.

Distance of photodetector from the laser source (cm)	Maximum voltage(V)	(max voltage)/e^2 (V)	X1(cm)	X2(cm)	Spot size=(x2-x1)/2 (cm)
40	12.82	1.735	.13287	.32765	.097391
80	2.738	.371	.039926	.25863	.16935
80(with the converging lenses)	.965	.1306	.046422	.38186	.10772

now the divergence = d2-d1/x2-x1

d1=.19478cm ,d2=.21870 cm, x1= 40 cm ,x2 = 80 cm

divergence= 3.0980×10^{-3} radians

so we can see that the spot size increase as we move farther away from the laser source and the spot size at 80 cm without the converging lens is greater than the spot size when the converging lens is put in between .

INFERENCE:

The spot size of the laser beam increases as we move farther and farther away from the laser source and the divergence of the laser beam is really small which makes it highly usable in laser cutting ,laser printing ,in operations and in many other fields.

The intensity profile of a laser beam is basically a Gaussian and is the maximum at the center of the beam.

ERRORS:

1. There may be various human errors such as while measuring the voltage across the photodetector as the voltage keeps on fluctuating so there might be some errors .
2. There may be some backlash errors generated while moving the screw gauge.
3. There will also be an error in the voltage reading as even when the laser is not on there may be some voltage reading due to the light source from outside.
4. There may be some systematic errors in the laser beam emitter as to not emitting perfect laser or in the markings of the screw gauge.