Date 8/3/21

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Experiment - 7

Aim:

To calculate the beam divergence and spot size of the given laser beam.

Theory:

LASER is the acronym for Light Amplification by Stimulated Emmission of Radiation. It is a mechanism for emmiting electromagnetic radiation via the process of stimulated emmission.

LASER BEAM PARAMETERS

The light emmitted by lasers is unified to a rather narrow beam. With covering distance, it slowly diverges or fans out.

If d_2 and d_1 are diameters at two distances z_1 and z_2 respectively, from the laser source, then

$$\text{Divergence Angle} = \frac{d_2 - d_1}{z_2 - z_1}$$

SPOT SIZE

Spot size is the radius of the beam itself. Beam diameter is defined as the distance over which the intensity of beam equals $1/e^2$ (0.135) of the maximum radiance.

Teacher's Signature:

Observation table :

Distance $(x) \times 10^{-2}$	$z = 75$ cm	$z = 100$ cm	$z = 150$ cm	$z = 200$ cm
0	0.0350	0.0010	0.229	2.179
1	0.6030	0.0050	0.775	3.882
2	51.4180	0.0340	1.774	6.798
4	93.0350	01.1990	8.730	14.697
6	0.6030	9.4950	15.780	21.362
8	51.4180	55.9990	49.905	40.334
9	93.5320	82.1460	58.022	44.185
10	120.0480	90.4310	60.575	45.535
11	93.5320	78.2930	56.786	43.598
12	51.9180	50.6250	47.802	39.834
14	0.6030	12.0220	23.453	26.643
16	0.0350	3.5180	14.947	20.021
18	0	0.280	7.625	14.157
20	0	0.0010	0.310	2.315

Calculations :

Spotsize :

$z = 75$ cm, $(1.297 - 0.7024) \times 10^{-4} = 0.593$ mm

$z = 100$ cm, $(1.418 - 5.860) \times 10^{-4} = 0.0822$ mm

$z = 150$ cm, $(1.611 - 3.825) \times 10^{-4} = 0.1226$ mm

$z = 200$ cm, $(1.815 - 1.876) \times 10^{-4} = 0.1609$ mm

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Procedure :

- Select the desired laser source.
- fix the detector at a distance z.
- for a fixed distance z, change distance x, and note the current reading from the detector.
- Draw the graph and calculate beam divergence and spot size.

Result :

Beam Divergence = 0.40306 .

Spot size :

z = 75 cm, 0.0593 mm

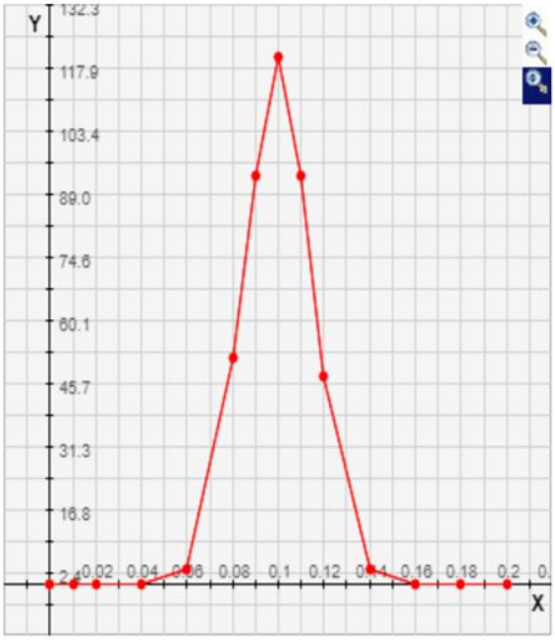
z = 100 cm, 0.0822 mm

z = 150 cm, 0.1226 mm

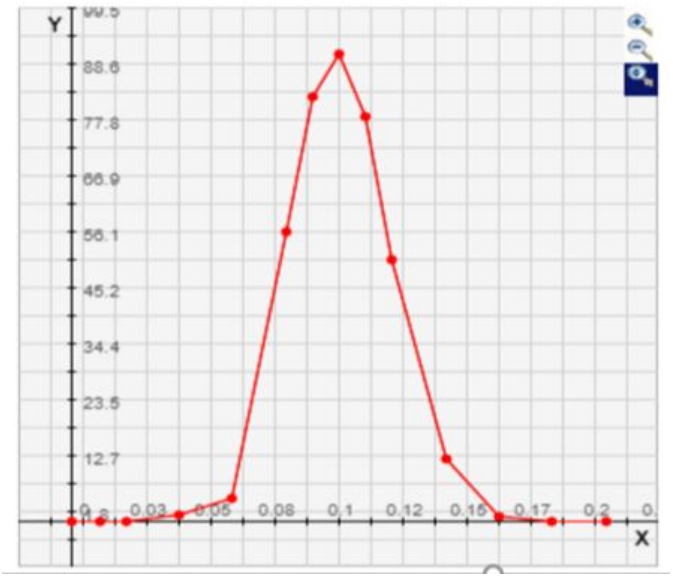
z = 200 cm, 0.1609 mm .

Teacher's Signature:

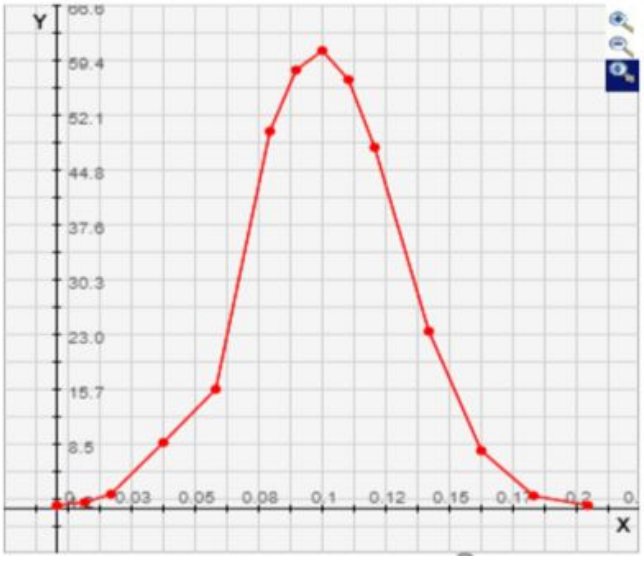
Z = 75 cm



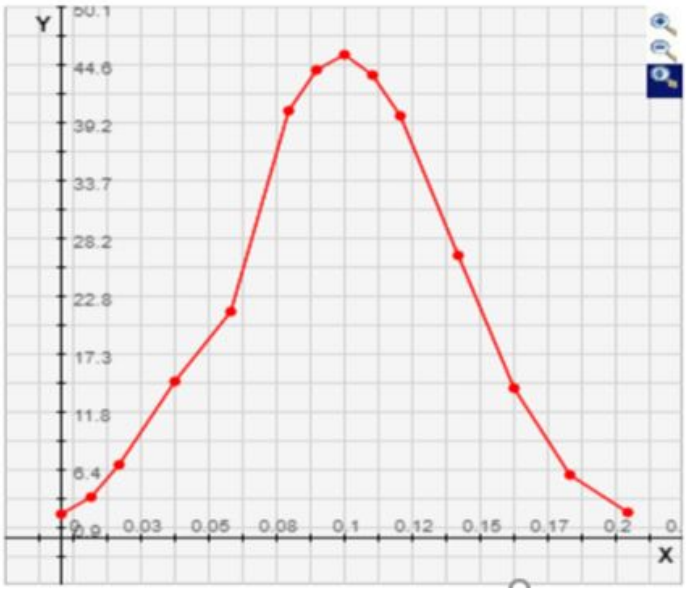
Z = 100 cm

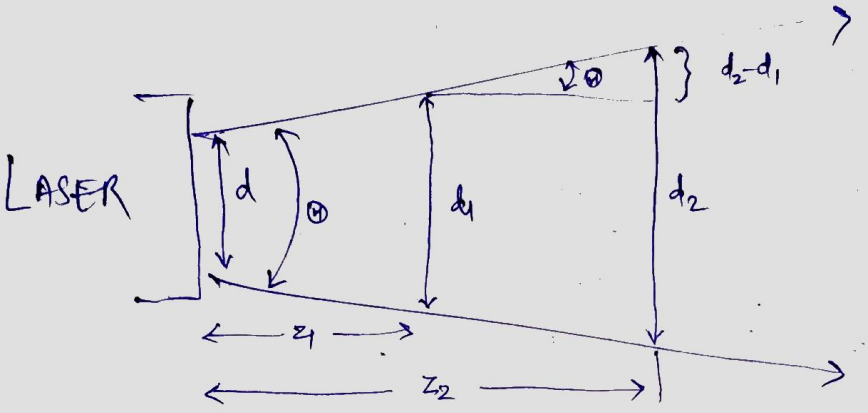


Z = 150 cm



Z = 200 cm





$W_0 = 6.553 \times 10^{-3} = 0.000\,6653$ mm

Beam Divergence $= \frac{\lambda}{\pi W_0} = \frac{632.8 \times 10^{-9}}{3.14 \times 0.0006653}$

$= 0.40306$.