

EXPERIMENT No. –

Experiment Title: - Angular Divergence of LASER Beam

Aim: - To determine the **angular divergence of laser beam** for a given laser source.

Apparatus required: -

S. No.	Name of equipment	Specifications/Purpose	Quantity	Remark
1	He-Ne or Diode Laser	Light source	1	
2	Optical Bench	Supports equipment	1	
3	Screen	Displays laser spot mounted on a movable stand	1	
4	Meter Scale	Distance measurement	1	
5	Vernier Scale/Ruler	Spot diameter measurement	1	
6	Graph Sheet	Observation and plotting	1	

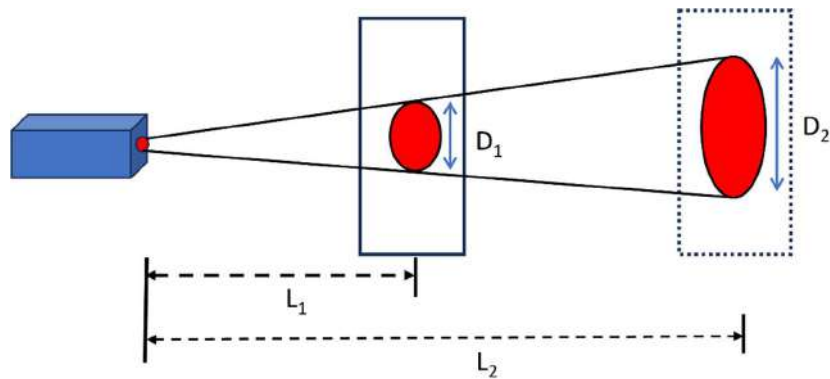
Theoretical Background: -

A laser produces light that is highly directional and travels almost parallel to its propagation direction. However, no practical laser beam remains perfectly parallel. As the beam propagates through space, its diameter gradually increases. This gradual increase is called the **Angular Divergence of the Laser Beam**. The divergence occurs because of diffraction and the finite diameter of the laser cavity.

Laser beam divergence is one important parameter to know for laser manufacturers and users alike who need to take control of their laser spot size. From laser welding applications to wafer dicing or eye surgery, knowing your beam divergence is a must for building a functional setup and directing the energy precisely where it is needed for a given process.

The angular divergence of a laser beam is determined by how much the beam expands as it travels away from the laser aperture. It is measured as the angular spread of the beam, often visualized as a cone with the tip at the laser source.

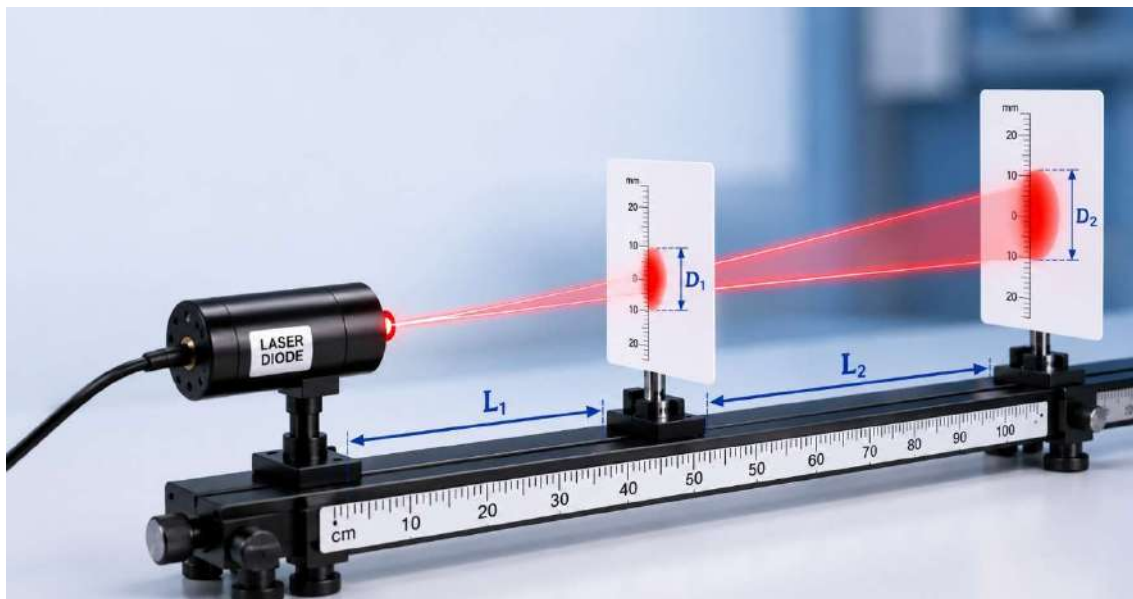
If the initial diameter of the laser beam at the exit aperture is D_1 at a distance L_1 , and the diameter grows to D_2 at a further distance L_2 , the angular divergence (θ) can be calculated using simple trigonometry.



The formula to calculate the **laser beam divergence experiment** angle is given by:

$$\theta = \frac{D_2 - D_1}{L_2 - L_1}$$

Experimental set-up: -



Procedure: -

1. Place the laser source securely on one end of the optical bench.
2. Align the laser source horizontally.
3. Set up the screen covered with a sheet of graph paper.
4. Keep the screen close to the laser.
5. Measure distance L_1 of the screen from the laser exit aperture.
6. Switch on the laser source. **Note:** *Never look directly into the laser beam.*
7. Observe the circular spot formed on the graph paper.

8. Carefully mark the boundaries of the main central spot on the graph paper
9. Measure the diameter of the spot along both the horizontal and vertical axes to find the average diameter D_1 .
10. Move the screen further away to a new distance L_2 .
11. Mark the boundaries of the expanded laser spot at this new position and record its diameter D_2 .
12. Repeat the process for at least five different distances to ensure statistical accuracy.
13. Calculate the angular divergence for each set of readings using the formula and find the mean value.

Observations Table: -

Wavelength of Laser used -

Laser Type-

S. No.	Distance b/w source and screen (at 1 st position) (L_1) cm	Diameter of the beam spot (at 1 st position of screen)			Distance b/w source and screen (at 2 nd position) (L_2) cm	Diameter of the beam spot (at 2 nd position of screen)			$\theta = \frac{D_2 - D_1}{L_2 - L_1}$ (in rad)
		Horizontal diameter (a)	Vertical diameter (b)	$D_1 = (a + b) / 2$ cm		Horizontal diameter (c)	Vertical diameter (d)	$D_2 = (c + d) / 2$ cm	
1									
2									
3									

Calculations:

Mean of the Angular divergence calculated

$$\theta = \frac{\theta_1 + \theta_2 + \dots + \theta_n}{n}$$

Results:

The angular divergence of the given laser beam is approximately rad.

Precautions: -

1. Never look directly into the laser beam.
2. Keep the laser properly aligned.
3. Measure beam diameter carefully.
4. Avoid vibrations during measurements.
5. Perform the experiment in a dark room.
6. Keep the screen perpendicular to the beam.
7. Record multiple observations.