Experiment 1 Spectral Characteristics Of Laser Light 雷射的特性

Translation: J D White (Bench 4)

1. Theory (See Online Links)

2. 實驗儀器 (Laboratory instruments)

Chinese	English Name	Label
氦氖雷射(含雷射架)	Helium-neon laser (with laser frame)	HeNe
45 deg 反射鏡組	45 degree mirror group,	
光學桌(含空壓機)	optical tables (including air compressor)	
可調式光圈	adjustable apertures (2)	
支撐棒	support rods,	
支撐座	support base,	
	Paper Screen	SCR
光度計	Photo-diode	PD
光孔罩	Light Hole Cover	
1 吋凸透鏡 f=25.4mm	convex lens f=25.4mm (ϕ=1") with mount	f
2 吋凸透鏡 F.L.100mm	convex lens f=100mm (ϕ=2") with mount	f
可調傾角鏡架	Tilt frame	
	glass plate	
底片	slide with grid pattern	
捲尺	Tape Measure	TM

3. 實驗目的 (Purpose)

- To become familiar with the basic characteristics of laser light

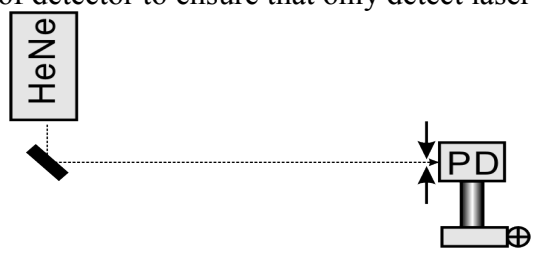
4. 注意事項 (Precautions)

- Due to laser cavity design, the laser beam is collimated (light does not diverge), the change in intensity over distance is minimal
- Whenever doing any intensity measurements, let the laser warm up for at least 30 minutes. This is because temperature changes in the cavity will result in slight displacement of mirrors as the laser temperature increases.

5. 實驗步驟 (Procedure)

5.1 光束特性 (Changes in output power as laser warms up)

a. Using 2 apertures ensure that the laser is parallel to the optical table (constant height beam)
b. Set up the detector to receive the laser beam and maximize signal
c. Put the aperture in front of detector to ensure that only detect laser beam (block scattered light)

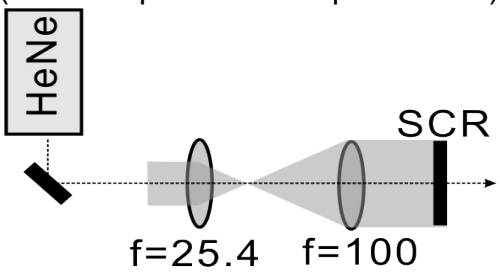


d. Turn off the laser and wait 10 minutes. Then turn laser on.
e. Continuously measure laser power for 15 minutes (fill in data sheet)

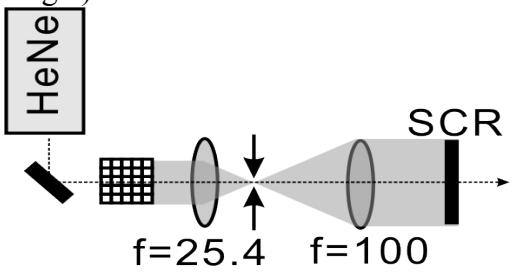
5.2 光束特性 (Beam Divergence)

a. Place a paper screen in the laser beam. Observe the distribution around the laser spot. Explain any unevenness
b. Measure the intensity dependence across the laser beam. Using the X-translation stage move the PD across the beam and record the intensity as move away from beam center. Find the distance at which the Intensity has dropped by 50%. Use this to calculate the divergence angle of the laser beam.
c. Using the tape measure, record the variation of spot size as a function of distance from the laser source. Using this data, calculate the divergence angle of the laser beam.
d. Compare the divergence angle obtained from the two measurements.

5.3 光束擴展器與空間濾波 (Beam Expander and Spatial Filter)



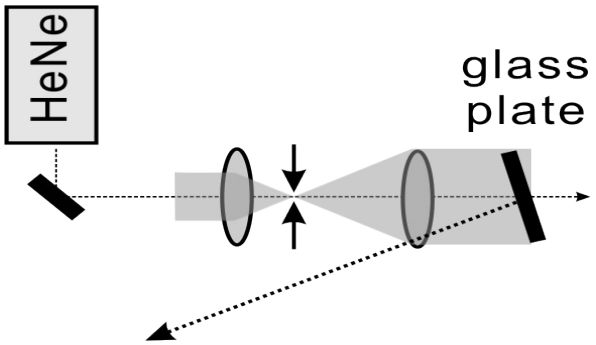
a. Place a lens in the laser beam to expand the beam to ϕ=10 cm diameter. Observe the beam distribution on the white paper. Take a photograph. Discuss the inhomogeneities in the laser beam
b. Making use of the f=25.4mm and f=100mm lens, expand the beam. Ensure that the final beam is parallel/collimated. (see Fig.2)



c. Place the following in the beam path (Fig. 3)
   1. Grid pattern before first lens.
   2. At the focal point of the first lens insert an aperture.
   3. Place a screen after 2nd lens to enable the image to be viewed clearly.
   4. Adjust the aperture size to see the grid pattern clearly on the screen.

5.4 反射干涉 (Reflection Interference)

a. Remove the grid pattern from the laser beam path



b. Place the glass plate in the expanded beam (after the f=100mm lens)

c. Adjust the angle of the mirror (vertical and horizontal) and observe the light reflected onto the wall. Observe how the interference fringes vary with angle. Record the information with the camera
d. Adjust the position of the f=100mm lens closer and farther from the aperture. Observe how the interference fringes vary. Record with a camera.

6. 實驗記錄 (Experimental Record)

6.1 光束特性 (Changes in output power as laser warms up)

Use 0.1mm aperture mask. Record at 30 s interval

Time (s)	0	30	60	90	120	150	180	210	240	270
Power										
Time (s)	330	360	390	420	450	480	510	540	570	600
Power										
Time (s)	630	660	690	720	750	780	810	840	870	900
Power										

6.2 光束特性 (Beam Divergence)

a. Use the 0.1mm aperture. The distance at which the laser Irradiance has dropped by 50%: _____
b. Scan the 0.1mm aperture across the beam. Locate the maximum intensity (I). Find the locations at which the intensity has dropped 50% (distance from center point of highest intensity)

	Left Side	Right Side
1		
2		
3		
4		
5		
Average		

c. Compare and compare the value of divergence calculated using the two methods

Distance:		Diameter:	

6.3 光束擴展器與空間濾波 (Beam Expander and Spatial Filter)

1. What is the relationship between the aperture size and the image on the screen?

6.4 反射干涉 (Reflection Interference)

1. If the glass is placed perpendicular to the beam, what will the interference fringes look like?
2. As one moves the lens, how do the interference fringes vary? Why?