Laser Applications (Make-up Lab)

Name_____ ID_____ TA_____

Partners_____

Date_____ Section_____

Please do not look into the laser directly. Set up the laser so that it is not at eye level.

1. Measuring of diameter of a wire:

➢ Formula

$$a = \frac{n\lambda}{\sin\theta}, \qquad \theta = \tan^{-1}\left(\frac{y_n}{D}\right)$$

where a is the diameter of the wire, n is the order of intensity maxima, λ is the wavelength of the laser, D is the distance between the wire and screen, and y_n is distance of n-th intensity maximum from the central maximum.

D = _____(feet) × 0.3048 + _____(inches) × 0.0254 ⇒ _____(meters)

$\lambda = 6.328 \times 10^{-7}$ (m)

n	left y_n	right y_n	Ave. y_n (left+right)/2	θ (=$\tan^{-1}y_n/D$)	a (diameter of the wire)
1					
2					
3					
4					
Average value of a ⇒					

How well do your values agree with each other and with the expected value of 1.57×10^{-4} m?

2. The coherency of laser beam:

Distance (feet & inches) ➔	Distance (m)	Diameter (m)

- The coefficient of coherency = _____

➢ **Quiz ☺** If the distance between the earth and moon is 3.9×10^8 m, what is the diameter of the laser spot?

_____ (m) _____(miles)

3. Measuring an altitude

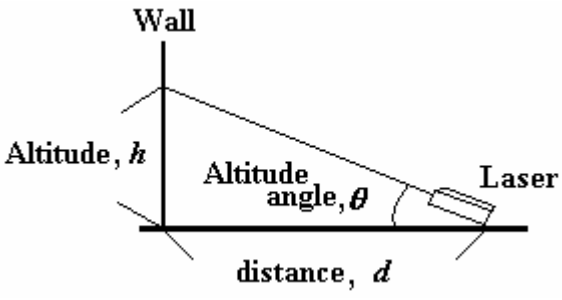

Figure 1

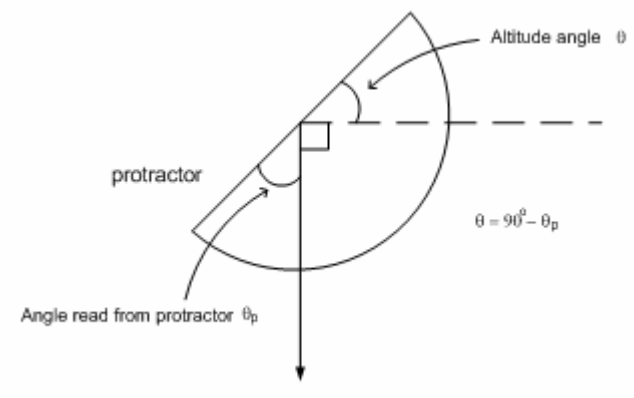

Figure 2

	Angle from protractor, (θ_p)	Altitude angle, (θ)	Distance from laser, (d)	Altitude, (h) $h = d \cdot \tan\theta$	Direct measurement of altitude $\pm\delta$
1					
2					
3					

*δ *is the radius of laser spot, which makes the uncertainty of measurement.*

➢ **Question**
Are the results within the uncertainties?

➢ **Quiz** ☺ If the distance between the laser apparatus and some mountain is 1500 m, what is the uncertainty of the altitude measurement? (Hint: Refer to the second part.)

Lab Procedure for Laser Applications

Please do not look into the laser directly. Set up the laser so that it is not at eye level.

1. <u>Measuring the diameter of a wire</u>

- **Hang the wire on a bar; to make it stable, hang a weight at the end of the wire.**
- **Illuminate the laser beam on the thin wire to get a diffraction pattern.**

- **Measure the distances from central max to several intensity maxima, left and right y_n. Also calculate the average.**
  You will use a caliper to measure them. The procedure is the same as the double-slit experiment.

- **Measure the distance between the wire and the screen.**

- **Use the wavelength of the laser beam, 6.328×10^{-7}(m), and the order *n* for each case; then, calculate the diameter of the wire with the provided formula.**

2. <u>The coherency of the laser beam</u>

- **Go to a corridor with the laser, screen, and caliper.**

- **Fix the laser on a certain place, and illuminate it onto the screen; then measure the diameter of the spot.**
  The separation distance should be about 2.0 m.

- **Repeat the previous procedure 5 times.**

- **Plot the graph, distance vs diameter; then find the slope (The coefficient of coherency) by using Excel.**
  The x-axis is the distance. The y-axis is the diameter. After obtaining the line equation, take the coefficient of the variable, x. If you are not sure how to get the slope with Excel, please refer to the manual provided by TA.

- **Calculate the laser spot diameter when you illuminate the moon.**
  1 mile = 1.61×10^3 m

3. <u>Measuring an altitude</u>

- **Set up the experimentation as in Figure 1.**

- **To measure the angle, use a protractor.**
  Refer to Figure 2.

- **While measuring the angle, mark the laser spot on the wall.**
  The radius will be the uncertainty. Please use a caliper to measure it.

- **Measure the distance between laser apparatus and wall.**
  See Figure 1.

<u>Lab report</u>

Answer the questions on the data sheet. Then feel free to discuss what you learned, what you didn't understand.