S. Kunal Keshan

RA2011004010051

ECE – A

Physics: Electromagnetic Theory, Quantum Mechanics, Waves and Optics- 18PYB101J

18.06.21

EXPERIMENT-8

PARTICLE SIZE DETERMINATON USING LASER.

AIM:

To determine the size of micro particles using laser.

APPARATUS REQUIRED:

Fine micro particles having nearly same size (say lycopodium powder), a glass plate (say microscopic slide), diode laser, and a screen.

PRINCIPLE:

When laser is passed through a glass plate on which fine particles of nearly uniform size are spread, due to diffraction circular rings are observed. From the measurement of radii of the circular rings are observed. From the measurement of radii of the observed rings, we can calculate the size of the particles.
Since for diffraction to occur size of the obstacle must be comparable with wavelength, only for extremely fine particles of micron or still lesser dimension, diffraction pattern can be obtained.

Diffraction is very often referred to as the bending of the waves around an obstacle. When a circular obstacle is illuminated by a coherent collimated beam such as laser light, due to diffraction circular rings are obtained.

If "r" is the radius of the first dark ring and "D" is the distance between the obstacle and screen on which the diffraction pattern is obtained, then.

$\tan\theta = \frac{r}{D}$, Since θ is very small in this

$$\theta = \frac{r}{D}$$

According to the theory, the diameter of the circular obstacle is given by,

$$2a = \frac{1.22\, n \lambda D}{r_n}$$

r_n - radius of n^{th} order dark ring
D: distance btwn obstacle and screen
λ: Wavelength of the laser light. (Å)

OBSERVATION:

Wave length of the laser light (λ) = 6328 Å

Diffraction order n = 1 and 2.

Distance between Obstacle and Screen D = (15, 20, 25) cm.

CALCULATIONS:

$$2a = \frac{1.22\, n \lambda D}{r_n}$$;

For n = 1

$$2a = \frac{7720.16 \times D}{r_n} \text{ Å}$$

For n = 2

$$2a = \frac{15440.32\, D}{r_n} \text{ Å}$$

1. For D = 15 cm

n = 1

$$2a = \frac{7720.16 \times 15 \times 10^{-2} \times 10^{-10}}{1.3 \times 10^{-2}} = 8.90\ \mu m.$$

n = 2

$$2a = \frac{15440.32 \times 15 \times 10^{-2} \times 10^{-10}}{2.6 \times 10^{-2}} = 8.90\ \mu m.$$

2. For D = 20 cm

n = 1

$$2a = \frac{7720.16 \times 20 \times 10^{-2} \times 10^{-10}}{1.7 \times 10^{-2}} = 9.08\ \mu m$$

n = 2

$$2a = \frac{15440.32 \times 20 \times 10^{-2} \times 10^{-10}}{3.5 \times 10^{-2}} = 8.82\ \mu m.$$

3. For D = 25 cm

n = 1

$$2a = \frac{7720.16 \times 25 \times 10^{-2} \times 10^{-10}}{2.2 \times 10^{-2}} = 8.77\ \mu m$$

$n = 2$

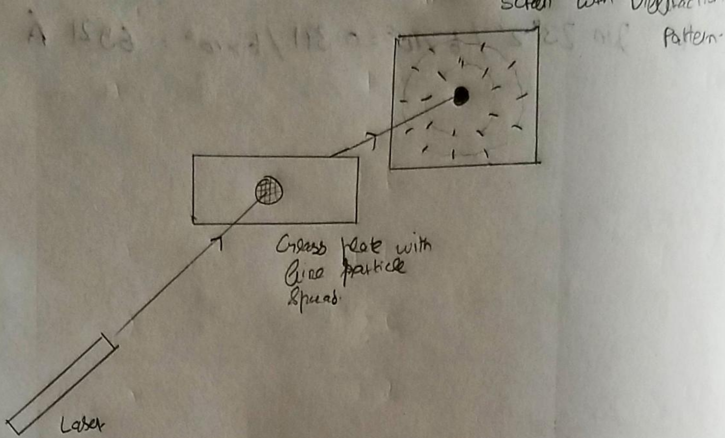
$$2a = \frac{15440.32 \times 25 \times 10^{-2} \times 10^{-10}}{4.4 \times 10^{-2}} = 8.77\ \mu m.$$

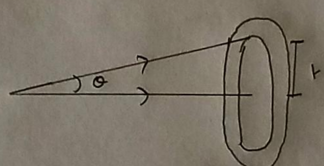
$$\text{Mean particle Size} = \frac{53.24}{6} = 8.87\ \mu m.$$

RESULT:

The average Size of the particles measured using laser $= 8.87\ \mu m.$

PARTICLE SIZE DETERMINATION USING LASER.





Particle Size Determination using Laser.

Table: Determination of Particle Size.

Sl. No	Distance (D) cm	Diffraction Order (n)	Radius of Dark Ring (r_n) cm	Particle Size (2a) μm
1.	15	1	1.3	8.92
		2	2.6	8.9
2.	20	1	1.7	9.08
		2	3.5	8.82
3.	25	1	2.2	8.77
		2	4.4	8.77
			Mean:	8.87