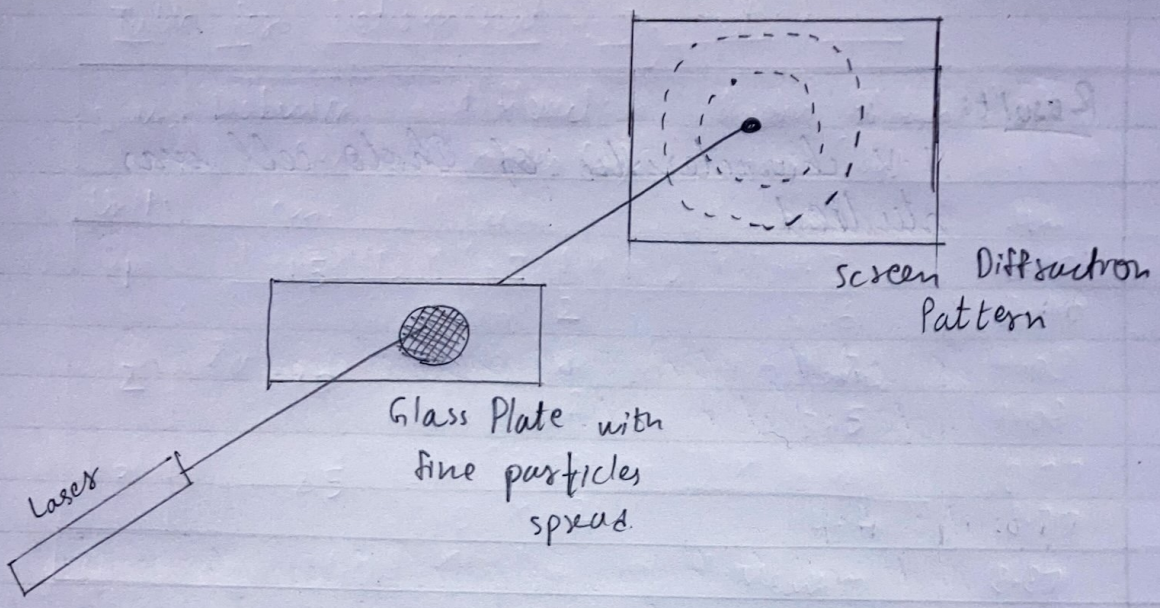
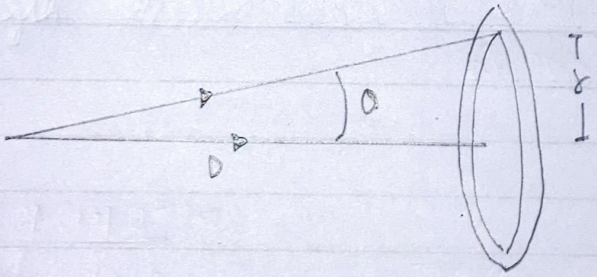
Experiment

Name .....




Particle size determination using laser

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# PARTICLE SIZE DETERMINATION 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 measurements of radii of the observed rings, we can calculate the size of the particles. Since for diffraction to occur size of the obstacle must

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## Table for Determination of particle size.

| Sr. No. | Distance (D). | Diffraction order (a). | Radius of dark ring ($\gamma_a$). | Particle size ($2a$) |
|---|---|---|---|---|
| Unit. | cm. | | cm | mm |
| 1 | 15 | 1 | 1.3 | 8.90 |
| | | 2 | 2.6 | 8.90 |
| 2 | 20 | 1 | 1.7 | 9.08 |
| | | 2 | 3.5 | 9.08 |
| 3 | 25 | 1 | 2.2 | 8.77 |
| | | 2 | 4.4 | 8.77 |
| | | | Mean | 8.87 |

OBSERVATION →

Wavelength of the laser light ($\lambda$) = 6328 $A^{\circ}$

MODEL CALCULATION

① For Particle Size

(i) $2a = \frac{1.22 \lambda D}{\gamma_n} = \frac{1.22 \times 1 \times (6328 \times 10^{-10}) \times (15 \times 10^{-2})}{1.3 \times 10^{-2}}$

$2a = 8.90 \times 10^{-6}$ m

$= 8.90$ mm

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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 "$y$" 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

$$\tan\theta = \frac{y}{D}$$

Since $\theta$ is very small in this experiment

$$\tan\theta = \theta = \frac{y}{D}$$

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(iii) $2a = \frac{1.22 \times 2 \times (6328 \times 10^{-10}) \times 15 \times 10^{-2}}{2.6 \times 10^{-2}}$

$\Rightarrow 2a = 8.90 \times 10^{-6}\ m$

or $8.90\ \mu m$

(iii) $2a = \frac{1.22 \times (1) \times (6328 \times 10^{-10}) \times 20 \times 10^{-2}}{1.7 \times 10^{-2}}$

$\Rightarrow 2a = 9.08 \times 10^{-6}\ m$ or $9.08\ \mu m$

(iv). $2a = \frac{1.22 \times (2) \times (6328 \times 10^{-10}) \times 20 \times 10^{-2}}{3.5 \times 10^{-2}}$

$2a = 9.08 \times 10^{-6}\ m$ or $9.08\ \mu m$

(v). $2a = \frac{1.22 \times (1) \times (6328 \times 10^{-10}) \times 25 \times 10^{-2}}{2.2 \times 10^{-2}}$

$= 8.77 \times 10^{-6}\ m$ or $8.77\ \mu m$

(vi) $2a = \frac{1.22\ (2) \times (6328 \times 10^{-10}) \times 25 \times 10^{-2}}{4.4 \times 10^{-2}}$

$= 8.77 \times 10^{-6}\ m$ or $8.77\ \mu m$

(c) Mean $= \frac{(8.90 + 8.90 + 9.08 + 9.08 + 8.77 + 8.77)\ \mu m}{6}$

$= 8.87\ \mu m$ or $8.87 \times 10^{-6}\ m$

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

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

where,

$r_n$ = radius of the $n^{th}$ order dark ring (m)

D = distance b/w the obstacle & the screen (m)

$\lambda$ = wave length of the laser light (Å).

RESULT →

The average size of the particles measured using laser = 8.87 μm

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