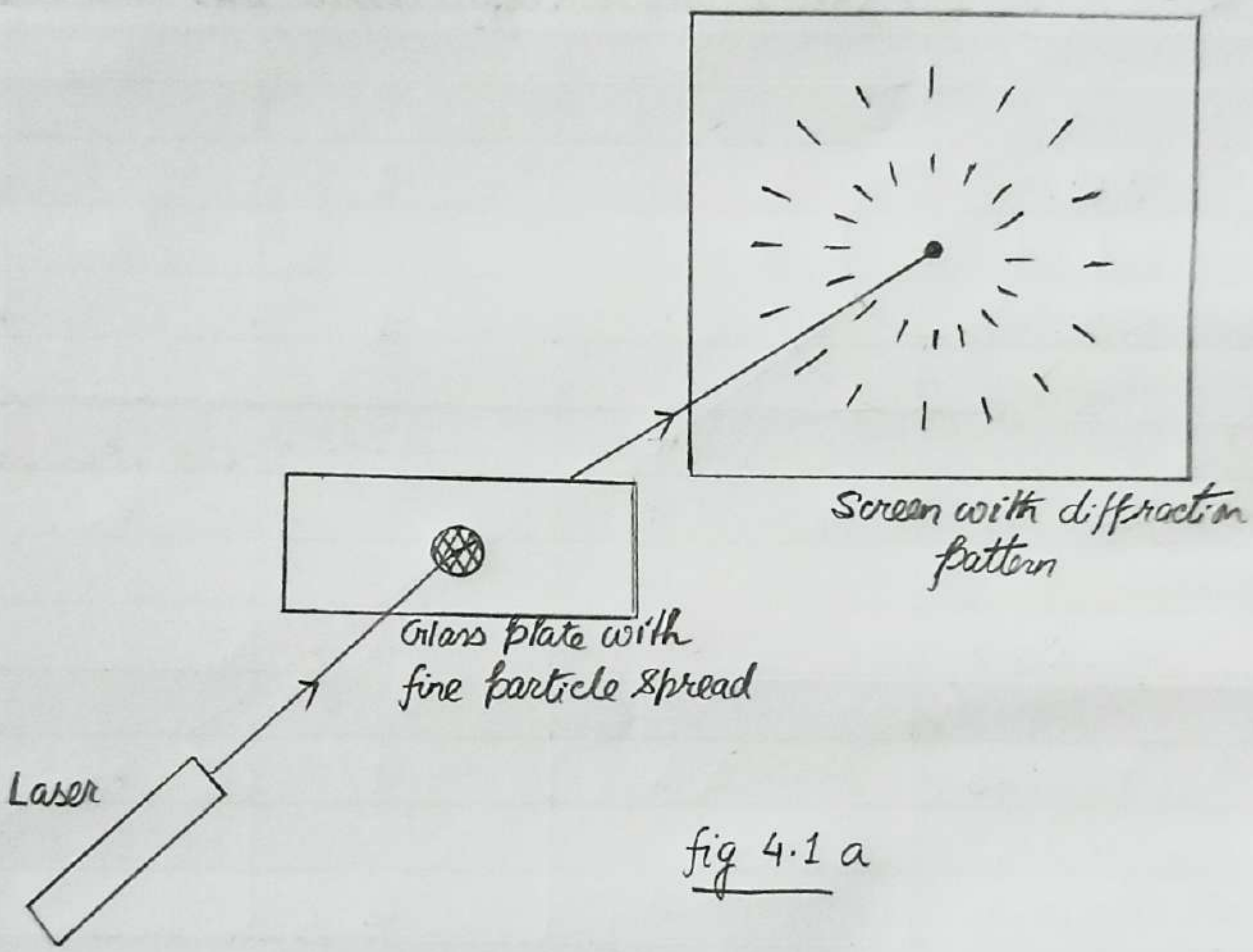

fig 4.1 a

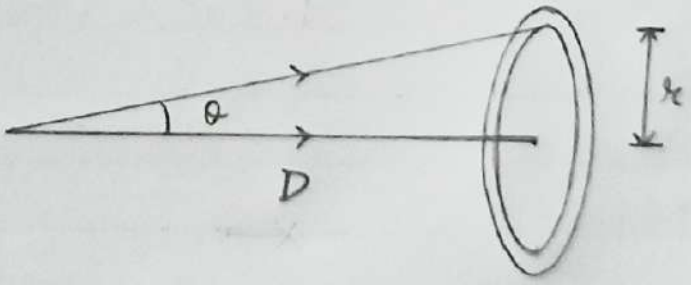

fig 4.1 b

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 :

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 observed rings, we can calculate the size of particles. Since the diffraction of occur, size of obstruction should 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 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

$$\tan\theta = r/D$$

Teacher's Signature .....

Since θ is very small in this experiment

$$\tan\theta = \theta = r/D$$

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 n^{th} order of dark ring (m)
D = distance between obstacle & screen.
λ = wavelength of laser light (Å)

CALCULATIONS:

① $D = 0.15\ m$; $r_n = 0.013\ m$; $\lambda = 6328 \times 10^{-10}\ m$; $n = 1$

$$\therefore 2a = \frac{1.22\, n\lambda D}{r_n} = \frac{1.22 \times 1 \times 6328 \times 10^{-10} \times 0.15}{0.013} = 89078 \times 10^{-10}$$

$$= 8.9078 \times 10^{-6}\ m$$

$$= 8.9078\ \mu m$$

OBSERVATIONS :

SL.NO	Distance (D)	Diffraction order (n)	Radius of dark ring (r_n)	Particle size (2n)
Unit	cm		cm	μm
1.	15	1	1.3	8.9078
		2	2.6	8.9078
2.	20	1	1.7	9.0825
		2	3.5	8.8230
3.	25	1	2.2	8.7729
		2	4.4	8.7729
			Mean :	8.8778 μm

Wavelength of laser light (λ) = 6328 Å

CALCULATIONS (cont.)

② $D = 0.15\,m$; $r_n = 0.026\,m$; $\lambda = 6328 \times 10^{-10}\,m$; $n = 2$

$$2a = \frac{1.22 n \lambda D}{r_n} = \frac{1.22 \times 2 \times 6328 \times 10^{-10} \times 0.15}{0.026} = 8.9078 \times 10^{-6}\,m$$

$$= 8.9078\,\mu m$$

③ $D = 0.20\,m$; $r_n = 0.017\,m$; $\lambda = 6328 \times 10^{-10}$; $n = 1$

$$2a = \frac{1.22 n \lambda D}{r_n} = \frac{1.22 \times 1 \times 6328 \times 10^{-10} \times 0.20}{0.017} = 9.8025\,\mu m$$

④ $D = 0.20m$; $r_n = 3.5 \times 10^{-2}\,m$; $\lambda = 6328 \times 10^{-10}$; $n = 2$

$$2a = \frac{1.22 n \lambda D}{r_n} = \frac{1.22 \times 2 \times 6328 \times 10^{-10} \times 0.20}{0.035} = 8.8230\,\mu m$$

⑤ $D = 0.25m$; $r_n = 0.022$; $\lambda = 6328 \times 10^{-10}$; $n = 1$

$$2a = \frac{1.22 n \lambda D}{r_n} = \frac{1.22 \times 1 \times 6328 \times 10^{-10} \times 0.25}{0.022} = 8.7729\,\mu m$$

⑥ $D = 0.25m$; $r_n = 0.044$; $\lambda = 6328 \times 10^{-10}$; $n = 2$

$$2a = \frac{1.22 n \lambda D}{r_n} = \frac{1.22 \times 2 \times 6328 \times 10^{-10} \times 0.25}{0.044} = 8.7729\,\mu m$$

RESULT :

The average size of the particles measured using laser = 8.8778 μm