SEMESTER IV

17PHU412 NUCLEAR AND PARTICLE PHYSICS PRACTICAL **L T P C**
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Any 4 Experiments

1. Young's Modulus – Elliptical Fringes (Cornu's method).
2. Viscosity of liquid – Mayer's oscillating disc method.
3. Michelson Interferometer – Determination of λ and dλ.
4. 'e/m' by Thomson's method and Magnetron method.
5. Young's Modulus – Hyperbolic Fringes (Cornu's method).
6. 'e' by Millikan's method.
7. Young's Double slit – Determination of Wavelength of monochromatic source.
8. G.M.Counter-Absorption co-efficient and inverse square law.

REFERENCE BOOKS

1. Advanced PRACTICAL Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics PRACTICAL s, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of PRACTICAL Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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MICHELSON INTERFEROMETER

Aim

To determine the wavelength of the monochromatic source and to find the difference in wavelength of sodium vapor lamp using Michelson interferometer.

Apparatus Required

Sodium vapor lamp and Michelson interferometer.

Formula used

The wavelength of sodium light is given by $\lambda = 2d/N$ (Å)

The difference in wavelength of d_1 and d_2 lines is given by $\Delta\lambda = \frac{\lambda^2}{2(d_2 - d_1)}$

where, d_1 – initial position of mirror M_1 (cm)

d_2 - final position of mirror M_1 (cm)

N- number of fringes

d- distance between two indistinct positions of mirror (m)

Initial adjustment

(i) The movable mirror M_1 and M_2 has to be moved using drum head to adjust the distance of G_1M_1 and G_2M_2.

(ii) Aluminum sheet with single hole is placed between the monochromatic source and the glass plate. So that four images can be viewed at different position. By adjusting the screws behind the mirror M_1 and M_2, these can be reduced to two images in a same horizontal line.

(iii) Remove the aluminum sheet. Fringes appear in the field of view. To obtain a clear circular fringes gently tilt the mirror with the help of screws.

(iv) The fringes should not converge or diverge. If so, made a small tilt in the mirror M_2.

Experimental Procedure

(i) Let 'x' be the center of fringes. The position of the mirror M1 is adjusted by turning drum head and the readings on the scale is noted.

(ii) The micrometer readings have to be noted for each 30 fringes until x+180.

(iii) To obtain the difference in wavelength, note the readings on micrometer for consonance (d_2) and resonance (d1) of fringes simultaneously. Note three set of readings on each.

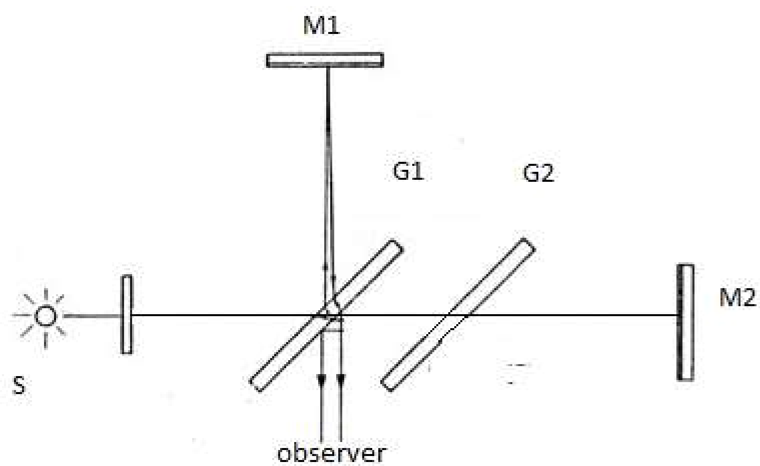

Fig. 1

Tabulation

L.C of rough micrometer screw = 0.001 cm

L.C of fine micrometer screw = 0.00001 cm

No. of fringes	Position of mirror (cm)				Difference (cm)	Mean difference (cm)
	Main scale reading	R.M.S reading	F.M.S reading	Total		
x						
x_1 =x+30						

$x_2 = x_1+30$						

Appearance of fringes (d_1)

Position of mirror (cm)			
Main scale reading	**R.M.S reading**	**F.M.S reading**	**Total (d_2)**

Disappearance of fringes (d_2)

Position of mirror (cm)			
Main scale reading	**R.M.S reading**	**F.M.S reading**	**Total (d_2)**

Calculation

$$\lambda=2d/N \text{ (Å)}$$

The difference in wavelength of d_1 and d_2 lines is given by $\Delta\lambda = \frac{\lambda^2}{2(d_2 - d_1)}$ (Å)

Result

The wavelength of sodium vapor lamp = ---------Å

The difference in wavelength = ---------Å

Viva Voce

1. What is meant by interferometer?
2. Shall we do this method with mercury lamp?
3. What types of glass is used in this method?
4. What types of glass is mirror in this method?

e/m – MAGNETRON METHOD

Aim

To determine the charge to mass ratio by Magnetron method.

Apparatus Required

Magnetron valve, power supply, solenoid, ammeter, voltmeter, rheostat.

Formula used

$$\frac{e}{m} = \frac{8V}{B_c^2 R_a^2} \, C/kg$$

Where, Va – anode potential (V)

Bc – critical value of the magnetic field produced by current

r_a- radius of the valve (m)

$Bc = \frac{4\pi NIc}{10}$ oersted

Where, N- number of turns on solenoid

Ic – critical value of current in solenoid (mA)

Experimental Procedure

(i) Place the valve at the center of the solenoid and connect it to the power supply.

(ii) Made the plate voltage as constant and increase the solenoid current from 0 A. Some deflection is observed on plate current (mA).

(iii) Plot a graph between solenoid current and plate current. Sudden fall will appear and noted as critical current (Ic).

(iv) Repeat the process for different plate voltage.

Tabulation

Solenoid current (A)	Plate voltage (V)	Plate current (mA)	Critical current (A)	e/m (C/kg)
	0.2			

	0.4			
	0.6			

Observations

Radius of the valve …….. cm

No. of turns per cm on solenoid ------------

Calculations

Ic = ………

$$Bc = \frac{4\pi NIc}{10} \text{ oersted}$$

Bc = ------------

$$\frac{e}{m} = \frac{8V}{B_c^2 R_a^2} \, C/kg$$

Result

The value of e/m = ………..C/kg

Standard value = 1.76 x 10^{11} C/kg

Percentage of error = ………

Viva Voce

1. Define magnetic field.
2. What is critical magnetic field?
3. What is solenoid?
4. What is magnetron valve?

VISCOSITY OF A LIQUID- MAYER'S OSCILLATING DISC METHOD

Aim

To determine the viscosity of a liquid by Mayer's oscillating disc method

Apparatus required

Metallic circular disc, stand, telescope and scale, mirror, stop clock, weight hanger, liquid (water) and string.

Formula used

$$\text{Viscosity of the liquid, } \eta = \frac{16I^2}{\pi\rho T_0\,(r^4+2r^3d)^2}\left[\frac{\lambda_w-\lambda_a}{\pi}+\frac{(\lambda_w-\lambda_a)^2}{\pi}\right]^2 \text{Ns/m}^2$$

$$\text{Moment of Inertia, } I = 2M(d_2^2-d_1^2)\frac{T_1^2}{T_2^2-T_1^2}\ \text{kg/m}^2$$

where, M-mass placed on either side of the disc (kg)

r- radius of the disc (m)

d- thickness of the disc (m)

ρ- density of the liquid (kg/m^3)

T_0, T_1 and T_2 – period of oscillation of the disc without and with mass at distance d1 and d2 (s)

λa – logarithmic decrement of air

λw – logarithmic decrement of water

d_1 & d_2 – distance between the center of the disc and the center of the mass placed on either side (m)

Experimental Procedure

A metallic circular disc suspends horizontally with the help of tension free wire in a stand shown in Fig.1. A disc is oscillated and time taken for 10 oscillations has been noted. Place two slotted weights on both sides of the string in a disc and note the time taken for 10 oscillations. Let the distance of the weight from center is taken as d_1. Place the weights on the disc at a distance d_2 and repeat the procedure.

Now remove the weights from the disc, suspend it freely;

1. Fix a mirror on the string.

2. Place a telescope scale horizontally and view the scale in a mirror through the telescope (place it opposite).
3. Gradually oscillate the disc and note down the readings viewed in the mirror. Let it be θ' and θ" of λa.
4. Immerse the disc in water placed in a tub and repeat the procedure. Let it be θ' and θ" of λw.

Thickness of the disc can be obtained with the help of screw gauge.

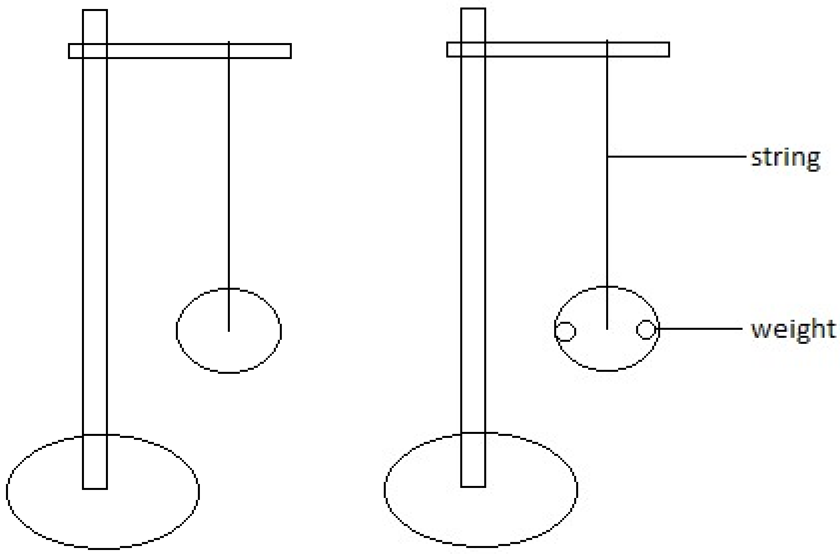

Fig. 1

Tabulation:

Thickness of the disc (d) LC = ………… cm

S.No.	PSR	HSR	HSC = HSR x LC	PSR±HSC	THICKESS d (cm)
1					
2					
3					
4					

POSITION OF MASS	Time for 10 oscillations (s)			Time for one oscillation (s)
	t_1	t_2	mean	
Without mass				
With mass at d_1				
With mass at d_2				

Logarithmic decrement of water

S.No.	θ'	θ''	λ_a=(2.303/10) log(θ'/ θ'')
1			
2			
3			
4			
5			

Logarithmic decreament of water

S.No.	θ'	θ''	λ_a=(2.303/10) log(θ'/ θ'')
1			
2			
3			

4			
5			

Calculations

Circumference, $2\pi r$ = ----------

r = --------- (cm)

$$\eta = \frac{16I^2}{\pi\rho T_0\,(r^4+2r^3 d)^2}\left[\frac{\lambda_w-\lambda_a}{\pi}+\frac{(\lambda_w-\lambda_a)^2}{\pi}\right] \text{Ns/m}^2$$

Result

The viscosity of the given liquid using Mayer's disc method is, η = ------------- Ns/m^2.

Viva voce

1. What is coefficient of viscosity?
2. What is the principle of torsion pendulum?
3. Is this method applicable to any other liquid?

YOUNG'S DOUBLE SLIT

Aim

To determine the wavelength of the monochromatic source using double slit.

Apparatus required

He-Ne laser, double slit, screen, travelling microscope and meter scale.

Formula used

The wavelength is given by $\lambda = \frac{\beta d}{D}$ Å

Where, β- fringe width (m)

d- width of the slit (m)

D-distance between the slit and cress (m)

Experimental Procedure

(i) Place the double slit frame in front of the He-Ne laser at certain distances.

(ii) Switch on the laser and gradually open the window of the double slit, so that the fringes can be viewed in the screen.

(iii) Adjust the distance between screen and double slit to obtain clear and number of fringes.

(iv) Record the fringes viewed in screen in the graph sheet for the number of fringes.

(v) Remove the double slit with altering the width of the slit.

(vi) Using microscope measure the slit width.

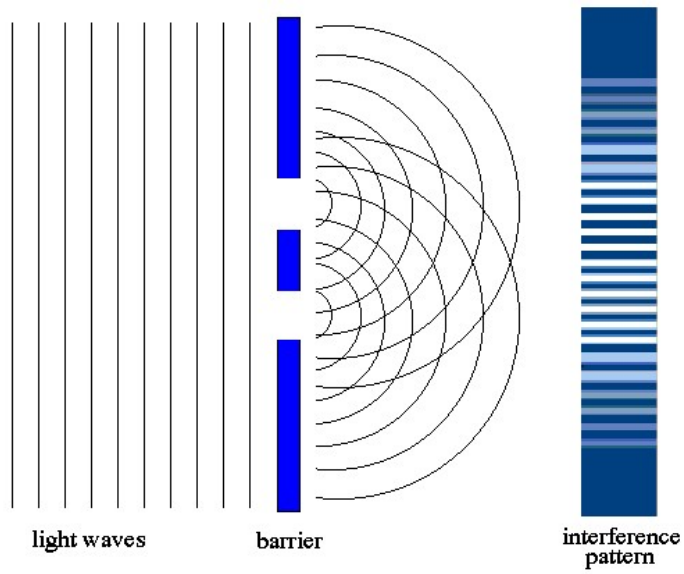

Fig. 1

Tabulation

Order of fringes	Distance between the fringes (mm)	Width of the three fringes (mm)	Fringe width
n n+1 n+2 . . . n+9			

To find d

Position on double slit	Microscope reading (m)			AD (m)	BC (m)	d= (AD+BC)/2 (m)
	MSR	VSR	TR			
A B C D						

Calculation

Result

The wavelength of the monochromatic source is ---------- Å

Viva voce

1. What is the wavelength of He-Ne laser?
2. What is double slit?
3. What is the principle of this method?