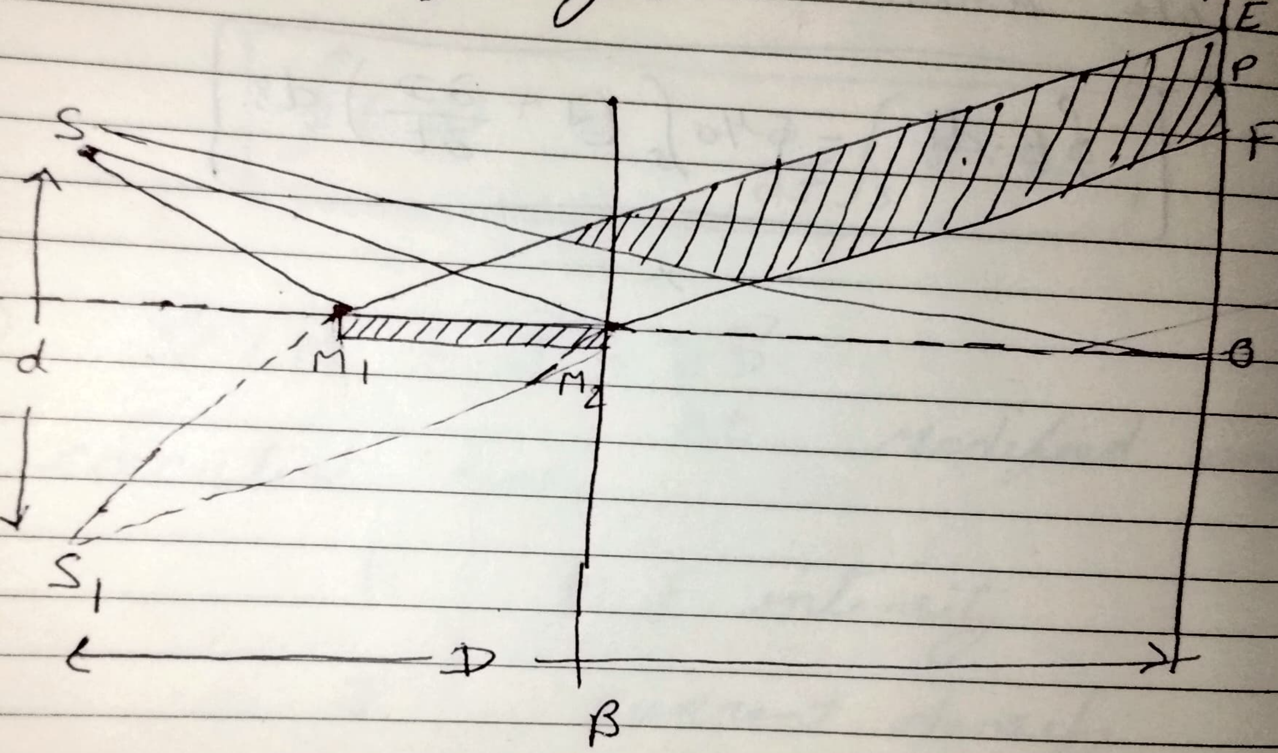
Lloyd Mirror

Lloyd's mirror is used to find the wavelength of light using the phenomenon of interference. The mirror devised by Dr. Lloyd is an arrangement to produce two coherent sources of light to produce interference fringes.



It consists of a highly polished plane mirror $M_1 M_2$ on front surface and blackened at the back to avoid multiple refractions. S is a source of monochromatic light in the form of slit which is placed with its length parallel to the surface of the mirror as shown in fig.

light from the source S

2010	AUGUST					2010	SEPTEMBER				
Mon	30	2	9	16	23	Mon		6	13	20	27
Tue	31	3	10	17	24	Tue		7	14	21	28
Wed		4	11	18	25	Wed	1	8	15	22	29
Thu		5	12	19	26	Thu	2	9	16	23	30
Fri		6	13	20	27	Fri	3	10	17	24	
Sat		7	14	21	28	Sat	4	11	18	25	
Sun	1	8	15	22	29	Sun	5	12	19	26	

falls on the mirror at almost grazing incidence so that the entire incident light is reflected. This also produces a good contrast in the fringes. Incident and reflected beam of light which interfere have nearly same amplitudes. The light after reflection from the mirror appears to diverge from S_1 which is a virtual image of the source S. The sources S and S_1 act as two coherent sources. The waves from these two sources superimpose each other and interference fringes are obtained in the region EF on the screen. The fringes are equally spaced and are observed in a microscope.

The central fringe is obtained at a point O on the screen where the geometrical path difference between the wave coming from S and S_1 is zero. As the point O receives light only from the sources S and no reflected light reaches the point O, therefore, the central fringe at O is not available. However, if the screen is shifted in the new position AB touching M_2 shown by dotted line the central fringe can be seen at M_2. The central fringe at M_2 is found to be dark instead of bright. It is only possible if the crest of one wave falls over the trough of other wave reaching the point M_2 i.e a phase difference of π between the incident and reflected ray is produced at M_2. Since no change in phase takes place in the incident light coming from S, therefore a phase change of π is produced in the reflected light on reflection from the mirror which acts as a denser medium.

This proves that a light beam after reflection from an optically denser medium undergoes a phase change of π.

The intensity at any point P on the screen will depend upon the geometrical path difference between the rays coming from S and S_1 and reaching P.

If the path difference

$$S_1P - SP = \frac{(2n+1)\lambda}{2},$$

The point P is bright where $n = 0, 1, 2, 3 \ldots$ and if the path difference

$$S_1P - SP = n\lambda,$$ the point P is

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dark, where $n = 0, 1, 2, 3 \ldots$