Khatra Adibasi Mahavidyalaya: Lecture Notes

Dr. Siddhartha Sinha

Interference of two coherent point sources

Consider two monochromatic point sources of equal strength S & S' which are in phase & separated by a distance d. For distances R of a field point (measured from mid-point of SS') satisfying $R >> d$, the difference in amplitude due to difference of path from S & S' to the field point can be neglected. In this far-field region, the condition of maximum brightness is given by

$$r - r' = n\lambda, \ n = 0, \pm 1, \pm 2, ... \tag{1}$$

These are hyperbolas with foci at S & S'. For example $r - r' = \lambda$ is a branch of a hyperbola with S' as the first focus. The other branch, with S as the first focus is $r - r' = -\lambda$. For n=0, *i.e.* the central maxima, the curve is a straight line which perpendicularly bisects SS'. For $n \neq 0$, all the hyperbolae have vertices on SS' & distance between the vertices of the two branches for a particular n is $n\lambda$. Therefore, for the n-th bright fringe, the major axis length is given by $2a = n\lambda$ & the eccentricity is obtained from the relation $SS' = 2ae$.

Similarly, dark fringes are given by

$$r - r' = (n + \frac{1}{2})\lambda, \ n = 0, \pm 1, \pm 2, ... \tag{2}$$

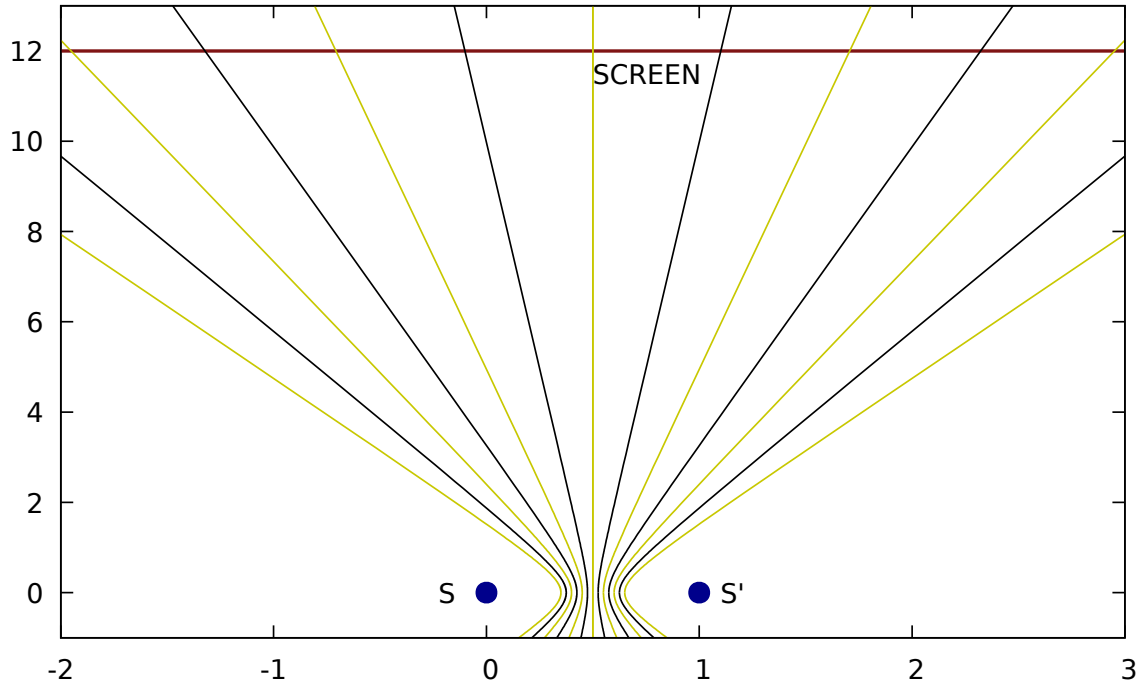

Figure 1: Curves of maximum (yellow) & minimum (black) brightness for two monochromatic point sources of equal strength S & S', emitting wavelength $\lambda = 0.1$ units, physically separated by $d = 1$ units. This pattern is obtained in any plane containing S & S' at distances large compared to d. A screen of width 5 units is placed at $D = 12$ units from the sources on which point fringes of approximately equal width will be seen.