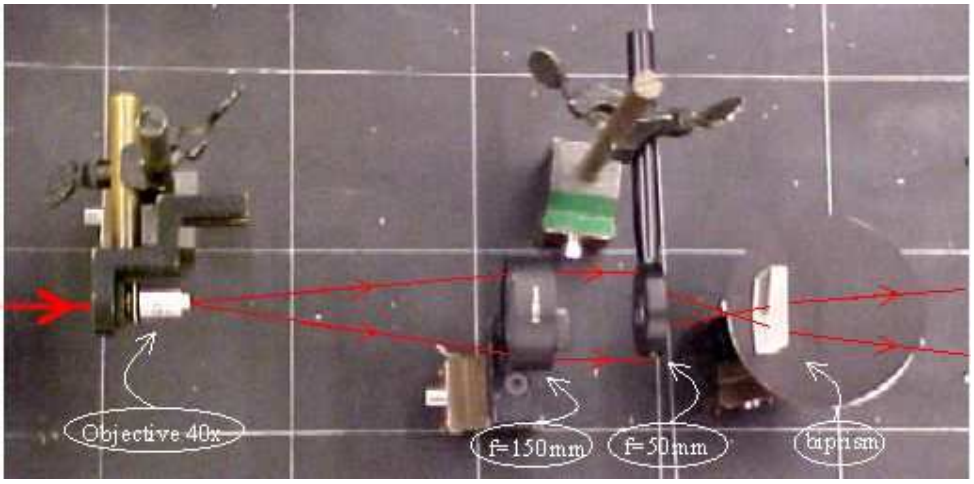
Fresnel double prism

Aim: To show the interference of two coherent, virtual, sources (wavefront splitting).

Subjects: 6D10 (Interference From Two Sources)

Diagram:



Equipment:

- Laser.
- Microscope objective (40x)
- Lens, 150mm.
- Lens of short focal length (we use 50mm)
- Double prism (we use: Phywe 08556.00).
- Viewing screen/wall.

Fresnel double prism

Presentation: Preparation

The laserbeam is switched on and expanded using a telescope consisting of the microscope objective and the converging lens of 150mm. The expanded beam is then focussed by the lens of 50mm.

Presentation

On the viewing screen, a couple of meters away we see a large circular light spot. (Blowing smoke into the lens set-up enlightens the lightpath).

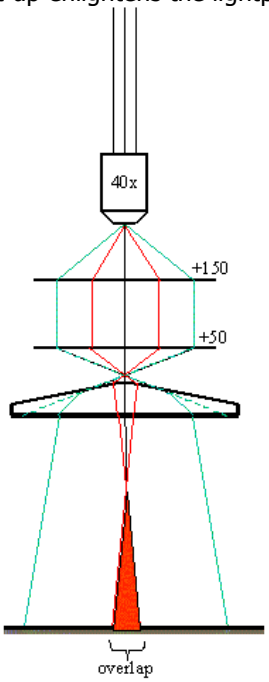


Figure 1

When descending the biprism (apex line vertical) into the diverging beam, close to the focal point (see Figure1), we see that the original circular light spot is refracted into two half circle segments and that in the centre these two halves overlap (see Figure2), narrowing the original lightspot.

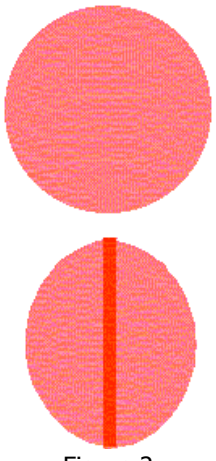


Figure 2

Fresnel double prism

The centre shows an increase in light intensity. When the biprism is moved closer to the focal point of the 50mm lens, we will easily see that the centre contains fringes, lines of positive and negative interference. When the biprism is close to this focal point the fringe spacing is large; when the biprism is moving away from the focal point, the fringe spacing is smaller but can still be observed when the viewing screen is tilted.

Explanation: See figure 3. The left portion of the wavefront is refracted to the right, the right portion to the left. In the region of superposition interference occurs.

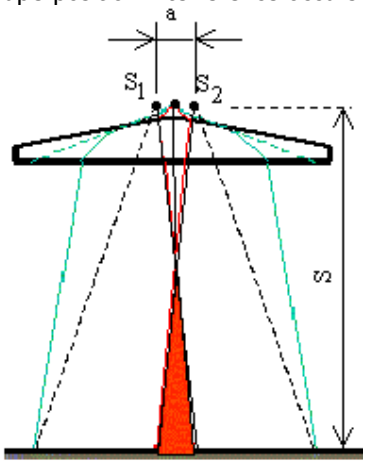


Figure 3

The virtual sources S_1 and S_2 can be considered as separate virtual coherent sources placed a distance a apart. The seperation of the fringes (Δy) is given by: $\Delta y \approx \frac{s}{a}\lambda$ (s being the distance between the plane of the two sources and the screen).

Remarks: When the biprism approaches the focal point too close, the interference image becomes distorted. This happens largely due too the fact that we use spherical lenses in stead of cilindrical.

Sources:

- Hecht, Eugene, Optics, pag. 391
- Leybold-Heraeus, Physikalische Handblätter, pag. DK 535.412;d
- Phywe, University Laboratory Experiments, part Vol. 1-5, pag. 2.5
- Sutton, Richard Manliffe, Demonstration experiments in Physics, pag. 403