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Herschel's Interference Demonstration

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Early in the nineteenth century, W. Herschel introduced a striking demonstration of interference arising from many coherent rays.[1] Today's students can reproduce this demonstration and attain beautiful multiple-beam interference[2] patterns similar to those in Fig. 1.

Materials needed are two glass prisms (3 x 3 x $3\sqrt{2}$ cm) of 2-cm thickness, padded clamps, a concentrated white light beam, a lens (optional), and screens. Following the geometry of Fig. 2, press together the hypotenuses of the two prisms (45°—45°—90°) with the padded clamps, leaving a very small gap as shown. The screen is situated about a meter away from the prism. Place the light source about 3 cm from the prism and direct the beam as shown in the diagram so that the light hits the hypotenuses almost at the critical angle where the reflection coefficient is almost one. If the gap is not too small, a focusing lens can yield a large (over half a meter across) and beautiful multiple-beam interference pattern. The multiple interference occurs for each frequency making up the white light.

You can also do this experiment by just holding the two prisms in your hand close to a high-intensity desk lamp. Fiddle a little with the orientation of the prism assembly and you will get good results. The lens (which helps focus the image) is not essential, since L/l is huge.

Fig. 1. Multiple-beam interference pattern.

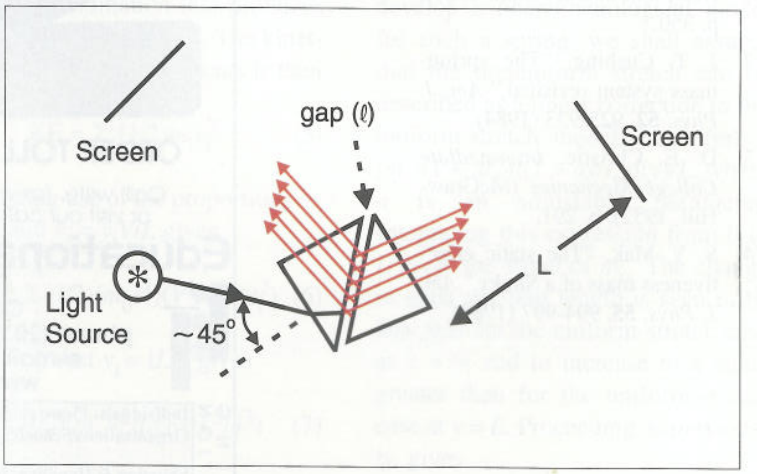

Fig. 2. Sketch of apparatus setup.

References

1. W. Herschel, *Phil. Trans.* 259 (1809).
2. E. Hecht, *Optics* (Addison-Wesley, Reading, Mass., 1987), pp. 363-368.