Deviation of light by a prism

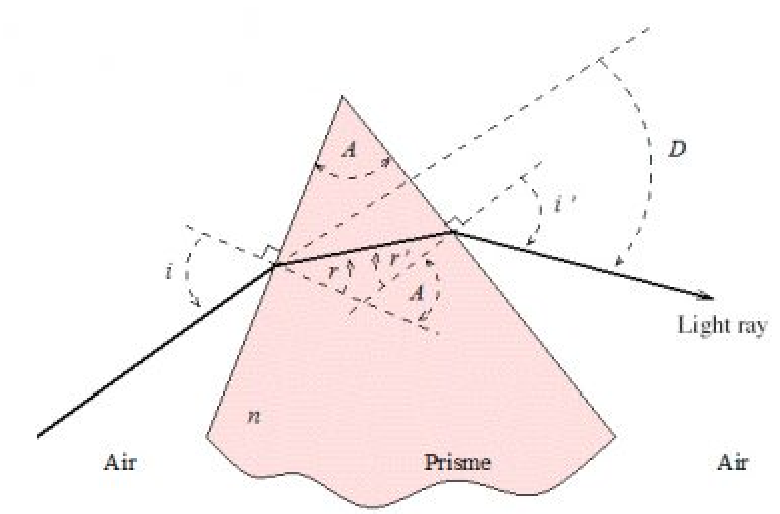

Figure 1. Deviation of a light beam by a prism of angle at vertex A and refractive index n.

A prism of angle at the apex *A* and index *n - the* air, of unit index, surrounds the prism - deflects a light beam, whose angle of incidence on one of the lateral surfaces of the prism is *i*, according to the laws of Snell-Descartes of geometric optics: sin *i* = *n* sin *r* and *n* sin *r'* = sin *i'* (Figure 1 for the notations). The angle of deflection *D* = *i* + *i'* - *A*, with *A* = *r* + *r'*.

The light beam can only emerge from the prism if *A* < 2 a sin(1/n) *;* for ice n = 1.31, hence A < 99.5^0. If we trace the deviation *D* as a function of *i*, we see that it decreases rapidly, reaches a minimum *minimorum* corresponding to a symmetrical crossing of the prism *(i* = *i'*), then increases slowly. The minimum is very flattened, so that a change in the angle of incidence around the incidence that corresponds to this minimum does not significantly change its value; it results in an accumulation of light and therefore a high luminosity around this minimum. For *A* = 60^0, the minimum is 22^0; if *A* = 90^0, it is 46^0 (Figure 2). Figure 3 shows the value of this minimum for the different values of *A* allowed: it increases with *A*.

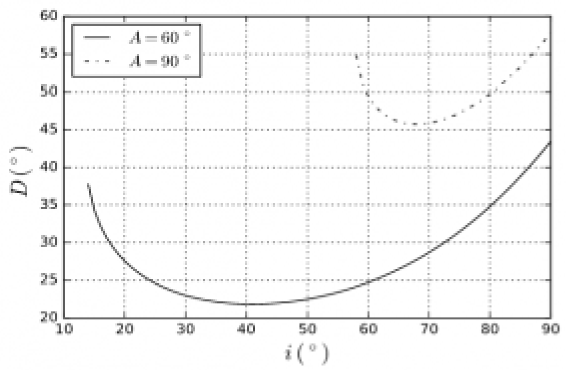

Figure 2. Deviation D as a function of the angle of incidence i on a prism of angle A = 60^0 and angle A = 90^0.

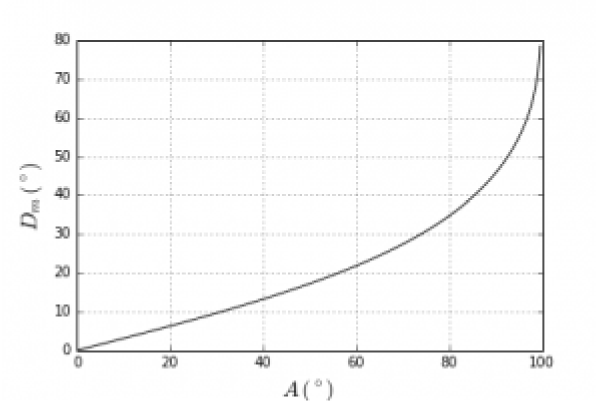

Figure 3. Minimum deviation Dm as a function of the angle A of a prism.

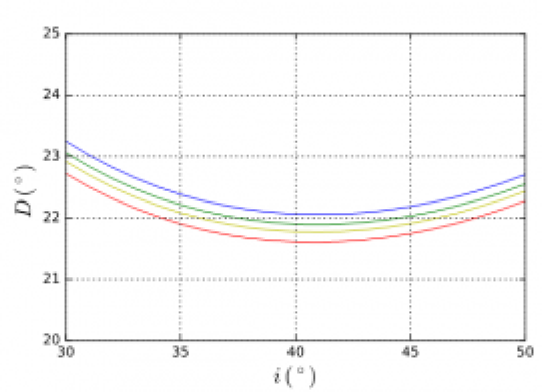

Figure 4. Deviation D for an angle prism A = 60^0 depending on the colour of the incident light. Each of the four curves is colored according to the color it represents.

In addition, since the index *n* depends on the colour of the incident radiation, the minimum also depends on it; a prism breaks down white light into its various monochromatic components. This explains the iridescence of halos obtained by refraction. For $A = 60^0$, we have a minimum close to 22^0 that grows from red to blue (Figure 4).

References and notes

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