Answer on Question #39441, Physics, Optics

Can dispersive power be negative? Why?

What will be the sign of dispersive power if a hollow prism is immersed into water?

Solution:

The dispersive power ω for the material of a prism is given by the relation

$$\omega = \frac{n_v - n_r}{n - 1}$$

where n_v is the refractive index for violet light, n_r is for red light and n is the mean refractive index. For a source like the hydrogen discharge tube, dispersive power is defined by the relation

$$\omega = \frac{n_F - n_C}{n_D - 1}$$

where the subscripts referring to the following definite colours of light:

C	λ = 6563 Å	Red
D	λ = 5893 Å	Yellow
F	λ = 4861 Å	Blue

In some unusual circumstances, called cases of ***anomalous dispersion***, the rate of change of the index of refraction with respect to the wavelength changes sign and dispersive power can be negative.

The dispersion doesn't occur through a hollow prism.

When the glass prism is immersed into water, each of the refractive indices in the first equation will be divided by refractive index of water.

When the hollow prism is immersed into water we obtained

$$\omega = \frac{1/n_v - 1/n_r}{1/n - 1}$$

Hence numerator will have a negative sign and the denominator will have a negative sign. Thus, the dispersive power of the hollow prism immersed into water has a positive sign.

Answer. The dispersive power can be negative, when the medium have anomalous dispersion.

The dispersive power of the hollow prism immersed into water has a positive sign.