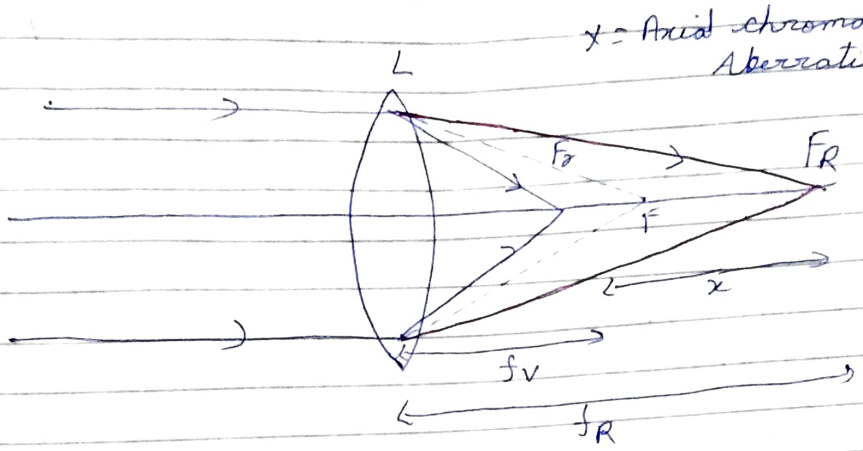
Expression for logitudinal chromatic aberration for an object at infinity



$$x = f_v - f_v$$

By using Lens maker formula

$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] \quad \text{——(i)}$$

$$\frac{1}{f(\mu-1)} = \left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{——(a)}$$

For Red colour

$$\frac{1}{f_R} = (\mu_R - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{——(ii)}$$

For violet colour

$$\frac{1}{f_V} = (\mu_V - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{——(iii)}$$

By using eqn (a)

$$\frac{1}{f_R} = \frac{(\mu_R - 1)}{f(\mu - 1)} \quad \text{——(iv)}$$

$$\frac{1}{f_V} = \frac{(\mu_V - 1)}{f(\mu - 1)} \quad \text{--- (V)}$$

$$\frac{1}{f_V} - \frac{1}{f_R} = \frac{1}{f(\mu - 1)} \times (\mu_V - \mu_R + 1)$$

$$\frac{1}{f_V} - \frac{1}{f_R} = \frac{\mu_V - \mu_R}{f(\mu - 1)}$$

$$\frac{f_R - f_V}{f_V f_R} = \frac{\mu_V - \mu_R}{f(\mu - 1)}$$

[By taking $f_V f_R = f^2$]

$$\frac{f_R - f_V}{f^2} = \frac{\mu_V - \mu_R}{(\mu - 1) f}$$

$$f_R - f_V = \left(\frac{\mu_V - \mu_R}{\mu - 1}\right) f$$

$$\boxed{\chi = \omega f}$$

$\left(\because \frac{\mu_V - \mu_R}{\mu - 1} = \omega\right)$
