Chromatic Aberration

656 nm (red): C line

589 nm (orange-yellow): D line

489 nm (aqua-blue): F line

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

$$CA_{surface} = \frac{F_D}{\upsilon} \quad CA_{thinlens} = \frac{F_D}{\upsilon}$$

for a pair of thin prisms:

$$CA_{prism} = \frac{Z_1}{\upsilon_1} + \frac{Z_2}{\upsilon_2}$$

Monochromatic Aberration

$$\sin\theta = \theta - \frac{\theta^3}{3!}$$

$$LSA[\mathrm{D}] = F'_{marginal} - F'_{paraxial}$$

$$LSA[\mathrm{m}] = f'_{paraxial} - f'_{marginal}$$

$$\left.\begin{aligned} P_t &= P\left[1 + \frac{4\phi^2}{3}\right] \\ P_s &= P\left[1 + \frac{\phi^2}{3}\right] \\ RA &= P_t - P_s = P\phi^2 \end{aligned}\right\}$$

when

θ < 20 deg

and

n = 1.5

$$K = P / n$$

$$K = \sum_j \frac{P_j}{n_j}$$

Wave Model for Light

$$f = \frac{1}{T} \qquad \lambda = \mathrm{V} \cdot \mathrm{T}$$

$$\lambda f = \mathrm{V} \qquad \mathrm{I} \,\alpha\, \mathrm{A}^2$$

$$\lambda_{\mathrm{m}} = \frac{\lambda}{n}$$

$$E = A \cdot \sin(kx - \omega t + \varepsilon)$$

$$k = \frac{2\pi}{\lambda} \equiv \text{propagation number}$$

$$\omega = 2\pi f \equiv \text{angular frequency}$$

$$\varepsilon \equiv \text{initial phase [in radians]}$$

$$\frac{\omega}{k} = f\lambda = \mathrm{V}$$

speed of light in vacuum = 3×10^8 m/s

[redacted]

Thin film coatings:

$$t_{dest} = \frac{\left(m + \frac{1}{2}\right)}{2} \frac{\lambda}{n_2}, \quad m = 0, 1, 2 \ldots$$

$$t_{const} = \frac{m}{2} \frac{\lambda}{n_2}, \quad m = 0, 1, 2 \ldots$$

These rules apply whenever the phase change by reflection is the same for both waves (ie both 180 deg or both 0. When only one wave undergoes a phase change by reflection but the other does not, then the equations are reversed.

amplitude condition for an ARC: $n_c = \sqrt{n_g}$

$$r = \left|\frac{n' - n}{n' + n}\right| \qquad \text{for intensity: } R = (r)^2 = \left[\frac{n' - n}{n' + n}\right]^2$$

Diffraction

Slit Aperture

minima occur when $\theta = \frac{m\lambda}{a}$ or $x = \frac{m\lambda t}{a}$ $\quad m = \pm 1, \pm 2 \ldots$

Circular Aperture

1st minimum occurs when $\theta = \frac{1.22 \cdot \lambda}{a}$ or $x = \frac{1.22 \cdot \lambda t}{a}$

Phase

$$\frac{(\text{angles in degrees}) \times \pi}{180} = (\text{angles in radians})$$

$$\frac{(\text{angles in radians}) \times 180}{\pi} = (\text{angles in degrees})$$

$$\frac{(\text{phase difference in distance})}{\lambda / (\text{index through which light is passing})} = (\text{phase difference in waves})$$

$$(\text{phase difference in waves}) \times 2 \times \pi = (\text{phase difference in radians})$$