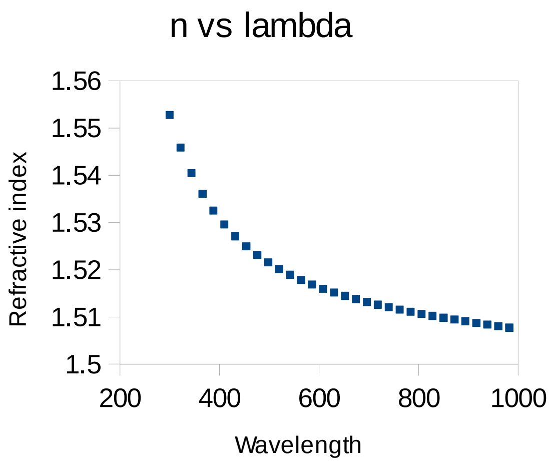
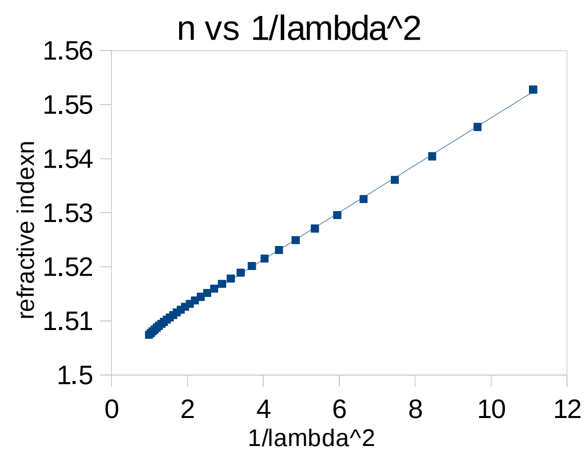
Angle of minimum deviation

A = apex angle
θ = deviation angle
n = refractive index

$$n=\sin\frac{\left(\frac{A+\theta}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Dependence of refractive index on wavelength – BK7 glass
(http://refractiveindex.info/?shelf=glass&book=BK7&page=SCHOTT)





With the wavelength in μm, the straight line fit the second graph gives

$$n=1.504+\frac{0.00437}{\lambda^2}$$

Dispersion of a prism

$$\frac{d\theta}{d\lambda}=\frac{d\theta}{dn}\frac{dn}{d\lambda}$$

with

- λ = 0.52 nm = 520 nm
- A = 60°
- n = 1.5206 (from data table)
- θ = 38.98° (calculated from 1st equation)

$$\frac{dn}{d\theta}=\frac{1}{2}\frac{\cos\left(\frac{A+\theta}{2}\right)}{\sin\left(\frac{A}{2}\right)}=0.6496\ \text{rad}^{-1}$$

$$\frac{dn}{d\lambda} = \frac{2*0.00437}{\lambda^3} = 0.0622\,\mu m^{-1}$$

$$\frac{d\theta}{d\lambda} = \frac{d\theta}{dn}\frac{dn}{d\lambda} = \frac{0.0622}{0.6496} = 0.0957\frac{rad}{\mu m} = 5.48\frac{deg}{\mu m} = 0.00548\frac{deg}{nm}$$

At R = 50 cm

$$\frac{ds}{d\lambda} = R\frac{d\theta}{d\lambda} = 500\,mm * 0.0957\frac{rad}{\mu m} = 47.9\frac{mm}{\mu m} = 0.0479\frac{mm}{nm}$$

Given the dispersion, suppose the light then passes through a slit which is 50 μm wide. The the range of wavelength which will pass through the slit at is

$$\delta\lambda = \frac{d\lambda}{ds}\delta s = \frac{1}{0.0479}\frac{nm}{mm} * 0.05\,mm = 1.04\,nm$$