Answer on Question:54962

A 400 cm diameter lens has focal lengths in the blue and red regions of the spectrum given by: FB = 2995 mm, FR = 3000 mm.

(i) What is the value of the focal length corresponding to the position of the circle of least confusion?

(ii) What is the linear size of the image of a star at its focal position?

Solution:

(i) By similar triangles:

$$\frac{D}{F_B} = \frac{d}{F_C - F_B}, \text{ and } \frac{D}{F_R} = \frac{d}{F_R - F_C}$$

Dividing these identities:

$$\frac{F_R}{F_B} = \frac{F_R - F_C}{F_C - F_B}$$

giving:

$$F_C = \frac{2F_B \times F_R}{F_R + F_B}$$

Inserting the values gives:

$$F_C = \frac{2 \times 3000 \times 2995}{5995} = 2997mm$$

Answer: F_C = 2997 mm

(ii) Again by similar triangles:

$$\frac{d}{F_C - F_B} = \frac{D}{F_B}$$

Hence:

$$d = \frac{D \times (F_C - F_B)}{F_B} = \frac{40 \times 2}{2995} = 0.33mm$$

Answer: $d = 0.33$ mm