Keplerian 10X Eye Relief

Design a Keplerian telescope with a magnifying power of 10 and an eye relief of 11 mm. Specify the two focal lengths and the separation.

Solution:

Requirement:  
10X → MP = −10

\[ ER = 11 \text{mm} \]

\[ m = \frac{1}{MP} = -\frac{f_{\text{OBJ}}}{f_{\text{EYE}}} = -\frac{1}{10} \]

\[ f_{\text{OBJ}} = 10 f_{\text{EYE}} \]

The XP is the image of the stop/objective through the eye lens (f₂)

\[ z'_{XP} = ER = 11 \text{mm} \]

\[ z_{\text{STOP}} = -L = -\text{Seperation} = -(f_{\text{OBJ}} + f_{\text{EYE}}) \]

\[ z_{\text{OBJ}} = -11 f_{\text{EYE}} \]

\[ \frac{1}{z'_{XP}} = \frac{1}{z_{\text{STOP}}} + \frac{1}{f_{\text{EYE}}} \]

\[ \frac{1}{11} = \frac{1}{-11 f_{\text{EYE}}} + \frac{1}{f_{\text{EYE}}} \]

\[ f_{\text{EYE}} = 10 \text{mm} \]

\[ f_{\text{OBJ}} = 100 \text{mm} \]

\[ L = \text{Seperation} = 110 \text{mm} \]