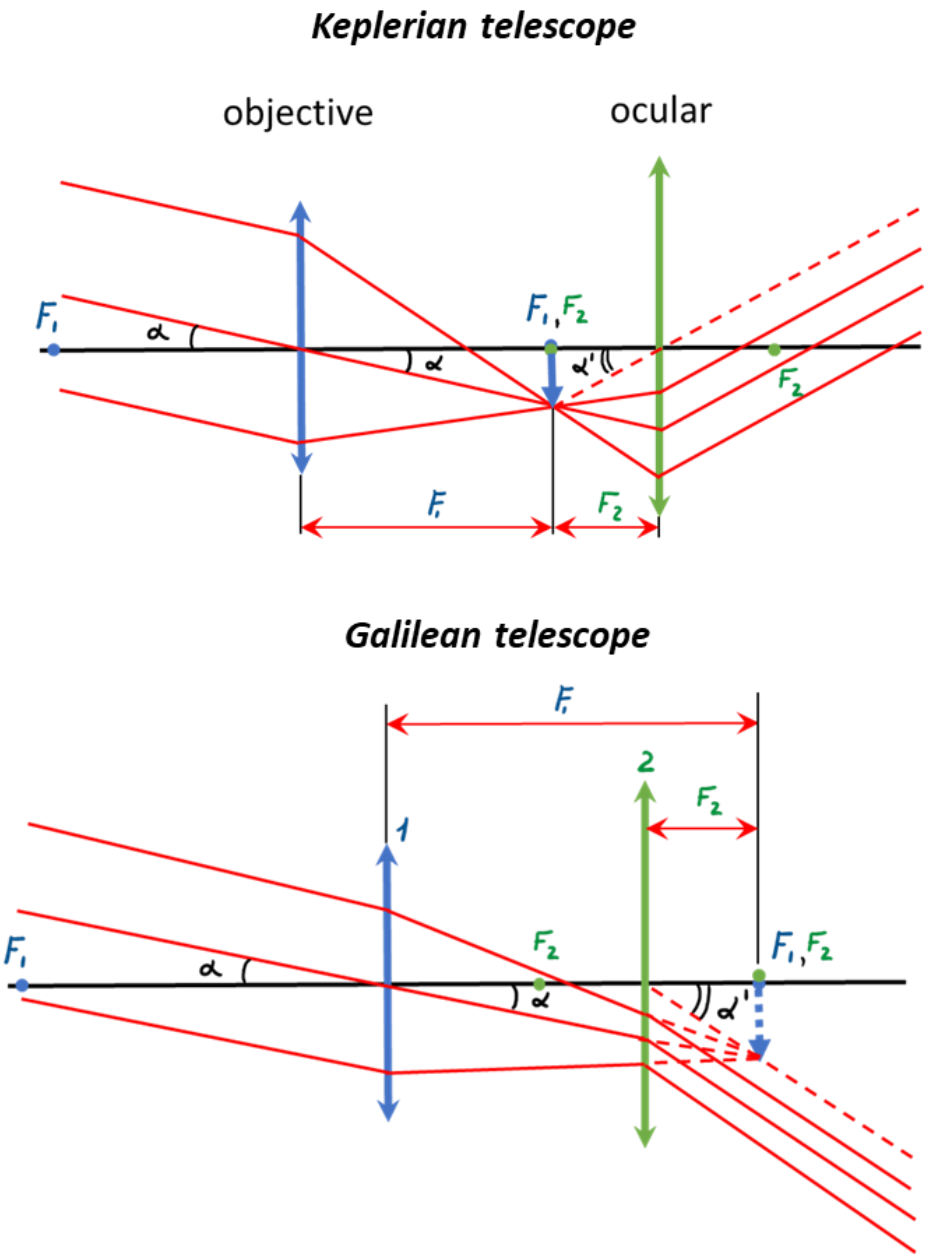
Homework 9

Astronomical telescope.

We have discussed astronomical telescope. The optical scheme of 2 variants of the astronomical telescope (Keplerian and Galilean) are presented in the Figure below:



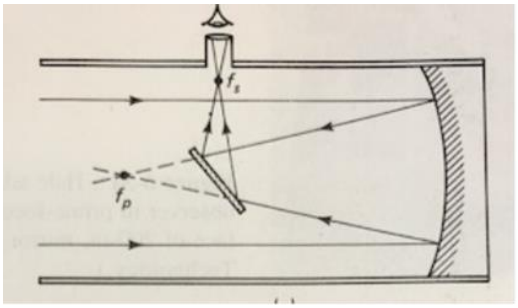
Both types comprise 2 lenses with different focal distances: objective and ocular (eyepiece). The telescope is, generally, used to observe distant objects. As long as the distance to the object is large, almost infinite (a star, for example), regular magnification is not very useful. A more convenient parameter is angular magnification. Angular magnification M is the ratio of the angle subtended by the image α_M to the angle subtended by the object α_O.

As we can see from the picture, the angular magnification of an astronomical telescope is:

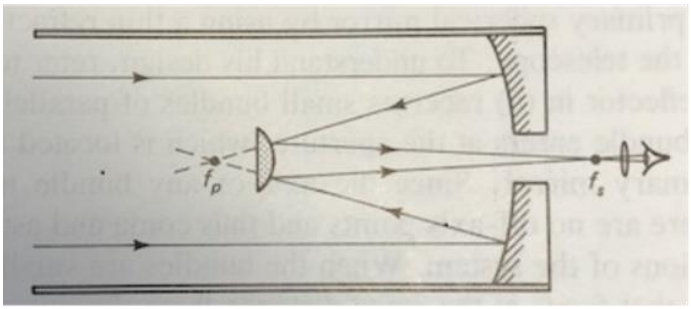
$$M = \frac{\alpha'}{\alpha} = -\frac{f_o}{f_e}$$

The total length of a telescope is $L=f_o+f_e$.

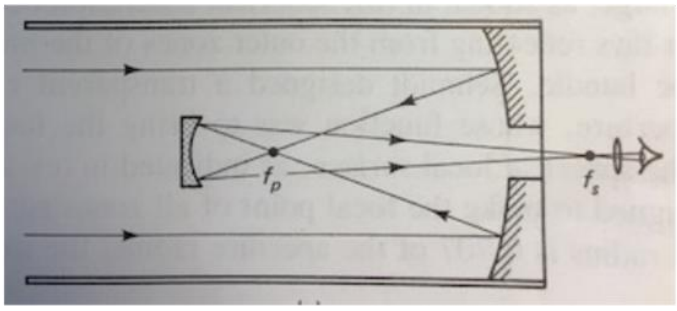
Larger objective lenses collect more light and provide higher resolution. However, they are difficult to produce and their weight is difficult to support. The chromatic aberration is another disadvantage of the refractive optics. Application of the reflection optics can solve these problems. Below are the optical schemes for reflective telescopes:



Newtonian telescope



Cassegrain telescope



Gregorian telescope

(The pictures are taken from "Introduction to optics" by Frank L. Pedrotti and Leno S. Pedrotti).

Problem:

1. An astronomical telescope is used to project a real image of the moon into a screen 25cm from an ocular lens with a focal length of 5cm. How far must the ocular be moved from its normal position?

2. Explain the operation principle of the reflective telescope.