

Donald P. Shiley School of Engineering
EGR 491 Telescope Design, Fall 2019
Assignment 7 – Eyepieces

Eyepieces are equally as important, if not more important than the telescope's optics themselves. Since they are complex designs, requiring sophisticated manufacturing, very few ATM'ers (amateur telescope makers) ever attempt making their own eyepieces – they let the pro's handle it. And why not, acceptably good eyepieces start at about \$50. However, as with any hobby, there is always opportunity to spend more if you want to. Very good eyepieces cost \$100-\$200 and premium can cost over \$800.

So how much should you spend? My recommendation for any hobbyist (regardless of the hobby) is to purchase good quality, but not necessarily the best quality. As a beginner, it is usually easy to tell the difference between "cheap" and "good quality", but noticing the difference between "good" and "excellent" often requires familiarity only gained through practice. I would recommend purchasing 1 or 2 good quality (\$50 range for each) medium to low power (50X-100X) eyepieces for your telescope. In a year, buy a second or third one (~150X). Three is a good complete collection. As you go to star parties, ask others if you could look through their telescope, and do a comparison between your \$50 eyepiece and their \$200 (or \$800) eyepieces. See what you enjoy – not all \$200 eyepieces are the same. Some are better for planets, some are better for star clusters. All eyepieces work well for both, even \$50 ones.

A 2X Barlow lens is a good way to double your eyepiece collection. Barlow's are placed in series with the eyepiece to cut their focal length in half (double the magnification). They are cost around \$50 and work well.

Personally, I use two eyepieces for about 75% of my observing: a low power (40X) and a medium power (110X). I use a moderate-high power (180X), fairly regularly, but less frequently I use a higher power (210X). Very rarely do I use magnification much over 200X.

The basic job of an eyepiece is to make the image produced through a telescope usable by your eye. The key characteristic of any eyepiece is its focal length. The magnification produced by your telescope and eyepiece is a function of their focal lengths: $M = FL_{\text{primary}} / FL_{\text{eyepiece}}$. Even the cheapest of eyepieces come a variety of focal lengths, so what makes one piece better than another? There are a number of parameters, which you will explore in this assignment to help answer that. Some characteristics are more important to some people than to others. There is no perfect eyepiece. Some characteristics include *apparent field of view*, *eye-relief*, "flatness of field" (something I don't really understand), image sharpness, contrast (dark things remain dark), and barrel size (1.25", 2").

Read the following to fill in the blanks below.

<https://starizona.com/tutorial/understanding-eyepieces/>

https://www.astronomics.com/how-to-pick-an-eyepiece_t.aspx

<https://www.skyandtelescope.com/astronomy-equipment/telescope-eyepiece-guide/>

Of course, doing a google search to help with any specific question may be a good idea.

Sketch of basic telescope/eyepiece optics:

Magnification is determined by (equation):

Eye relief is (sketch and describe).

Field of view (define):

Apparent field of view (define):

The three common eyepiece sizes (the diameter of the barrel that is inserted into the telescope focuser) are 0.963", 1.25" and 2.0". Which is the most common? Which should be avoided? When is 2" useful (are they more common/necessary for high power or lower power)?

Now read through the following link to learn a little about the wide variety of optical designs. Then answer the questions below regarding a few commonly used designs (because they are good). https://www.chuckhawks.com/common_eyepiece_designs.htm

Sketch and discuss orthoscopic eyepieces:

Sketch and discuss Plossl eyepieces:

The premium modern eyepieces are made by Tele Vue optics (televue.com) founded by Al Nagler. Sketch (or cut and paste) and discuss Nagler type eyepieces:

Discuss Radian eyepieces. Visit televue.com (or google) to determine cost range.

Discuss Panoptic eyepieces. Visit televue.com (or google) to determine cost range.

Discuss Ethos eyepieces. Visit televue.com (or google) to determine cost range.

From any resource: what is a Barlow lens and what is it used for? Why might someone want to purchase one?