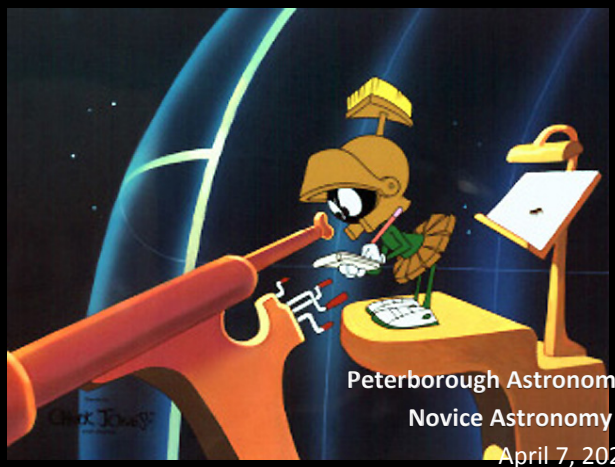
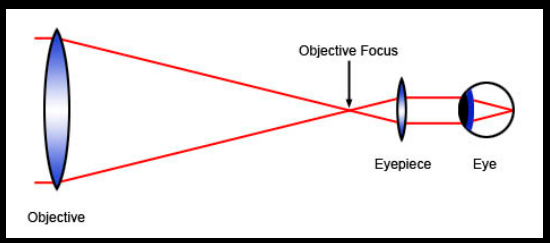
Eyepieces & Observing Techniques



Peterborough Astronomical Association
Novice Astronomy Class # 13
April 7, 2023
Brett Hardy

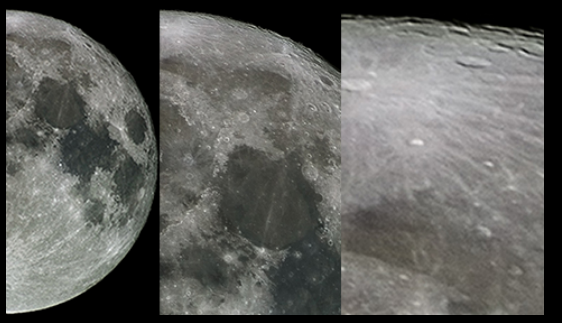
What is an eyepiece?

- Optical device composed of two or more glass elements
- Provides a magnified view



Magnification

- The most important factor in an eyepiece is magnification
- Magnification is determined by the focal length of the eyepiece (mm)
- The smaller the focal length, the greater the magnification
- Magnification changes by telescope
- Magnification = Telescope focal length ÷ Eyepiece focal length
- 1,400 mm ÷ 26 mm = 53.8x
- 1,400 mm ÷ 8.8 mm = 159x
- Increasing magnification gives a larger image
- Increasing magnification gives a smaller field of view and dimmer object

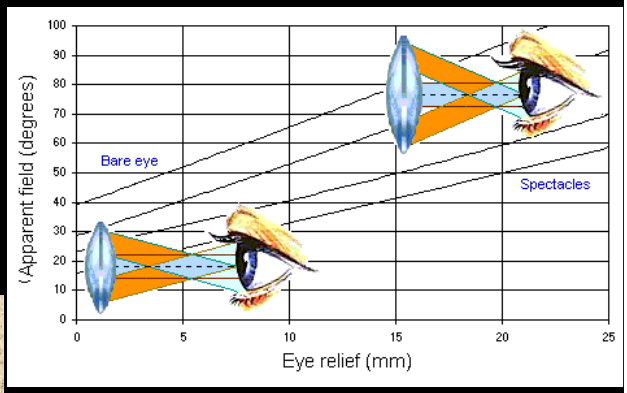


Field of View

- Amount of sky seen through an eyepiece = actual (true) field of view
- Apparent field of view is a design characteristic of an eyepiece
- Narrow apparent field of view vs. wide apparent field of view
- Remember, field of view is also changed with magnification
- AFoV ranges from 40° to 110°
- Actual field of view (true field) = Apparent of view ÷ magnification
- For example: 22 mm Panoptic has 68° AFoV and 64x (1,400 ÷ 22 = 64)
- Actual Field of View = 68° ÷ 64x
  = 1.06°

Eye Relief

- Light cone or exit pupil distance from an eyepiece
- Eye relief determines the comfortable eye distance from an eyepiece
- Eyepieces with small focal lengths (higher power) have shorter eye relief
- > 25 mm can be a problem
- Glasses
- Astigmatism



ATM

Space.FM

Eyepiece Quality

- You get what you pay for ☺
  - Fit & finish
  - Sharper images
  - Higher contrast
  - Less ghosting and flaring
  - Number of elements
  - Coatings: ***fully*** multi-coated
  - Eye cup
- Apparent field of view
- Optical aberrations

Eyepiece Barrel Size

- Designed to fit focusers
- Two standard sizes: 1.25” & 2”
- 0.965” are to be avoided
- 1.25” are more common
- 2” generally for lower magnification wide field views
- Hybrid 1.25 & 2” barrels

Barlows

- Two different barrel sizes
- 2x barlow is most common
- Chosen wisely, a barlow ***can*** double your eyepieces
- 40 mm, 26 mm, 10 mm + 2x barlow = 20 mm, 13 mm, 5 mm
- Placing barlow ahead of the diagonal gives ~ 50% more magnification

Diagonal

- Two different barrel sizes
- Comfortable viewing angle
- 2” to 1.25” adapter ?
- Mirror reversed image

Recommendations

- Standard kit:
  - 1 low (25-90x)
  - 1 medium (100-175x)
  - 1 high (180x >)
- 2” low magnification wide field
- At least one premium medium power eyepiece
- Optimum medium power eyepiece = focal ratio of telescope x 2
- For example: f/8 x 2 = 16 mm
  Magnification = 1,400 ÷ 16
  = 87.5x
- Quality barlow
- Quality diagonal
- Neutral density filter
- Purchase best budget permits
- Utilize a case

Plössl Eyepieces

- Least inexpensive, descent quality
- Good starter eyepieces
- Good eye relief
- 3 – 4 element design
- 1.25″ barrel
- ~ 52° AFOV

Purchasing Equipment

Telescopes Canada
Ontario Telescope & Accessories
KW Telescope
Amazon

Meade
Celestron
TeleVue
Vixen
Orion
Explore Scientific
William Optics
Baader

Used Market
Canada-Wide Astronomy Buy & Sell
https://www.astrobuysell.com/

Care & Cleaning

- Resist the temptation to clean!
- Fingerprints
- Eyelashes
- Dew, dust, pollen
- Cap & replace

Cleaning Procedure

- Remove loose dust/debris
- Lens blower duster
- Camel hair brush
- Cleaning Solution: 1/3 isopropyl alcohol (99%), 2/3 distilled water and 1 drop biodegradable dish soap
- Pure cotton balls & Q-tips
- LensPen for stubborn spots

- Optics Clinic: July 8

Optimize Your Eyepieces

- Filters
- Eyepieces come threaded for filters
- You guessed it!
- Neutral density filters: moon filters
- Improve contrast & preserve night vision
- 0.9 density = 13% transmission
- Colour-neutral views
- Polarizing filter
- Often threaded for stacking
- NOT FOR SOLAR VIEWING!

Photographic Filters

- Blue, green, red, orange, yellow
- Useful for enhancing features on Jupiter, Saturn, Mars & Moon
- NOT FOR SOLAR VIEWING!

Light Pollution & Sky Glow Filters

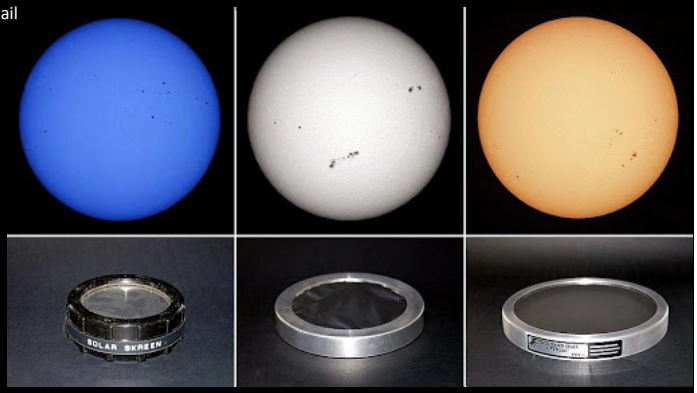
Broadband filters that block most common wavelengths of LP
Darkens background/Increases contrast
Most useful on star clusters & galaxies
Useful in dark skies too!
NOT FOR SOLAR VIEWING!

Narrow Band & Line Filters

- Often referred to as nebula filters
- Enhance emission & planetary nebulae
- Narrow band filters
- Block all wavelengths except ionized hydrogen and doubly ionized oxygen
- UHC
- Line filters
- Block all wavelengths except for a specific wavelength
- Oxygen III (OIII), Hydrogen alpha (Hα), Hydrogen-beta (Hβ)
- NOT FOR SOLAR VIEWING!

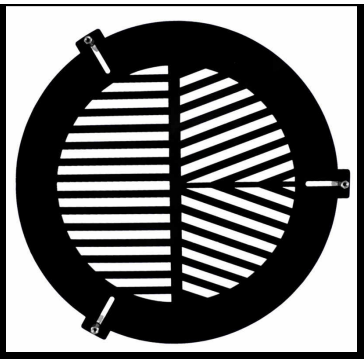
Solar Filters

- Block > 99 % of Sun's light
- Visual & Photographic
- Sun spots & surface detail



Observing Techniques

- Focus is critical
- Bahtinov Mask
- Focus changes as scope cools
- Focus will change when a new eyepiece is inserted: Parfocal eyepieces
- Focus will change when you put in a filter
- High magnification focusing is difficult
- Electronic focusers



STARWAVE™

Example Bahtinov mask diffraction pattern on a bright star:

Inside focus Perfect focus Outside focus

Observing Techniques

- Magnification
- Eye dominance
- Close one eye
- Glasses: yes or no?
- Rest face gently against rubber eye cup
- Look straight down the eyepiece
- Rubber eye cups block stray light & help centre your eye

Observing Techniques

- Get comfortable – sit down!
- Breathing
- Averted vision
- Gently tap the telescope to see dim objects
- Slow down & observe!
- Sketch and/or make notes
- Experience allows you to see more

Novice Astronomy Class # 14

Light Pollution

May 5, 2023

Blue Marble Navigator