

Culpeper Astronomy Club June 18, 2018



- Introductions
- Some Telescope Basics
- Double Stars
- Constellations
- Observing Session

Aperture

The Powers of a Telescope: Size Does Matter

1. Light-gathering power: Depends on the surface area A of the primary lens / mirror, proportional to diameter squared:

 $A = \pi (D/2)^2$



Limiting Magnitude

Aperture (inches)	Aperture (mm)	Limiting Magnitude (method 1)	Limiting Magnitude (method 2)	
1/4		7.5	6.3	
.31	8	8.2	6.9	
2	50.8	12.2	11.0	
3	76.2	13.1	11.8	
4	101.6	13.7	12.5	
5	127.0	14.2	12.9	
6	152.4	14.8	13.3	
8	203.2	15.2	14.0	
10	254.0	15.7	14.5	
11	279.4	15.9	14.7	
12	304.8	16.1	14.8	
14	355.6	16.4	15.2	
16	406.4	16,7	15.5	
17	431.8	16.8	15.6	
18	457.2	17.0	15.7	
20	508.0	17.2	16.0	
22	558.8	17.4	16.2	
24	609.6	17.8	18.4	
30	762.0	18.1	16.8	
32	812.8	18.2	17.0	
200	5080	22.2	21.0	

Method 1 M_L = 3.7 + 2.5 * Log₁₀(D²) where D = aperture in mm. From "VISUAL ASTRONOMY FOR THE DEEP SKY" by Roger N. Clark.

Method 2 M_L = 9.5 + 5.0 * Log₁₀(D) where D = aperture in inches. From "THE OBSERVATIONAL AMATEUR ASTRONOMER" by Patrick Moore.

The differences in columns reflect differences in initial assumptions about sky conditions, visual acuity and others. Your results may vary.

Magnification

- <u>Magnification</u> for a specific telescope changes with the eyepiece used
 - Calculated by dividing the focal length (FL) of the telescope (usually marked on the optical tube) by the focal length (fl) of the eyepiece
 - Mag = FL / fl
 - For example:
 - My Stellarvue SV110ED with a 770mm focal length using a 10mm eyepiece produces 77x magnification (770/10=77x)
 - My 102mm Unitron with a 1500mm focal length using a 10mm eyepiece produces 150x magnification (1500/10=150x)
 - 30 inch Obsession, f4.5, about 3500mm focal length using 31mm eyepiece produces 112x (3500/31=112x)
 - Higher the magnification smaller the field of view (FOV)

Resolving Power

- <u>Resolving power</u> is the ability of an optical instrument to produce separate images of closely placed objects...a double star
 - In 1867, William Dawes determined the practical limit on resolving power for a telescope, known as the Dawes limit...the closest that two stars could be together and still be seen as two stars
 - The Dawes Limit is 4.56 seconds of arc, divided by the telescope aperture in inches; converted to metric (approx): PR = 120/DO)
 - For example, my SV110ED with 110mm aperture (120/110) has a resolving power of 1.09 arc seconds
 - My 102mm Unitron has a resolving power nearly the same at (120/102) 1.18 arc seconds
 - The 30 inch Obsession, theoretically, yields 0.16 arc seconds

Binary/Multiple Stars – The Motivation

- They can be observed with a large or small telescope
- There are plenty of targets even for a small telescope
- They are beautiful, like multicolored gems in the sky
- They are a great challenge, some difficult to split
- They can be observed even with LP and full moon around

Categories of Binary/Multiple Stars - Optical

- Two and more stars may just happen to be nearly along the same line of sight
 - With one star being much farther than the other
- Viewed from Earth appear close together
 - Visually appear to be many of these
- Alcor and Mizar are examples

Categories of Binary/Multiple Stars - Physical

- <u>Telescopic</u> appear as one but separate through a telescope
 - Thousands that can be split with amateur telescopes
- <u>Astrometric</u> detected through changes in motion
 - Sirius B was detected in this manner
- <u>Eclipsing</u> detected through changes in brightness
 - Agol (the Demon Star in Perseus) is brightest example
 - Usually never see the companion star
- <u>Spectroscopic</u> detected through changes in spectral images over time
 - By definition can't be split with telescope
 - Spectroscope distinguishes two suns traveling together in space

Observing and Measuring Double Stars





Binary/Multiple stars – Mizar and Alcor

- <u>Mizar</u>: Middle star in the Big Dipper
- Should be able to detect faint companion with naked eye – Alcor
- Pair is commonly referred to as "Horse and Rider"
- Mizar was first double star discovered and photographed
- Secondary takes several thousand years to complete orbit
- Distance: 80LY
- Magnitudes: 2.0; 4.0
- Separation: 14"



Binary/Multiple stars – Cor Caroli

- Brightest star in Canes Venatici is Cor Caroli
- Named for King Charles (one of them!)
- The two stars are separated by 20 sec of arc, corresponding to a projected separation of 680 AU
- Yellowish-white and lilac
- Distance: 110LY
- Magnitudes: 2.84; 5.60
- Separation: 19.6"





Binary/Multiple stars – Izar

- Izar (Epsilon Bootis) is easy to spot along the eastern side of the Bootes
- The name Izar comes from the Arabic word for "veil."
- Difficult split because of magnitude difference
- Gold and slate blue at about 200X
- Distance: 203LY
- Magnitude: 2.5; 4.6
- Separation: 2.8"





Binary/Multiple stars – Gemini

- <u>Alpha Geminorium (Castor):</u>
- Both are viewed as yellow-white
- Actually 6 stars gravitationallybound making it a sextuplet system
- Nice pair at 100x
- Distance: 50LY
- Magnitudes: 1.9; 2.9
- Separation: 2.2"
- Kappa Geminorium
- Distance: 43.4LY
- Magnitudes: 3.7; 8.2
- Separation: 7.5"







Binary/Multiple stars – lota and Zeta Cancri

- <u>lota Cancri</u>: yellow-blue/white pair with 60,000 year period
- Distance: 298LY
- Magnitudes: 3.9; 6.8
- Separation: 30.6"
- <u>Zeta Cancri</u>: Multiple star system; first yellow-white pair easily split; second not so;
- Distance: 83.4LY
- Magnitudes: 5.58; 5.99
- Separation: 5.06" (<1")





Binary/Multiple stars – Algieba

- Brightest star (after Regulus) in the "Sickle" of Leo
- Algieba, comes from the Arabic *Al* Jabbah (The Lion's Mane).
- A clean split requires a magnification of 100X or more
- What makes Algeiba so visually striking is its rich golden-yellow hues
- Distance: 130LY
- Magnitudes: 2.4; 3.6
- Separation: 4.6"





Binary/Multiple stars – Porrima

- Virgo has the fine binary star Porrima, one of the few stars close enough to show detectable motion during our lifetime
 - Separation less than 1.0" in 2005
- The two stars in this system revolve about each other in 169 years
- Distance: 39LY
- Magnitudes: 3.48; 3.53
- Current Separation: 2.5"



RESOURCES

- Sky and Telescope website: <u>http://www.skyandtelescope.com/</u>
- Stellarium software application: <u>www.Stellarium.org</u>
- Suggested books:











HERCULES – "THE HERO"

- The fifth largest constellation in the sky; has no first magnitude stars
- Rasalgethi: (Alpha Herculis)
 - Multiple star system 360 LY Distant
 - Primary star is a red giant; 400X Sun
 - Orange-Green Pair
- Hercules contains two Messier objects:
 - Messier 13 (M13, NGC 6205) Globular Star Cluster
 - Messier 92 (M92, NGC 6341) Globular Star Cluster



CYGNUS – "THE SWAN"

- Cygnus: Easy to find as it features a well-known asterism known as the Northern Cross
- Double Stars
 - Albireo: Marks the head of the swan; also known as "the beak star"; yellow primaryblue companion
 - 61 Cygni: "Bessel's Star"; composed of a pair of two dwarfs; first star to be measured
- Deep Sky Objects
 - "Veil Nebula" (NGC6990/2/5)
 - "Fireworks" Galaxy NGC 6946
 - M39 Open Star Cluster



LYRA – "THE LYRE"

- Lyra represents the lyre of Orpheus, the musician and poet in Greek mythology
- Epsilon Lyrae, The "Double Double"
 - Multiple star system about 162 LY distant
 - Apparent visual magnitude 4.7
 - Can be resolved into two binaries when observed through a telescope
- Beta Lyrae, Eclipsing Double
 - Pair of stars in a very tight orbit
 - Light varies gently and continuously over its 12.9-day period
- Deep Sky Objects:
 - M57 Planetary Nebula
 - M56 Globular Star Cluster



METEOR SHOWERS

shower	average date of maximum	normal duration (days)	visual strength (Northern Hemisphere)	entry velocity (km/sec)	associated comet
Quadrantid	January 3	1	medium	41	not known
Lyrid	April 22	1	irregular	48	Thatcher
Eta Aquarid	Мау З	5	weak	66	Halley
Southern Delta Aquarid	July 29	8	medium	41	not known
Capricornid	July 30	3	medium	23	not known
Perseid	August 12	5	strong	59	Swift-Tuttle
Andromedid	October 3	11	weak	21	Biela
Draconid	October 9	1	irregular	20	Giacobini-Zinner
Orionid	October 21	2	medium	66	Halley
Taurid	November 8	30	weak	28	Encke
Leonid	November 17	less than 1	irregular	71	Tempel-Tuttle
Geminid	December 14	4	strong	34	(3200) Phaethon*



UPCOMING EVENTS

- Date: July 23, 2018 at 7-9 p.m.
 - Topic: Variable Stars
- Mars Opposition: July 27
- Perseid Meteor Shower: August 11-14
- Comet 46P/Wirtanen: December 2018

COMET 46P/WIRTANEN

- Small short-period comet orbital period of 5.4 years
- Discovered on Jan 17, 1948, by the American astronomer Carl A. Wirtanen
- On 16 December 2018 the comet will pass within 7.2M miles of Earth
 - Estimated magnitude of 3 to 7.5
- Brightest predicted pass to date...and all future passes



Stars

- Binary/Multiple Stars
 - Numerous targets available
 - Can be Physical or visual
 - Provide great contrasting colored pairs
 - Can be challenging to split depending on scope size and atmospherics
- Carbon Stars
 - Most are Red Giants
 - Red complexion comes from carbon in their atmosphere
- Variable Stars
 - Observed over time



