Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers April 2018

Events:

General Meeting :

Monday, April 2, 2018 at the Temecula Library, Room B, 30600 Pauba Rd, at 7 pm.

After opening comments by Vice President Skip Southwick, "What's Up" will be presented also by Skip.

Then Tom Mulder will give a talk on "An Overview of the Boeing CST-100 Starliner". Goodies afterward courtesy of Chuck Dyson.

Please consider helping out at one of the many Star Parties coming up over the next few months. For the latest schedule, check the Calendar on the web page.

An artist's depiction of Tiangong-1, China's first-ever space station. Click here for latest re-entry prediction. Credit: China Manned Space Agency

WHAT'S INSIDE THIS MONTH:

Send newsletter submissions to Mark DiVecchio <markd@silogic.com> by the 20th of the month for the next month's issue.

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General information:
Subscription to the TVA is included in the annual $25 membership (regular members) donation ($9 student; $35 family).

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Cosmic Comments
by President Mark Baker

OUTREACH… a year ago I spoke about being a new Docent at CalTech Palomar Observatory and how, growing up, it was one of my favorite places to visit. Even as a kid, I marveled at the engineering of such a monumental undertaking… without computers, 3D printers, or electronics of any kind, it is an amazing edifice.

I could tell you just how much I have learned in that year, but doubt any of you would "buy the book"!!! More importantly, I could tell you how much information, historical and current, I have shared with those that visit. That is Outreach…

So, it is now the season where we recruit new Docents to keep the story alive and promote the cutting edge science the "old girl" and her companions still provide. What do you say?? Looking for a way to contribute, even more than you already do, to opening up the cosmos?? Hoping to inspire even one youth, or old person, to look up?? Well, here's your chance…

IF you would like to look into being a Docent up at the 200" dome, you can visit the website at http://www.astro.caltech.edu/palomar/community/docents.html or talk to Curtis Croulet, Mark DiVecchio, Jim Mettler, Roger Weber, or even me. The recruiting meeting is coming up and we'd love to see more of TVA represented!!

But, if nothing else, I'd hope that all of you take the opportunity to visit this local wonder in the near future…who knows, maybe you'll even get stuck with me as your Docent!!! It's still worth the trip…

And if you then realize that you can complement and supplement the work being done there with your own telescope and equipment, think how fulfilling that would be…as well as the contribution to the Sciences you can make in your own small way. This is how we add up to being greater than the sum of our parts!!!

Clear, Dark Skies my Friends…

Looking Up Redux
by Clark Williams

ALL TIMES ARE LOCAL PST WILDOMAR

*Times are given in 24-hour time either as hh:mm:ss or hhmmss. A time given as hhmm**+** indicates that it is the hour of the next day. Similarly a time hhmm− indicates a time in a previous day.*

Moon Phases for the month by date:

Sunday the 8th @ 00:18:48 PDT LAST QTR
Sunday the 15th @ 18:58:14 PDT NEW
Sunday the 22nd @ 14:46:44 PDT FIRST QTR
Sunday the 29th @ 17:59:23l PDT FULL

Apr 8 5:33 404144 km F+7d16h
Perigee comes on 2018-04-14 @ 08:46 368,712 km (229,108 mi)
Apogee comes on 2018-04-07 @ 22:33 404,144 km (251,124 mi)

2018 has: (12) new moons, (12) 1st Qtr moons, (14) Full moons, (13) 3rd Qtr moons (2) Blue moons and (1) Black moon

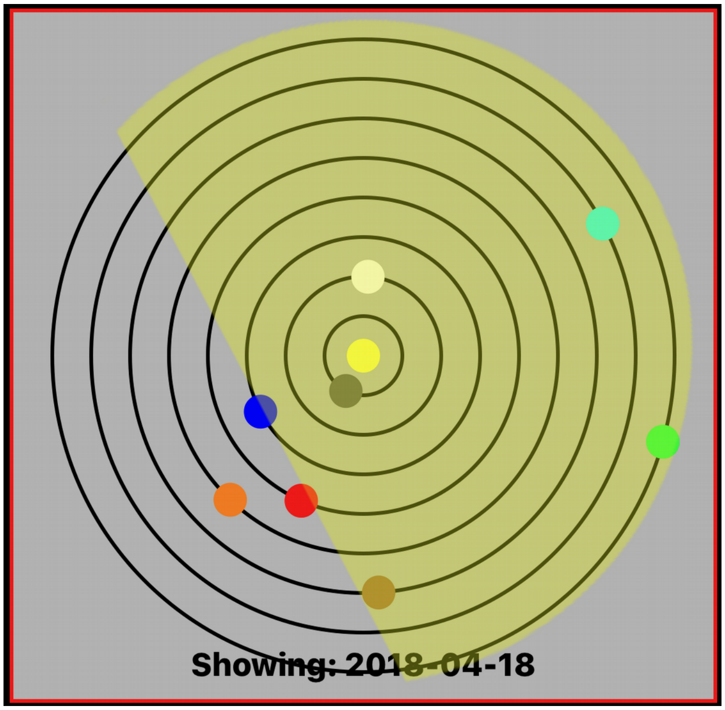
Luna:

The Luna phases all happen on the same day of the week this month: Sunday. Luna can be found in Virgo at the beginning of the month., rising at about 2036 LCL. It is near New phase in the middle of the month in Cetius. Luna closes out the month I Librae rising around 1933 LCL. NASA's own LRO has made a wonderful video of the entire moon as if it were not tidally locked. It was posted recently on APOD (Astronomy Picture Of the Day):

https://apod.nasa.gov/apod/ap180318.html

This is a very nice, highly detailed image of the moon. On the 3rd of April, the moon will be near Jupiter and near Regulus on the 24th of the month.

Planets:
Planetary Positions February 2018:



- **Mercury:** Mercury will be At its greatest western elongation on the 29th of April but it is still too close to the Sun for really good viewing..
- **Venus:** Is right next to Mercury. May will see some improvement. https://apod.nasa.gov/apod/ap180318.html
- **Mars:** On the 2nd of April Mars will be very close to Saturn. Mars rises at about 0149 LCL on that day and about 0300 LCL would be a great viewing/imaging time.
- **Jupiter:** Jove is moving into some great viewing spaces. Early in the morning still at the beginning of the month it rises around 2208 LCL. By the middle of the month it is rising at 2115 LCL and by the end of the month it is rising at 2008 LCL.
- **Saturn:** On the 2nd of April Saturn will be very close to Mars. This is early in the morning so be prepared for a 0300 viewing session. Saturn is moving into great viewing range along with Mars and Jupiter. Saturn will be rising about 0141 LCL in the beginning of April, 054 LCL vy mid month and 2345 LCL toward the end of the month.
- **Uranus:** Uranus has slipped into Sol's glare.
- **Neptune:** (see Uranus)
- **Pluto:** My favorite PLANET (besides earth of course) is unfortunately leaving the Solar System completely on the 1st of April. It seems New Horizons went by it so fast that the probe is pulling Pluto deep into the Oort Cloud. Pluto may even collide with Voyager I. We'll find out on April 1st 3018 for sure.

The dearth of planetary observing is finally coming to an end!

Meteors:

- It is April it is time for the Lyrids. Look up on the 22nd of April for this lovely show. The Lyrids are detritus left in the wake of Comet Thatcher. Tatcher is a long period comet with an orbit of 415 years. It was last swinging around the Sun in 1861 and won't be returning until 2276. We humans have been observing the Lyrids since around 687 BCE.

Comets:

- There are several comets coming in 2018 but for April they all have an apparent magnitude between 13 and 26. May will show an improvement in comets.

Deep Sky:

In each case you should look for the following on or about the 15th Day of April 2018 at 2100 PST and you will have about 20 minutes of viewing time total.

The one thing April:

- **M 37** (also known as NGC 2099) is the richest open cluster in the constellation Auriga. It is the brightest of three open clusters in Auriga and was discovered by the Italian astronomer Giovanni Battista Hodierna before 1654. M37 was missed by French astronomer Guillaume Le Gentil when he rediscovered M36 and M38 in 1749. French astronomer Charles Messier independently rediscovered M37 in September 1764 but all three clusters were recorded by Hodierna. It is classified as Trumpler type I,1,r or I,2,r.
- **M44** – The Beehive Cluster (also known as Praesepe (Latin for "manger"), M44, NGC 2632, or Cr 189), is an open cluster in the constellation Cancer. It is one of the nearest open clusters to Earth, containing a larger population of stars than other nearby bright open clusters. Under dark skies, the Beehive Cluster looks like a small nebulous object to the naked eye; as known since ancient times. Classical astronomer Ptolemy described it as "nebulous mass in the breast of Cancer," and it was among the first objects that Galileo studied with his telescope.
- **Spica**, also designated Alpha Virginis (α Virginis, abbreviated Alpha Vir, α Vir), is the brightest star in the constellation of Virgo and the 16th brightest star in the night sky. Analysis of its parallax shows that it is located 250 ± 10 light years from the Sun. It is a spectroscopic binary and rotating ellipsoidal variable; a system whose two main stars are so close together they are egg-shaped rather than spherical, and can only be separated by their spectra. The primary is a blue giant and a variable star of the Beta Cephei type. Spica, along with Denebola or Regulus depending on the source and Arcturus, is part of the Spring Triangle asterism, and by extension, also of the Great Diamond together with the star Cor Caroli.
- **M67** – an open cluster in the constellation of Cancer. M67's Trumpler class is variously given as II 2 r, II 2 m, or II 3 r. It was discovered by Johann Gottfried Koehler in 1779. Age estimates for the cluster range between 3.2 and 5 billion years, with the most recent estimate (4 Gyr) implying stars in M67 are younger than the Sun. Distance estimates are likewise varied and typically range between 800–900 pc. Recent estimates of 855, 840, and 815 pc were established via binary star modeling and infrared color-magnitude diagram fitting, accordingly
- M42 – a diffuse nebula situated in the Milky Way, being south of Orion's Belt in the constellation of Orion. It is one of the brightest nebulae, and is visible to the naked eye in

the night sky. M42 is located at a distance of 1,344 ± 20 light years and is the closest region of massive star formation to Earth. The M42 nebula is estimated to be 24 light years across. It has a mass of about 2,000 times that of the Sun.

These are great for imaging especially in this Jovian only planet lull and may get you into practice for the later spring and summer months of viewing.

For now – Keep looking up.

Random Thoughts
by Chuck Dyson

It is Time to Get Under the Skin of Mars

In the late 1950's, my father was the lead reservoir engineer for Chevron in Kern County California. If there were major decisions that needed to be made on whether or not to continue drilling on a well the engineer on site would shut down the drilling, pull the drill pipe, shoot a sound log of the well, collect rock samples from the drilling mud discharge tube, we used rock chips from the drilling process because getting a complete core sample from the bottom of the well was very expensive, and then call my father at 1 AM to 2 AM in the morning to consult with him on a proper course of action. My father would wake me and have me get out my black light in order to check the rocks for fluorescence and then we would roll out the sound log strip down the hall way, in the 50's and 60's all data was on paper strip charts, and look at what we had. A well log shows the changes in rock densities as one goes down into the earth, rock strata, and one gets quickly adept at reading the well logs. In addition to the well logs we had direct evidence of the type of rocks we were in from the drilling samples and the fluorescent data that my black light provided.

This was prospecting for oil in the 50's but however primitive it was compared to today's computer generated maps, in color of course, of the rock strata in the oil fields I think it fair to say that my father and I knew more about the interior of the Earth than scientists studying Mars know about the interior of Mars today.

What is known about the interior of Mars today comes mostly from remote sensors on orbiting satellites; one of my favorites is the Mars Reconnaissance Orbiter (MRO) that has two ground penetrating radars on board, one is for shallow (1km) high resolution penetration and the other is for deep (up to 5km) low resolution penetration. This instrument has given geologists the ability to look into Mars and at least see some of the structures that are inside the planet's outer crust.

Another Satellite based geology probe is the Thermal Emission Spectroscope (TES). This instrument measures the shaking pattern of different compounds and as each different compound shakes a little differently and produces a different signal in the infrared spectrum, you can tell from a distance what the compound is. When the TES instrument is coupled with another tool in the geologist's kit we can actually tell what minerals are in some of those strata imaged by ground penetrating radar.

The tool that I am talking about is large meteorites. When a large meteorite hits Mars it throws up a lot of debris and the top material goes the farthest from the impact site the material further down goes less far and the material from the bottom of the of the crater only goes a little way beyond the rim. Using the TES probe scientist can read the minerals in the different splash zones around the crater and get a good understanding of how the mineral makeup of Mars changes with depth. When the stratigraphic data from the ground penetrating radar is added to the TES probe data the geologists can get a good idea of how Mars was assembled layer by layer, at least to the depth of the deepest meteor crater.

The major method of determining what Mars is composed of deeper than 5km is to acquire a high quality signal from the satellites orbiting Mars and as the satellite goes over a denser than normal portion of Mars it will speed up, just a little, and the frequency of the signal will Doppler shift, just a little, to a shorter wavelength; when the satellite goes over a portion of Mars that is less dense normal the signal will Doppler shift, just a little, to a longer wavelength. By this method scientists have determined that Mars does have an iron core and approximately how big it is.

The reader may have gathered, by this time, that I may have exaggerated just a little when I said that my father and I knew more about the interior of Mars than the scientists actually studying Mars today. Be that as it may, this is the state of our knowledge of Mars at this time; however, it is all about to change as of May 5, 2018, I hope, because we will be launching three satellites on one rocket from Vandenberg and they are all bound for Mars. This will be the first interplanetary satellite to be launched from Vandenberg and the first multiple interplanetary satellite launch ever by NASA. The primary satellite will be InSight and it will be our first geology dedicated lander satellite to go to Mars. (Wikipedia)

The other two satellites will be cube satellites. Cube satellites are made from simple off-the-shelf components and the satellite frame is four inches by four inches in size although cube frames can be bolted together to make larger cube satellites. The cubes going to Mars are made from six cubes bolted together and are 14.4 X 9.5 inches in size each. The job of the two Mars Cube One (MarCO) satellites is to act as communication links between Earth and InSight during the landing phase of the mission so that the probe is never out of communication with Earth. The MarCO satellites will also be evaluated to see if they can form the basis for future low cost planetary satellite missions. The InSight probe will be the lander and is based on the Phoenix lander that looked for, and found, subsurface water in Mars' North Polar Region. InSight will have an upgraded atmospheric sensor package as this will be needed to accurately calibrate the instruments that will be measuring the heat flow from Mars' interior to its surface.

As long as we are talking about heat flow we should explore how it works for a bit. When bodies form and compress under gravity their cores get hot, very hot, and then over time cool down. Two examples are the Earth with a core that is today thought to be hotter than the surface of the Sun, 5,600 C, and the Moon with a core temperature today thought to be between 1,300C and 1,400C, estimated based on Apollo gathered data. The instrument on InSight that will measure Mar's temp is the HP3 probe and consists of a frame that holds the mole, the part that will actually dig into Mars, a tether that that will let the mole communicate with the InSight probe and also has temperature sensors embedded in it that will permit the measurement of that flow in the Martian soil. The mole itself has sensors in it to measure tilt because the mole needs to dig almost straight down for the experiment to work. If all goes perfect then the mole will dig down 5 meters and stop, 73%chance of this happening. After the mole stops digging or is ordered to stop because of unacceptable tilt, it has heating elements onboard that will heat the soil around it and this heat plume just like a plume of hot air will rise to the surface and the rate of rise, as measured by the tether's temperature sensors, will be recorded and this will permit scientists to calculate the thermal heat flow for Mars. The second instrument that will be placed on the surface of Mars by the is a good old fashioned seismograph, SEIS. Actually there will be six sensors inside of the seismometer housing and three of them will look at very broad based waves, VBB's, and three will measure short period waves, SP's. The SEIS sensors will not take kindly to temperature variations or to being buffeted by winds; so, the sensor pack will be encased here in a basic bun warmer that will reduce the temperature swings that the sensors will experience but will do nothing to stop the wind from shaking the instruments. After the SEIS package is placed on the Martian soil by the robotic arm on InSight, the arm will then pick up a large chafing dish like structure with flexible curtain sides and place, not drop, it over the top of SEIS now the sensor package should be warm and cozy as well as insulated from wind drafts and ready to get to work.

Much of what we know about Earth's interior and how it all works comes from knowing how different sound waves travel through different media at different temperatures and pressures. By analyzing the sound waves that SEIS receives we will learn much about the interior of Mars and how it works or doesn't work. The folks at JPL who are working on the InSight project have made a bunch of predictions on what we will find inside of Mars and how Mars works. If reality varies a great deal from the predictions, well then, we will need a whole new set of ideas on how Mars actually works.

The final seismic item that SEIS will look at is the hum of Mars. Even though the atmosphere of Mars is very thin, 1% as dense as the Earth's, as it blows over the surface of Mars it sets up a wave motion in the air and the air will transfer the energy of that wave motion to the ground. Depending on the surface composition of Mars, the ground will hum with a particular frequency and it is this hum that scientists hope to record. This will be a very, very faint signal.

The final geological instrument on InSight will be a radio communication horn and is the basis for the Rotational and Interior Structure Experiment, RISE. The goal of RISE is to measure the change in rotational speed and the wobble of Mars as it rotates and this will give indications as to what is inside Mars and how it is distributed. For an example of how this will work you can follow our Moon as it goes through its monthly cycle and over the course of a complete cycle you will be able to see about 59% of the Moon's surface not the 50% that you would expect. This is because of the lunar wobble that is known as libration.

If you are outside on May 5 between the hours of 4:04PM and 6:05PM and the sky is clear look for the launch of the satellite that will start the study of geology and geologic processes from the surface of Mars.

Cheers
Chuck

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The Five Numbers That Explain a Telescope
by Brian Ventrudo

May 4, 2016 Reprinted with Permission

A 14″ Schmidt-Cassegrain telescope (credit: Celestron).

Let's have a quick look at 5 key numbers that describe the operation and performance of every telescope, from the junk scopes in a department store to the venerable Hubble Space Telescope. Once you understand these 5 numbers, you will understand the similarities and differences between telescopes, and you will know how to choose the best scope for your own interests and budget.

1. Aperture – Buckets of Light

As mentioned in a previous article, the most important specification of any telescope is the *aperture*, the diameter of the main lens or mirror of the telescope. More aperture makes for a brighter image. Aperture also influences most of the other key specifications of a telescope, including practical (but non-optical) specs like cost and weight. A good backyard telescope for us amateur stargazers has an aperture of 80 mm to 300 mm (3.15" to 12") or more. Some big billion-dollar professional telescopes have mirrors with an aperture of 10 meters (400 inches), about the size of a small trout pond.

The aperture of a lens or mirror is the diameter of its light collecting region. The light-collecting ability of an objective lens or mirror is related to the square of the aperture.

The light collecting ability of a telescope is directly proportional to area of the lens or mirror, which is in turn related to the square of the aperture. So a telescope with an objective mirror of 200 mm aperture collects four times as much light as a scope with a 100 mm mirror. The cost and weight of a lens or mirror also go up proportionately, sometimes faster than the square of the aperture. That's the main tradeoff, and it's one of the reasons not everyone has a 25″ Dobsonian reflector sitting in their garage. They are big and heavy and expensive.

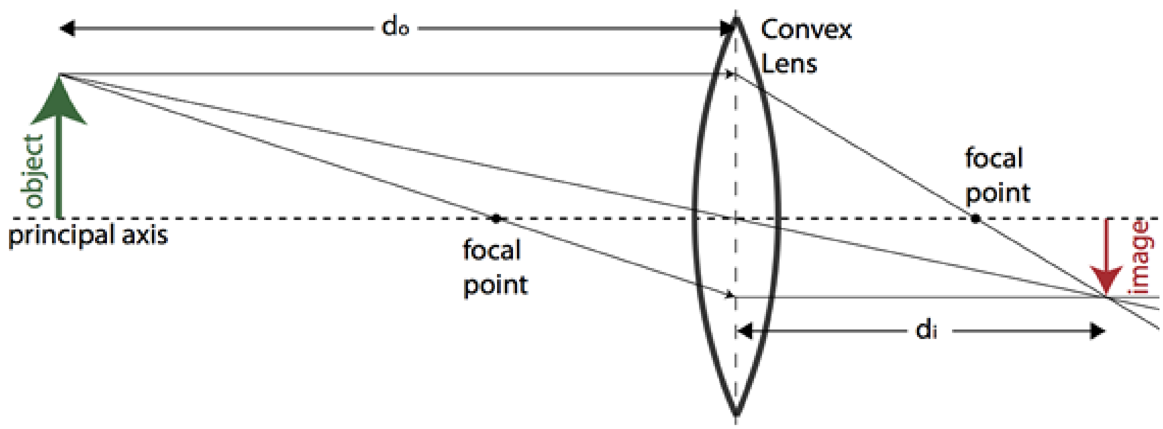
The aperture of a lens or mirror is the diameter of its light collecting region. The light-collecting ability of an objective lens or mirror is related to the square of the aperture.

For reference, the aperture of a healthy and dark-adapted human eye is 7 mm. So even a modest telescope with a 100 mm aperture (about 4 inches) has $(100/7)^2$ = 204 times the light-collecting ability of the eye.

2. Focal Length – Show Me the Image

Once light falls onto a mirror or through a lens, it's directed by the curvature of the optic to come to a focus at a plane some distance away. The length over which this happens is called the *focal length* of the objective. At the focal plane of a lens or mirror, you can actually see a real image of a distant object. So if a telescope with a lens is aimed at a distant tree, for example, or the Moon, an image of the tree or Moon would be visible on a screen placed at the focal plane of the lens.

The focal length of the objective lens or mirror of a telescope will influence to some degree the overall length of a telescope. This 12″ telescope, which uses a large mirror to collect starlight, has a focal length of about 60″. So the overall length of the scope is quite long and can be unwieldy for some. Some modern scope designs use a clever optical layout to squeeze a long focal length into a small optical tube. This telescope has an 8″ (200 mm) mirror with an 80″ (2000 mm) focal length, but the light folds into a tube less than 20″ (500 mm) long. More about this type of scope in a later article...



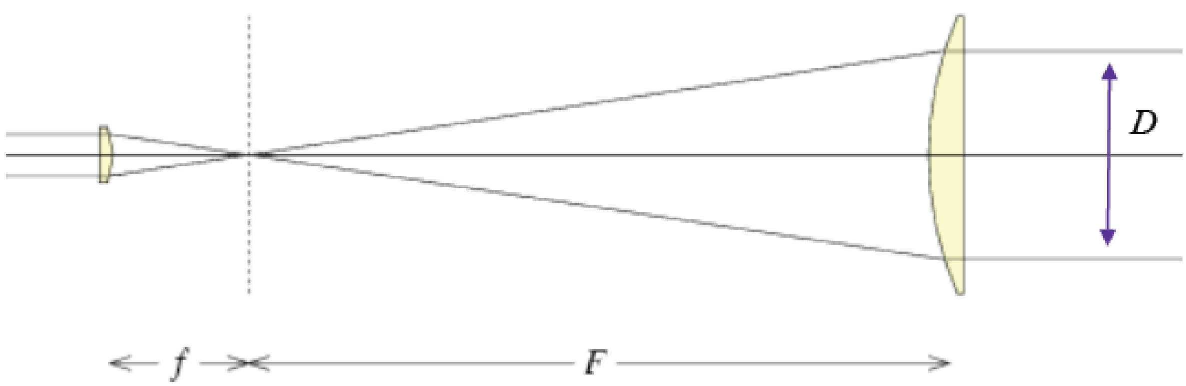
The production of an image of a distant object by a lens. In astronomy, where the objects are essentially at infinity, the image comes to focus at a plane that passes through the focal point.

3. Magnification – Far and Away, Up Close

To get an image suitable for observing with our eyes, a telescope uses a second lens, or collection of lenses, called an *eyepiece* at the focal plane. The eyepiece magnifies the image from the objective. The eyepiece also has a focal length. The magnification of a telescope and eyepiece is very simple to calculate. If the focal length of the objective is "F" and the focal length of the eyepiece is "f", then the magnification of the telescope/eyepiece combination is F/f. For example, if a telescope has an objective lens with focal length of 1200 mm (about 48") and it has an eyepiece of focal length 25 mm (about 1"), then it will have a magnification of 1200/25=48x. Nearly all telescopes allow you to change eyepieces to get different magnifications. If you want to get a magnification of 100x with this example, you use an eyepiece with 12 mm focal length.

The Moon seen through a telescope at high magnification

Another rule of thumb… the maximum useful magnification of a telescope is about 50x the aperture in inches. Any higher and the image gets too dim and fuzzy to be useful. So a 4-inch scope can get you about 200x before the image gets too fuzzy and dim, a 6-inch scope gets you 300x, and so on. This is not a hard-and-fast rule. Sometimes, when the atmosphere is unsteady, you can only get to 20x or 30x per inch of aperture. With high-quality optics and steady seeing, you might get to 70x or even 100x per inch of aperture, so for example, up to 400x with a 4-inch scope. But this is rare.



The aperture of the objective lens of this simple telescope is D. The focal length of the objective lens if F. The focal length of the eyepiece is f. So the magnification is F/f. The focal ratio is F/D.

4. Focal Ratio – Faster, Brighter, Smaller

The third key specification of a telescope is the focal ratio, which is the focal length divided by the objective diameter. A long focal ratio implies higher magnification and narrower field of view with a given eyepiece, which is great for observing the moon and planets and double stars. For such objects, a focal ratio of f/10 or more is ideal. But if you want to see wide views of star clusters, galaxies, and the Milky Way, a lower focal ratio is better. You get less magnification, but you see more of the sky. Wide field telescopes have a focal ratio of f/7 or less.

Focal ratio also influences the brightness of extended objects like a nebula or galaxy. For example, a telescope with focal ratio of f/5 will show an image of four times the brightness as a telescope with focal ratio of f/10, all other things being equal. But the image at f/5 will be only half as large. However, the brightness of stars, which are point sources of light, is influenced only by the telescope aperture.

5. Resolving Power – Sorting One Star From Another

Finally, the last important number of any telescope: the resolution. The resolution of a telescope is a measure of its ability to distinguish small details of an object or to distinguish two very closely spaced objects from each other. Resolution is important when you're trying to separate two closely-spaced stars, for example, or fine detail on the Moon or a planet. The resolving power of a telescope with an objective of aperture D (in millimeters) is

Resolving Power = 116/D (in arcseconds)

The resolution of a telescope is a measure of its ability to separate closely-spaced objects. The components of the double star Porrima are separated by just 1.8".

Resolution is directly proportional to the aperture of a telescope. A 200 mm scope can resolve details as close as 0.58 arcseconds, twice as well as a 100 mm scope, all other things being equal. (One arcsecond is 1/3600 of a degree). But the motion and instabilities in the Earth's atmosphere often limit the practical resolution of any telescope to 1″ or more.

Brian

The TVA is a member club of The Astronomical League.