nightwatch

Newsletter of the Pomona Valley Amateur Astronomers

Be glad of life because it gives you the chance to look up at the stars.
Henry Van Dyke

**VIRTUAL CLUB EVENTS
SEE WEBSITE FOR DETAILS**

Volume 40 Number 9 ***nightwatch*** **September 2020**

President's Message

I confess, it's kind of a depressing time to be writing about stargazing, penned in as we are by heat, smoke, ash, and poor air quality. The week before last, I had ash from the fires in San Dimas and Azusa swirling into little drifts in the corner of my driveway in Claremont. Fingers crossed that the wildfires end soon, and the air clears.

We have stuff to be looking forward to. Mars is racing toward opposition on October 13--or rather, we are racing toward it, as Earth catches up to the Red Planet. Jupiter and Saturn continue to put on a great show in the southern sky. Jupiter will overtake Saturn on December 21, but we'll have to be quick to catch that conjunction, since both planets will be behind the sun just one month later.

In lieu of doing much observing, I've been reading more--physics, astronomical history, observing guides, telescope catalogs, you name it. If the opportunities to let starlight tickle our retinas are few these days, we can look outward with the mind's eye instead. That's a pretty good setup for our speaker this month, Dr. Robert Piccioni. Dr. Piccioni trained at Caltech and Stanford, taught at Harvard, and did research at the Stanford Linear Accelerator. In recent years he has turned his energies toward outreach and education, writing books, teaching classes, and giving lectures. You can learn more at his website, https://www.guidetothecosmos.com/.

Einstein is one of Dr. Piccioni's favorite topics, and this Friday he'll be speaking to us about, "General Relativity for Everyone". The meeting starts at 7:30, via Zoom. I hope to see you there.

Matt Wedel

Club Events Calendar

Sep 25 Virtual General Meeting – Robert Piccioni "General Relativity for Everyone"

Oct 3 Star party/swap meet/social get together at Cahuilla Park - 6 pm
Oct 10 Star Party -- Cow Canyon Saddle, Mount Baldy
Oct 21 Virtual Board Meeting
Oct 30 Virtual General Meeting

Nov 7 Star Party -- Cottonwood Springs, Joshua Tree National Park
Nov 11 Virtual Board Meeting
Nov 20 Virtual General Meeting

Dec 5 Star Party -- Death Valley National Park
Dec 12 Christmas Party

PVAA General Meeting 08/28/20

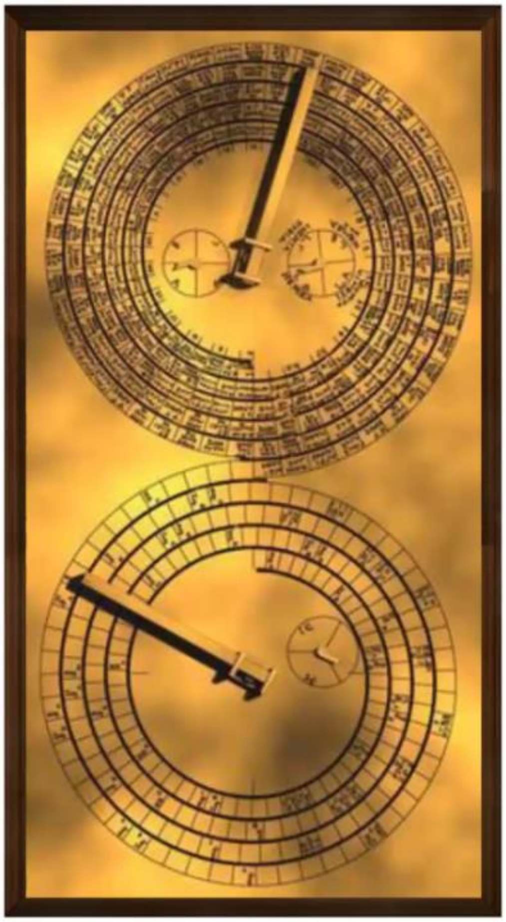
We had a virtual meeting using Zoom. PVAA President Matt Wedel did a short talk on http://www.astromediashop.co.uk/ - a website where you can buy very low cost, and very functional astronomy kits. They even sell a cardboard telescope, though the optics are not of cardboard. In addition to our current Club President, two past Presidents joined us for the call: Ron Hoekwater and, through the magic of our virtual meeting – Alper Ates, who led our Club before moving to Turkey in 2005. While he was thrilled to be reconnected with PVAA the only downside for Alper is that our meeting was held from 5:30-8:30 AM Turkish time! All in all, a very historic meeting, especially in light of the topic.

Ken Elchert, a PVAA member, gave a presentation on Antikythera Mechanism. This is a mechanical device that tracked the movement of the sun, moon, and we believe the planets, found in a shipwreck off the coast of the island of Crete. They believe the ship sank around 65 BC. The ship was 39 feet wide and 150 feet long. This is the largest shipwreck in ancient maritime history. The ship was found in 1900.

Ken went into great detail of the happenings of the time, the great minds of the era, and where they lived. Using the coins and artifacts found on the ship, researchers could tell were the ship had visited before it sank. Of all the people that could have had something to do with the creation of this remarkable device, the ship visited all of their cities.

Gary Thompson

Reconstructed Antikythera Mechanism:



Metonic Dial
5 spirals
235 glyphs

Saros Dial
4 spirals
223 glyphs

Back

Front

Exploded View
of the Gear Trains

A telescope everyone should own: the Orion SkyScanner 100

I've been thinking lately about my telescopes, and trying to decide which one is my favorite. I have an Orion XT10 that collects almost as much light as all my other scopes combined. I got my C80ED when Astronomers Without Borders was closing them out, and it has the most perfect star test of any telescope I've ever used. When the atmosphere permits, my Apex 127 will split double stars at 500x. I have a cute little Tasco 9VR, a jewel-like 60mm f/5 refractor made in Japan by Vixen, and its focuser is so smooth it feels like a product of some other, more advanced civilization.

But if push came to shove, and I was forced to pick my favorite, my answer might well be the Orion SkyScanner 100. It's a tiny thing, a 4-inch f/4 Newtonian reflector on a one-armed Dobsonian tabletop mount. The whole shebang weighs about 6 lbs assembled. The tube has a dovetail bar so it can be used on other mounts, or other small scopes can be used on its mount. The base has a 3/8" socket on the bottom so it can ride on most tripods as a lightweight alt-az mount. The focal ratio of f/4 is pretty darned fast, and the scope doesn't offer any native collimation for the primary mirror, although the secondary mirror can be collimated. The mirror is parabolic and diffraction-limited, though, so when the collimation is dialed in, it can support reasonable magnifications. I've had mine up to 80x and it was still sharp. But where the scope really excels is low-power, widefield scanning. A 32mm Plossl gives 12.5x and a true field of view more than 4 degrees across.

Why do I like this scope so much? Here are some reasons:

- **It's tiny.** Anyone over the age of six can carry it one-handed, especially if you put a handle on it, which I did (more on that in a sec). The tube is just under 16 inches long and weighs about three and a half pounds. I flew with it in carry-on luggage to see the total solar eclipse in 2017. It's been on countless car trips because it's so small there's no reason not to take it. I call it my "no excuses grab-n-go scope" because there really is no reason not to plunk it on the hood of the car for a quick look at the moon or Jupiter, even if the sky is dodgy or I'm tired.
- **It's powerful.** Four inches of aperture is a lot for such a tiny scope. My C80ED has more exquisite optics, but its tube alone weighs as much as the whole SkyScanner, it's half again as long, and yet it gathers only about two-thirds as much light. The refractor can outpace the SkyScanner on the planets, but put both scopes on faint deep sky objects and the little reflector wins in a walk.
- **It's easy to hack.** The tube is rolled steel and the mount is particle board covered with some kind of plastic finish, so it's a cinch to modify it. I moved the dovetail bar on mine, to put the eyepiece at a more comfortable angle; I added a handle and an eyepiece rack; center-spotted the mirror for more accurate collimation; and swapped the allen bolts for collimating the secondary mirror with regular hex-head bolts I can turn with my fingers, or with pliers. I've even played with elongating the bolt-holes for the primary mirror, so it can be roughly collimated by tilting.
- **It's cheap.** For a hundred bucks you get a whole working scope, on a solid mount, with two eyepieces. For people who aren't sure if they want to take the plunge with stargazing, it's a low-risk way into the hobby. For experienced observers, it's a great grab-n-go and travel scope. Since it was introduced, I've recommended the SkyScanner more than all other scopes combined, and I've had a lot of folks tell me how much they love theirs—and how much their kids love them, too.

I've seen other telescopes advertised as "a telescope everyone should own". For the SkyScanner 100, I think that's literally true. It's such a cute little thing, but it punches above its weight. I love mine, and if you get one, I predict you will love it, too.

Matt Wedel


ORION


F3 NEOWISE - Chris Weeks - Ludd's Nephew

Announcements

Dave Pearson of the Orange County Astronomers (OCA) is having a series of Beginning Level astronomy classes which is open to all the public. There are six classes held over six months five lecture-type sessions plus one hands-on practical session. Each class is held from 7:30 pm to 9:30 pm on the first Friday of each month from September 2020 through February 2021.

The lecture-type sessions will be held virtually using Zoom. To RSVP and get the passcode

1. go to the OCA website calendar (https://ocastronomers.org/calendar/)
2. select the calendar for the month of the session
3. click on the "Beginners Class" on the first Friday in the calendar
4. click on the Zoom website
5. enter your information

The September session has already been held but you can download a PDF file of the lecture charts. The October session will be held on October 2. All six sessions will be repeated from March 2021 through August 2021.

Dues Reminder

It's time to get your club dues in, if you haven't already. The rate is $30/year for individuals, $40 for families, and $12 for youth under 18. Please send your dues to:

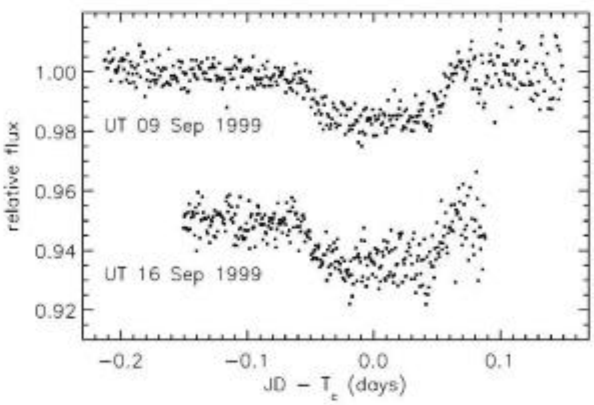
PVAA
Attention: Treasurer
P.O. Box 162
Upland, CA 91785

There will be an appulse of Mars and the Moon on Friday, October 2. The Moon will pass just south of Mars appearing to almost graze it. The minimum separation between these two bodies will occur at 8:21 pm PDT. This will happen just a day after the Full Moon -- the Moon will be in its waning gibbous phase with 98% illumination as seen from Earth.

Ken Elchert

Planetary bodies orbiting stars other than our own sun are called exoplanets. The existence of exoplanets had been postulated by astronomers since early in the 20th century, but the technology to actually search for them did not come into existence until the early 1990s when large telescopes combined with sensitive spectrometers provided the capability to detect the changes in radial velocity of a star due to the gravitational push and pull on the star from a large orbiting planet, a technique known as Doppler spectroscopy. In 1995, two astronomers in France, Mayor and Queloz, successfully detected an exoplanet "candidate" around the star 51 Pegasi. Detections by this method are called "candidates" because other possible physical phenomenon could possibly explain these measurements. In the next ten years, another 100 or so "candidate" exoplanet detections were made using the Doppler method. Estimates for minimum mass and orbital parameters for each of these potential exoplanets were made based on the Doppler measurements.

Meanwhile, astronomers were anxious to find a way to confirm these detections to be of real planets. They began to pursue a completely independent approach called the "transit method". Here, the light from a distant star with an orbiting planet will be slightly diminished, as seen from Earth, as the planet crosses the disc of the star. The geometry has to be just right for this to work and, from the vantage point of earth, only a small percentage of actual exoplanet transits are observable. Large planets in close orbits provide the best possibilities for transit detection. Astronomers were quick to start looking for transits from all the previous Doppler detections as this would provide the sure-fire confirmations they were looking for. In 1999, astronomers David Charbonneau and Timothy Brown hit pay dirt with HD 209458, a fairly bright, sun-like star 160 light-years away, in the constellation Pegasus. Using orbital parameters from Doppler measurements taken four years earlier, they calculated that transits might be observable on two nights in September. Using a purpose-built set-up dedicated to detecting transits, they collected photometric data before, during and after the expected transits.



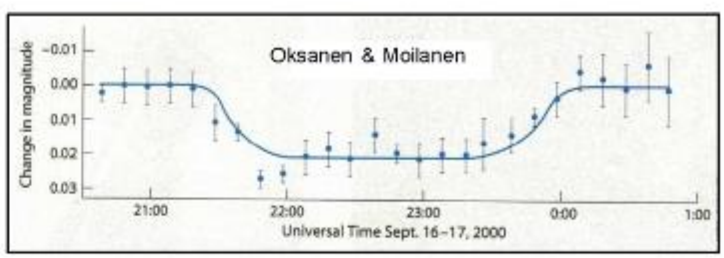
Raw data for the two transits is shown at the left. Even without further post-processing, the game was over. This was conclusive proof that HD 209458 has a real planet.

Combining the Doppler data taken in 1995 with the transit data taken in 1999 allowed much to be surmised about this planetary system:

Star radius = 1.1 * solar radius.
Star mass = 1.1 * solar mass.
Orbital inclination = 87.1 deg. (90 would be edge on).
Orbital period = 3.525 days.
Orbital radius = 0.047 A.U. (semi-major axis).
Planet mass = 0.63 * Jupiter mass.
Planet radius = 1.27 * Jupiter radius.
Planet density = 0.38 gm. per cubic cm.
Planet surface gravity = 970 cm. per second squared.

HD 209458-b, as the planet is called, is now known as a "Hot Jupiter". "Hot" because it is very close to the star and thus greatly heated by its radiation and "Jupiter" because its physical properties (size, mass, etc.) are similar to those of Jupiter.

As soon as the HD 209458-b transit results were disclosed, amateur astronomers took up the challenge. Just one year later, two amateurs from Finland took measurements of this planet using their club's 16-inch telescope and produced the post-processed light curve to the right.

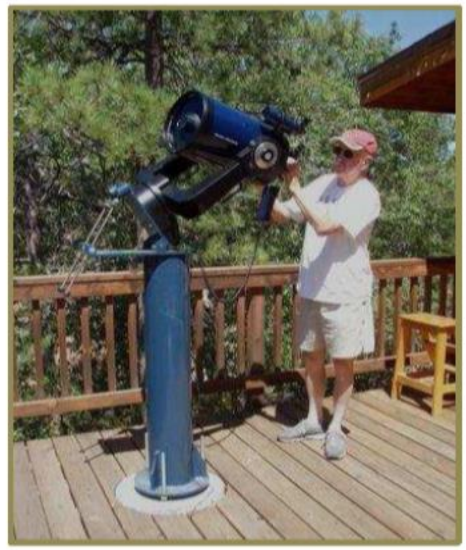


In spite of the ground-breaking results in 1999 with HD 209458-b, progress in the field was slow.
New discoveries from Doppler measurements trickled in, but this was a hit-and-miss proposition requiring a lot of time on big telescopes with precision spectrographs which were in high demand for many other studies. Conformations of these results by transit measurements were also slow to appear because only a small percentage of transits have the required geometry to be seen from our vantage point. By 2005, six years later, over 100 candidate exoplanets had been found, but only nine of these had been confirmed by transit measurements. Much later, one of these, HD 189733-b, would catch my attention in a big way.

In the meantime, other good things were happening. Amateurs continued to demonstrate that exoplanet light curves could be obtained using fairly modest equipment. Discovery of exoplanets using transits was made viable due to the development of automated search telescopes – arrays of computer controlled small telescopes that look for the telltale dimming of starlight from hundreds of stars in a single night. Results could then be followed up for confirmation with larger, more accurate telescopes. A good outcome for amateur observers was that a lot of these discoveries were within the grasp of modest amateur telescopes and detectors.

With its 2007 launch of the Keppler spacecraft, NASA upped the ante in a big way. The dam burst in 2008 as transit data came flowing in at a prodigious rate. Unless you've been in a monastery for the past decade, you've probably heard about this. Keppler was designed to stare continuously at a small patch of the sky (about 1/400 of the total sky) near the constellation Lyra. The light from 156,000 selected stars was monitored 24/7. I guess they thought they might find some exoplanets in there somewhere. In total, Kepler detected 2,748 (confirmed) planets. There are 3300 more discoveries yet to be confirmed. Having run out of working reaction wheels and then out of fuel, Keppler was finally decommissioned in November 2018, nine and a half years into a three and a half year mission. It used the equivalent of 3.1 gallons of gasoline during its lifetime. Your spacecraft mileage may vary.

In 2004, I undertook a major upgrade at my mountain-cabin observatory near Idyllwild at 6200 feet. Using the telescope on its tripod sitting on the wooden deck was extremely limiting for any precision imaging or even casual observing for that matter. Even the slightest moving around on the deck would cause unacceptable shaking of the images or even shifting of the scope position. The draconian solution to this problem would be the installation of a permanent telescope pier coming up from mother earth under the deck and touching nothing else on the way. I bought an 8-inch diameter steel Astro Pier complete with equatorial wedge which could be securely bolted down to studs embedded in a 16-inch diameter concrete column coming up about 10 feet from a large concrete foundation and through a hole in the deck. With much rebar included, the whole design was way overkill but I had decided I was only going to do this once. Shaking problem definitely gone. Maybe some future owner will put a 14 or 16-incher on there. I hope so.



Ten inch Meade LX-200 scope mounted on recently built pier (2005)

Meanwhile, Bruce Gary, an advanced amateur astronomer in Arizona, had gotten in on the ground floor of amateur exoplanet observing in 2002 with his first light curve, HD 209458, using a 10-inch telescope just like mine. His observatory has grown over the years and now consists of two completely independent setups in domes with 11-inch and 16-inch telescopes. In 2007 he self-published "*Exoplanet Observing for Amateurs*" and then followed it up with a second edition in 2010. At 250 pages, he literally "wrote the book" on this subject.

"Better late than never" being a mantra of mine, I didn't get around to thinking about doing my own exoplanet work until March of 2012. I started out by reading Gary's book cover to cover. Then I read it all over again, this time taking good notes and taking the time to figure out some of the things I didn't understand. Then I spent a couple of months figuring out how to do this with the hardware and software tools I planned to use. I thought my basic telescope and imager would be adequate for the class of exoplanets called BTE's (Bright Transiting Exoplanets) of which there were 50 or so known at the time.

A lot of advance planning is required to pull this off, not the least of which is to choose a target that will be transiting on the night you want to observe and in a place in the sky you can see, taking into account obstructions. Also, you need to observe continuously from about an hour before the transit starts to about an hour after transit ends. Transits last from one to five hours so the observing time may be up to seven hours, and this all has to happen while it's dark. You're probably starting to see why only the truly obsessed would ever get into this.

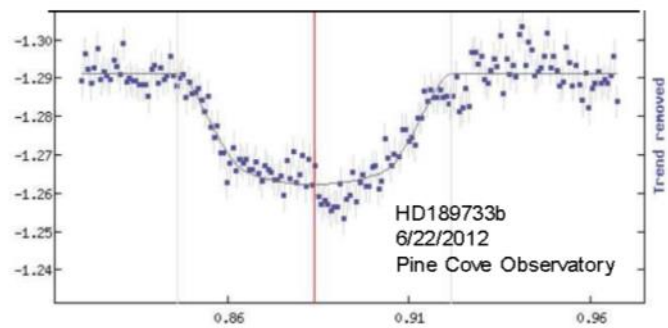
TRESCA, an organization in the Czech Republic, is a primary resource for amateurs interested in exoplanet observing. Their website provides useful tools including one providing transit predictions. You simply key in the name of the planet you are interested in and your location and it spits out the transit times for the next 365 days, just what you need to start planning for an observation. TRESCA is also the repository for the archiving of amateur exoplanet light curves. You send them your photometry data and they curve fit it to a planet model, rate it on a 1-5 quality scale, plot it and then put it in the archive. About 300 or so amateurs from around the world have submitted over 9000 light curves to TRESCA from a list of 350 known transiting exoplanets.

By June, I had done all my homework and was ready to plan an attempt at my first Exoplanet light curve. I chose a handful of the brighter candidates to see what might work for a few days around the 20th. The weather forecast was good and it was a time when both Julie, my companion for 37 years, and I could be gone. Looking at transit predictions for those planets and days I found what looked like a good fit : HD189733-b (Mv=7.67), a "hot Jupiter" orbiting very close to a bright star with "easy" transit properties. Transit duration is about 2 hours, with a pretty deep dip in the light curve. That is, if you call 0.03 magnitudes deep! There would be no problem with visibility and it would be a new moon so the sky would be dark. Mid – transit would occur at about two AM on the morning of 6/22/12 so this would be a very late night.

We arrived two days early so there was plenty of time to get everything working and to do a dry run the night before the transit to make sure we could get pointed on the field and to take test images to determine a good exposure time to use. We basically did a full walkthrough of everything we would have to do for real the following night. This allowed for many potential sharp corners to identified and avoided.

The following night, we got started at about 8 PM with the taking of calibration image sets that would be used during post-processing to correct the target images for optical and camera irregularities. With a lot of time to kill, we went into Idyllwild for dinner at La Casita for some good Mexican food. About 11 PM we got centered on the target field, got the focus where we wanted it and at midnight turned it all on to take continuous 30 second exposures. The computer controlling the camera and telescope was located indoors, allowing us to be comfortably situated while monitoring the process for the next four hours. Everything went well but we did learn a few things that will be helpful next time. At around 4 AM we shut the equipment off and went to bed. We had captured a time series of 170 images of the star HD189733 but had no idea whether or not these would reveal a planet passing in front of it.

After arriving back home, it took a few days of fussing with image processing software for me to be able to plot the raw photometric brightness values from our data. If we had been looking at the wrong time the data would be more or less a straight line but it wasn't. Right in the middle there was a small but definite dip in the curve for about two hours. I was amazed that we would get a result of any kind on the first try. Julie was only mildly impressed, like "Is that all there is?" I'm not sure she fully appreciated all the ways there were for us to go wrong with this. I spent another few days learning to do the differential photometry post-processing necessary to turn our raw results into a real light curve. On July 3, 2012 I submitted it to TRESCA for their archives.



Our light curve as archived in TRESCA. They rated at as a 2 on their 1 to 5 quality scale, 1 being best.

In early September, I came up with an audacious plan (ridiculous, actually) to do three light-curve measurements during one cabin visit – one on each of three consecutive nights. I figured that the planning could all be done in advance and once everything was set up it wouldn't be that hard. Oh, yeah? The targets would be TrES-3, WASP-2 and WASP-48. These are all about the same brightness (about Mv 12) - around 40 times dimmer than HD189733. This would be a challenge. In addition, I planned to do auto-guiding with a guide camera I recently acquired. Auto-guiding corrects telescope pointing errors to keep the images locked in place on the camera which reduces errors in the brightness data. What could possibly go wrong?

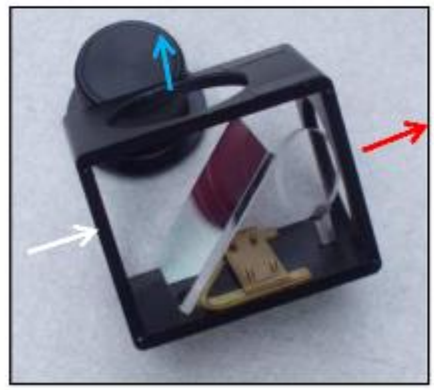
A lot, as it turned out. We never really got off the mark on TrES-3. An operator error on my part got the scope pointed to the wrong place in the sky and much confusion ensued. By the time the dust settled, the whole timeline was blown, so we pulled the plug. The next night we tackled WASP-2. All went well but a planning error had the whole schedule off, so we ended up missing about half the data. The following night it was WASP-48. All appeared to go well but, upon looking at the images, it was apparent that the guide camera, which looks at the sky through a small guide scope attached to the top of the main telescope, had been slipping alignment throughout the run. Three nights and three different problems. In the end, after data reduction, I was able to salvage some partial light curves.

The good news was that decent light curves would be possible using my setup with stars of this brightness. Much was learned from this experience that would lead to future improvements in the whole process. Bruce Gary would be proud. He believes that the best way to learn to do anything new is to dive in and flounder. I completely agree with him. I've been a flounderer my whole life.

The auto-guiding debacle with WASP-48 was actually fortuitous. It got me reading and thinking about the various methods used to do this. I concluded that guiding with a separate guide scope might work on very large telescopes but was a fools errand on a small scope like mine. The mechanical and optical setup could never be good enough to maintain sub-pixel alignment over hours of guiding. Of the remaining options, I decided to pursue a relatively new method called on-axis guiding ONAG). The basic idea is to split the light from the telescope into two beams, one going to the imaging camera and one going to the guide camera. Very helpful information was on a website by Kas Tanaka, an amateur astronomer in Japan. Kas had built an ONAG of sorts clear back in 2002 and documented his work for all to see. Ten years later, I was just catching up.

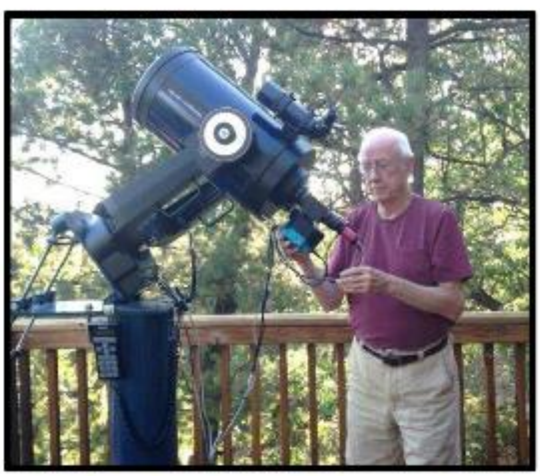
I immediately went to work on the design of an ONAG optical assembly that I could build myself. Much analysis was done in Excel for several choices of optical components. Once the optical design was chosen and a suitable metal housing was found (a re-purposed Orion flip-mirror housing) the actual construction went fairly fast. No machined parts were required. Everything could be made with hand tools. Optical parts were off-the-shelf from Edmonds.

In my design, the mirror splits the incoming light from the telescope (white arrow in photo) by reflecting visible light off of the front surface (blue arrow) while passing near-infrared light through (red arrow). This is known in optics as a “cold” mirror. By setting the mirror at 45 degrees to the incoming light, the two exiting beams come out at right angles, thus allowing visible light to go to the imaging camera and infrared light to go to the guide camera. A small corrector plate is placed in the light path to the guide camera to remove astigmatism induced on the guide image from the light passing through the mirror glass.



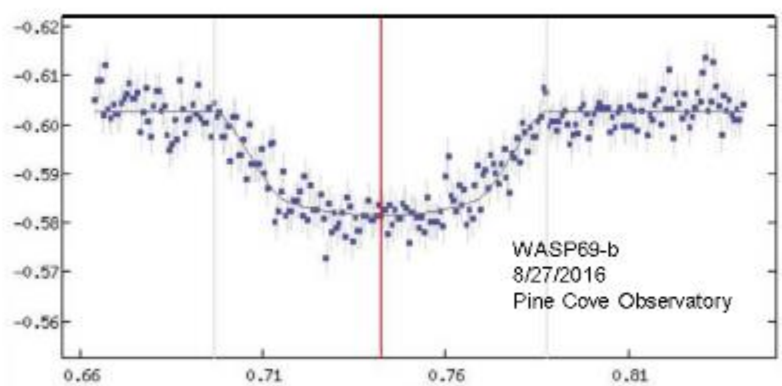
ONAG with the side plates off. All three optical ports are threaded so everything can be well tightened down.

In the fall of 2016 I decided to retire the trusty ST-6 imaging camera. It had given me reliable service for 24 years but a modern camera would improve greatly my ability to do exoplanet light curves and also to pursue other advanced projects I had in mind. I chose a QSI-660. This new camera, along with my home made on-axis guider optics made for a very fine imaging kit for my 10" telescope. On the pier and with everything screwed down, the whole thing is absolutely rock solid.



Telescope configuration as of 2016 at the cabin. A very clean setup.

Now it was time to put it all to the test. I tackled WASP-69-b (Mv= 9.85) with my new, as yet unproven, setup. Oddly, at that time, only two people had posted light curves for this planet and the best one was a three. On the evening of 8/27, I was ready to go. Everything went perfectly and I captured 260 one minute exposures.



After post-processing back home, I couldn't have been happier. I posted it on TRESCA and they rated it with a data quality of 2! All the work leading up to this effort paid off in the end.

Doesn't it usually?

Don Rea 2020

NASA Night Sky Notes September 2020

This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!

Summer Triangle Corner: Altair

David Prosper

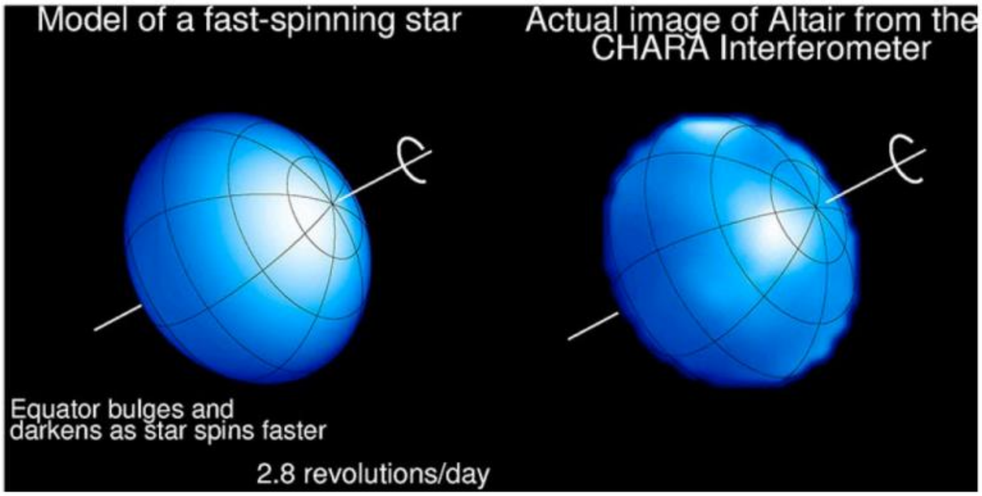
Altair is the final stop on our trip around the Summer Triangle! The last star in the asterism to rise for Northern Hemisphere observers before summer begins, brilliant Altair is high overhead at sunset at the end of the season in September. Altair might be the most unusual of the three stars of the Triangle, due to its great speed: this star spins so rapidly that it appears "squished."

A very bright star, Altair has its own notable place in the mythologies of cultures around the world. As discussed in our previous edition, Altair represents the cowherd Niulang in the ancient Chinese tale of the "Cowherd and the Weaver Girl." Altair is the brightest star in the constellation of Aquila the Eagle; while described as part of an eagle by ancient peoples around the Mediterranean, it was also seen as part of an eagle by the Koori people in Australia! They saw the star itself as representing a wedge-tailed eagle, and two nearby stars as his wives, a pair of black swans. More recently one of the first home computers was named after the star: the Altair 8800.

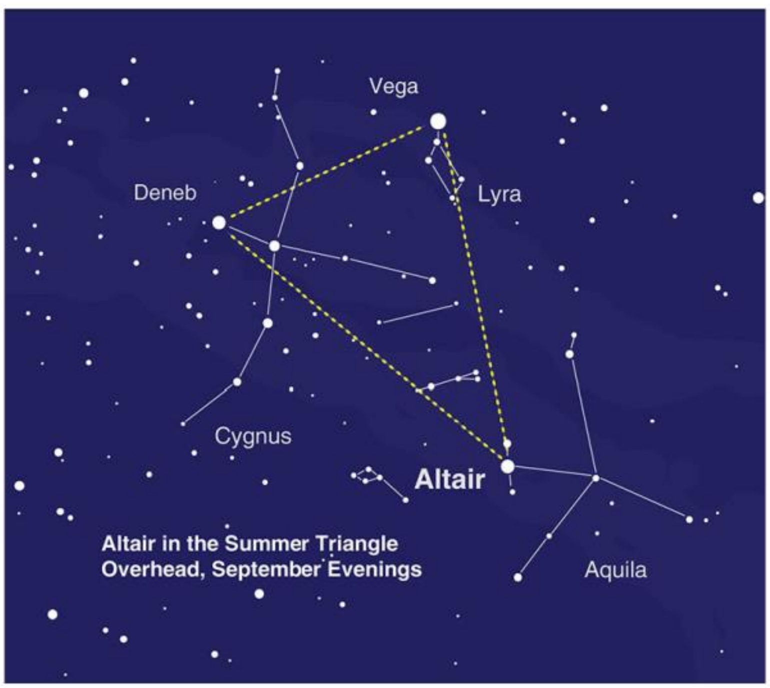
Altair's rapid spinning was first detected in the 1960s. The close observations that followed tested the limits of technology available to astronomers, eventually resulting in direct images of the star's shape and surface by using a technique called *interferometry*, which combines the light from two or more instruments to produce a single image. Predictions about how the surface of a rapidly spinning massive star would appear held true to the observations; models predicted a squashed, almost "pumpkin-like" shape instead of a round sphere, along with a dimming effect along the widened equator, and the observations confirmed this! This equatorial dimming is due to a phenomenon called *gravity darkening*. Altair is wider at the equator than it is at the poles due to centrifugal force, resulting in the star's mass bulging outwards at the equator. This results in the denser poles of the star being hotter and brighter, and the less dense equator being cooler and therefore dimmer. This doesn't mean that the equator of Altair or other rapidly spinning stars are actually dark, but rather that the equator is dark in comparison to the poles; this is similar in a sense to sunspots. If you were to observe a sunspot on its own, it would appear blindingly bright, but it is cooler than the surrounding plasma in the Sun and so appears dark in contrast.

As summer winds down, you can still take a Trip Around the Summer Triangle with this activity from the Night Sky Network. Mark some of the sights in and around the Summer Triangle at: bit.ly/TriangleTrip. You can discover more about NASA's observations of Altair and other fast and furious stars at nasa.gov.

NASA Night Sky Notes September 2020



The image on the right was created using optical interferometry: the light from four telescopes was combined to produce this image of Altair's surface. Image credit: Ming Zhao. More info: bit.ly/altairvsmodel



Altair is up high in the early evening in September. Note Altair's two bright "companions" on either side of the star. Can you imagine them as a formation of an eagle and two swans, like the Koori?

NASA Night Sky Notes October 2020

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Observe the Skies Near Mars

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October is a banner month for Mars observers! October 6 marks the day Mars and Earth are at closest approach, a once-every-26-months event. A week later, on October 13, Mars is at opposition and up all night. Mars is very bright this month, and astronomers are eager to image and directly observe details on its disc; however, don't forget to look at the space around the planet, too! By doing so, you can observe the remarkable retrograde motion of Mars and find a few nearby objects that you may otherwise overlook.

Since ancient times, Mars stood out to observers for its dramatic behavior. Usually a noticeable but not overly bright object, its wandering path along the stars showed it to be a planet instead of a fixed star. Every couple of years, this red planet would considerably flare up in brightness, for brief times becoming the brightest planet in the sky before dimming back down. At these times, Mars would also appear to slow down its eastward motion, stop, then reverse and head westward against the stars for a few weeks, before again stopping and resuming its normal eastward movement. This change in the planet's movement is called "apparent retrograde motion." While all of the planets will appear to undergo retrograde motion when observed from Earth, Mars's retrograde appearances may be most dramatic. Mars retrograde motion in 2020 begins on September 10, and ends on November 16. You can observe its motion with your eyes, and it makes for a fun observing project! You can sketch the background stars and plot Mars as you observe it night after night, or set up a photographic series to track this motion. Does the planet move at the same rate night after night, or is it variable? As you observe its motion, note how Mars's brightness changes over time. When does Mars appear at its most brilliant?

NASA has tons of great Mars-related resources! Want to know more about apparent retrograde motion? NASA has an explainer at: bit.ly/marsretromotion. Find great observing tips in JPl's "What's Up?" videos: bit.ly/jplwhatsup. Check out detailed views with NASA's HiRISE satellite, returning stunning closeups of the Martian surface since 2006: hirise.lpl.arizona.edu. NASA's Curiosity Rover will be joined in a few months by the Perseverance Rover, launched in late July to take advantage of the close approach of Mars and Earth, a launch window that opens two years: nasa.gov/perseverance. Calculate the ideal launch window yourself with this handy guide: bit.ly/marslaunchwindow. The Night Sky Network's Exploring Our Solar System handout invites you to chart the positions of the planets in the Solar System, and NSN coordinator Jerelyn Ramirez recently contributed an update featuring Mars opposition! You can download both versions at bit.ly/exploresolarsystem. Young astronomers can find many Mars resources and activities on NASA's Space Place: bit.ly/spaceplacemars. Here's to clear skies and good seeing for Mars's best appearance until 2033!

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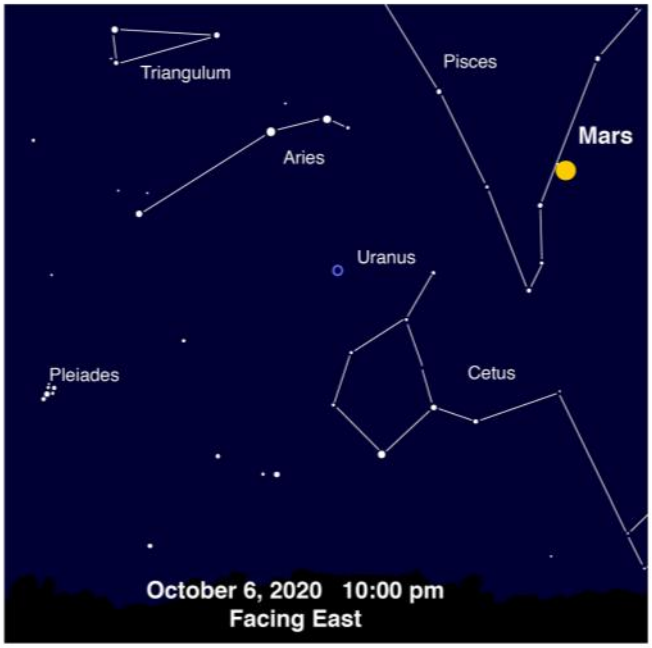

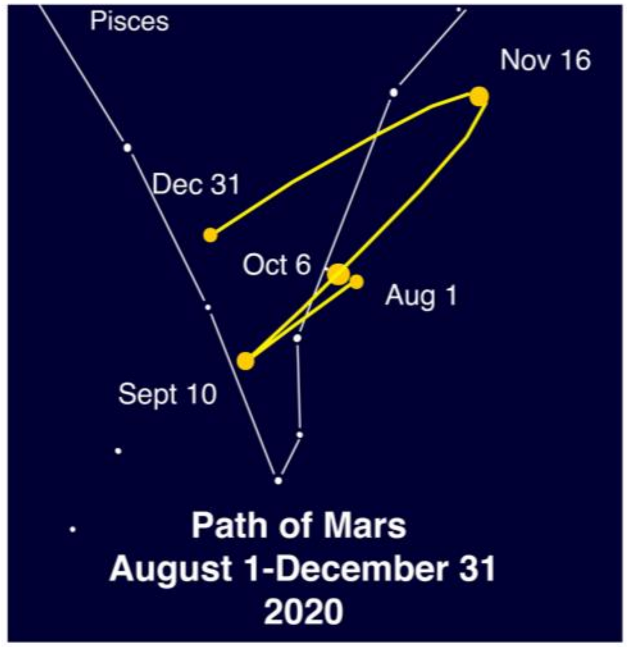

(left) If you are paying this much attention to Mars, you're likely curious about the skies surrounding it! Find Mars in the constellation Pisces, with constellations Aries, Triangulum, and Cetus nearby. Aries may be the only one of these dimmer patterns readily visible from light-polluted areas. The Pleiades rises shortly after Mars. Dim Uranus is found close by, in Aries. If you are observing Mars up close, use the same eyepiece to check out Uranus's tiny blue-green disc. If you are uncertain whether you spotted Uranus, you didn't see it! Unlike stars, Uranus doesn't resolve to a point at high magnifications.

(right) The path of Mars during the last five months of 2020. Notice the retrograde motion from September 10 to November 16, with prime Mars observing time found in between. October 6 is the day of closest approach of Earth and Mars, "just" 38.6 million miles apart. Images created with help from Stellarium: stellarium.org