Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers Dec 2018

Events:

General Meeting : No meeting this month but get ready for an Out of This World meeting on Jan 7, 2019.

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.

Comet 46P/Wirtanen - Image Credit & Copyright: Alex Cherney (Terrastro, TWAN)

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

I have spent the year trying to promote Outreach and I hope it struck a positive chord with you all…we have a rare gift of sharing Astronomy and the Cosmos with so many in our communities – and even some not local!!!

But this upcoming year may prove to be extra special…not only have we been blessed with donations of more equipment than ever – higher quality, bigger, and better too – but TVA will have the opportunity in 2019 to develop their own observatory complex!!! This will include facilities to house telescopes for a variety of purposes, a large pad area to set up personal scopes, and a structure for a warm room/office and equipment storage…

TVA members will have First Call of course, including instructional sessions to learn astrophotography, imaging, etc. But any open scheduling can be utilized by the local schools and other community entities…we can even do periodic Cosmic Camps for students. What Fun…!!!

Yes, it appears that I have a vision for the potentials for Outreach it can provide, but this has to be more than just my vision…this needs a coordinated and cooperative effort. I admit to excitement over the possibilities and hope as things unfold, you will join me!!! I am awed in what you all have accomplished without a facility…and proud to associate with each and every one of you!!! On to 2019…

Clear, Dark Skies my Friends…

Looking Up Redux

compiled by Clark Williams

from sources:
Sky and Telescope
Wikipedia
in-the-sky.org
The American Meteor Society, Ltd.
NASA.gov
TVA App
FullAndNewMoon App

ALL TIMES ARE LOCAL PST WILDOMAR/MURRIETA/TEMECULA

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. Some times are hhmm and seconds are not shown.

Moon Phases for the month by date: (all times are PST)

Thursday the 6th @ 2321 NEW in Ophiuchus
Saturday the 15th @ 0350 FIRST QTR in Aquarius
Saturday the 22nd @ 0949 FULL in Orion
Saturday the 29th @ 0135 THIRD QTR in Virgo

Apogee comes on 2018-12-12 @ 0427 – 405, 176 km (251, 765 mi)
Perigee comes on 2018-12-24 @ 0153 – 361, 059 km (224, 352 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: Luna will rise late on the first peeking above the horizon about fifty minutes past midnight giving you plenty of dark skies for viewing. Luna is heading toward New on the 6th of the month so you should have some dark nights until mid-month when Luna has gotten around to rising about noon-twenty-four local time. And won't be setting until 1223+. By the end of the month we're deep into the 3rd quarter and dark night viewing will be back. In fact on the 30th Luna has hit the pillow by 1246 and you will have a full dark night for viewing.

Highlights: (distilled from Sky & Telescope and Clark's planetary Orrey program[s])

6 December: Evening – A chance for a really cool image of Neptune almost being occulted by Mars. Neptune will pass very close to Mars (within 1') around 0500+ but it will be below the horizon. If you start viewing at 2100 you will see a very nice sight indeed (see Neptune under the Planets).

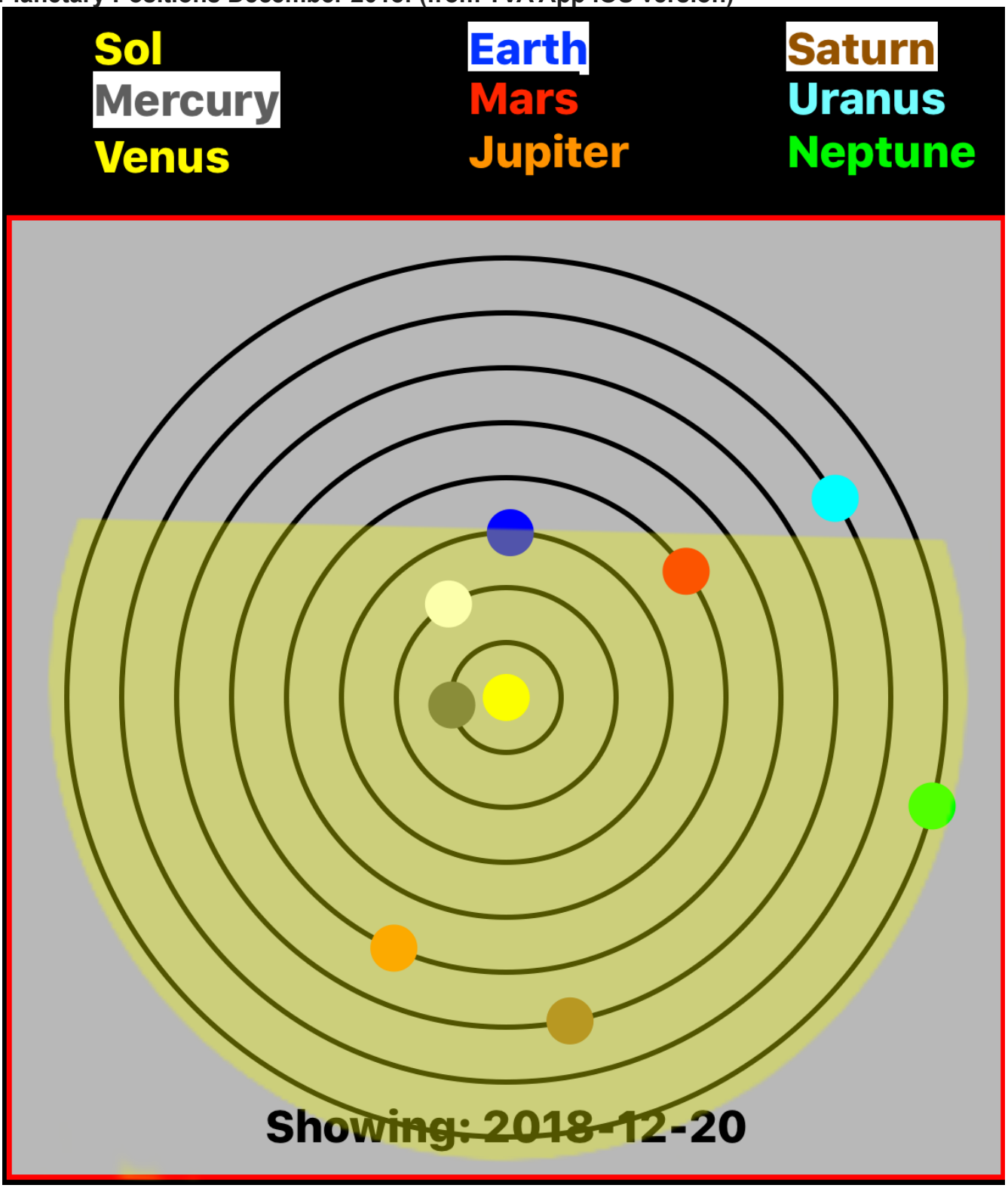
13-14 December: All Night – Geminids. Meteor Shower peaks.

Algol minima: (All times PST)

12/02/18	1953
12/05/18	1642
12/08/18	1331
12/11/18	1020
12/14/18	0709
12/17/18	0358
12/20/18	0047
12/22/18	2136
12/25/18	1826
12/28/18	1515
12/31/18	1204

Planets:

Planetary Positions December 2018: (from TVA App iOS version)



- **Mercury:** The Winged Messenger is lost to the glare of the Sun all month.
- **Venus:** Is the Morning Star. Your best bet in the beginning of the month is between 0345 and 0600. By mid-month this has dropped by 15 minutes to between 0400 and 0600. By the end of the month you'll still be in the same time period.
- **Mars:** Mars is still visible this month becoming truly viewable on the first about 1815 and not setting until 2323. Mid-month finds Mars visible about the same time and setting around 2322. The warrior is much nearer the western horizon. The end of December Mars will be visible until 2309. The planet feast is almost over until May 2019.
- **Jupiter:** Jupiter is also a morning object at the beginning of the month rising at 0615 but lost to the glare of the Sun by 0620. By mid-month Jove will be visible between 0545 and 0615. The end of the month you will have an hour between 0515 and 0615.
- **Saturn:** The start of December you'll have from dusk until 1838. But Saturn is closing in on the Sun and by mid month Saturn is setting at dusk and we'll just have to wait for May 2019.
- **Uranus:** Uranus is transiting at 2054 in the beginning of the month and doesn't set until 0328+. It is a good time to try imaging this jewel or even to try and find it. Uranus is worth it though and since it is at magnitude +5.7 and 100% illuminated it is not an impossible target even in an 8-inch scope. By mid-month you'll find Uranus transiting about 1957 and again not setting until early next morning but the viewing will be amped by a waxing gibbous moon. The end of the month finds Uranus visible from sunset until 0128+.
- **Neptune:** Neptune is still trailing Mars in the beginning of the month transiting at sunset and not setting until 2349. Moving quickly you'll find Neptune approaching very close to the Red Planet. In fact if you are viewing around 2100 on the 6th of December you should be able to get both Neptune and Mars in the same eyepiece all the way until the two set. Sometime around 0500 on the 7th Neptune will pass within 2' of Mars. Unfortunately both Neptune and Mars will be below the horizon. Even my friends in Hawaii won't quite get to see the close-but-no-cigar occultation because it will be below the horizon. By the end of the month Neptune will be visible until 2153.
- **Pluto:** Like the Elves of Númenor Pluto has faded in the West. Pluto is gone until we round the winter part of Earth's orbit and head into spring.

Asteroids:

- Saturday 08 December: Asteroid 40 Harmonia at opposition – Asteroid 40 Harmonia will be well placed for observation, lying in the constellation Taurus, well above the horizon for much of the night. Regardless of your location on the Earth, 40 Harmonia will reach its highest point in the sky at around midnight local time. From Temecula, it will be visible between 1835 and 0452. It will become accessible at around 18:35, when it rises 21° above your eastern horizon, and then reach its highest point in the sky at 23:42, 76° above your southern horizon. It will become inaccessible at around 04:52 when it sinks to 22° above your western horizon. (In-The-Sky.org)
- Sunday 16 December: Asteroid 433 Eros at opposition – Asteroid 433 Eros will be well placed for observation, lying in the constellation Camelopardalis, well above the horizon for much of the night. Regardless of your location on the Earth, 433 Eros will reach its highest point in the sky at around midnight local time. From Temecula, it will be visible all night. It will become visible at around 17:46 (PDT) as the dusk sky fades, 39° above your north-eastern horizon. It will then reach its highest point in the sky at 22:15, 63° above your northern horizon. It will

continue to be observable until around 05:21, when it sinks to 22° above your north-western horizon. (In-The-Sky.org)

- Saturday 29 December: Asteroid 6 Hebe at opposition – Asteroid 6 Hebe will be well placed for observation, lying in the constellation Monoceros, well above the horizon for much of the night. Regardless of your location on the Earth, 6 Hebe will reach its highest point in the sky at around midnight local time. From Temecula, it will be visible between 19:11 and 04:12. It will become accessible at around 19:11, when it rises 21° above your eastern horizon, and then reach its highest point in the sky at 23:39, 61° above your southern horizon. It will become inaccessible at around 04:12 when it sinks to 22° above your western horizon.

Meteors:

- In 2018, the Geminids will peak on the night between Nov 13–14.

Comets:

- Comets come in various classifications:
  - 1) Short Period comets – further broken down into:
    - Halley Type: The Halley Types are believe to come from the Kuiper Belt and have periods in excess of 20-years.
    - Jupiter Type: The Jupiter types have a period less than or equal to 20-years.
    - Short period comets may have a near circular orbit or an elliptical orbit. The latter being far more common.
  - 2) Long Period comets – thought to originate from the Oort cloud these comets have periods of over 200 years and have random inclinations around the celestial sphere.
- **46P/Wirtanen** –Originally discovered in 1889 by the American astronomer Lewis Swift, 64P rounds the Sun every 9.2 years. This time around it hangs out in the vicinity of Beta (β) Andromedae from late October through late December when it's brightest at magnitude 11. Not only is it well placed in the evening sky, the bright star will serve as a sweet guidepost. Is at perihelion on Monday 10 December and reaches its brightest on Sunday 19 December. (http://www.cometwatch.co.uk)
- **Comet 38P/Stephan-Oterma** – Long time no see! The 38th comet to have its orbit determined also takes 38 years to orbit the Sun. Discovered in 1867 and last seen in 1980, those of us who missed it then (yeah, yours truly) will finally get a second chance. It's predicted to be a fine apparition with the comet entering the stage 5° north of Betelgeuse in Orion at magnitude 10.5 during the first week of October. Come late December, it peaks around magnitude 9 in Gemini near Castor and Pollux and may be visible in binoculars. 38P remains brighter than magnitude 10.5 through New Year's Day 2019.:(http://www.cometwatch.co.uk)

Deep Sky:

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

Lets look for some more unusual objects:

- **Barnard's Loop** – Barnard's Loop (catalogue designation Sh 2-276) is an emission nebula in the constellation of Orion. It is part of the Orion Molecular Cloud Complex which also contains the dark Horsehead and bright Orion nebulae. The loop takes the form of a large arc centered approximately on the Orion Nebula. The stars within the Orion Nebula are

believed to be responsible for ionizing the loop. The loop extends over about 600 arcminutes as seen from Earth, covering much of Orion. It is well seen in long-exposure photographs, although observers under very dark skies may be able to see it with the naked eye. Recent estimates place it at a distance of either 159 pc (518 light years)[1] or 440 pc (1434 ly) giving it dimensions of either about 100 or 300 ly across respectively. It is thought to have originated in a supernova explosion about 2 million years ago, which may have also created several known runaway stars, including AE Aurigae, Mu Columbae and 53 Arietis, which are believed to have been part of a multiple star system in which one component exploded as a supernova. Although this faint nebula was certainly observed by earlier astronomers, it is named after the pioneering astrophotographer E. E. Barnard who photographed it and published a description in 1894.

- **The Iris Nebula** – AKA NGC 7023 and Caldwell 4 is a bright reflection nebula and Caldwell object in the constellation Cepheus. NGC 7023 is actually the cluster within the nebula, LBN 487, and the nebula is lit by a magnitude +7 star, SAO 19158. It shines at magnitude +6.8. It is located near the Mira-type variable star T Cephei, and near the bright magnitude +3.23 variable star Beta Cephei (Alphirk). It lies 1,300 light-years away and is six light-years across. (Wikipedia)

The Iris Nebula *By Hewholooks [CC BY-SA 3.0 or GFDL], from Wikimedia Commons*

- **R Leporis –** AKA Hind's Crimson Star is an intermediate spiral galaxy in the constellation Camelopardalis relatively close to the Milky Way. Despite its size and actual brightness, its

location in dusty areas near the galactic equator makes it difficult to observe, leading to the nickname "The Hidden Galaxy", though it can readily be detected even with binoculars. The dust makes it difficult to determine its precise distance; modern estimates range from about 7 Mly to about 11 Mly. The galaxy was discovered by William Frederick Denning in 1892. It is one of the brightest in the IC 342/Maffei Group, one of the closest galaxy groups to the Local Group. Edwin Hubble first thought it to be in the Local Group, but it was later determined not to be a member. In 1935, Harlow Shapley found that it was wider than the full moon, and by angular size the third-largest spiral galaxy then known, smaller only than the Andromeda Galaxy (M31) and the Triangulum Galaxy (M33). (Modern estimates are more conservative, giving the apparent size as one-half to two-thirds the diameter of the full moon). It has an H II nucleus. (Wikipedia)

R

Leporis *Photo: Adam Block/NOAO/AURA/NSF.*

- **IC 405** – (AKA the Flaming Star Nebula, SH 2-229, or Caldwell 31 is an emission and reflection nebula in the constellation Auriga, surrounding the bluish star AE Aurigae. It shines at magnitude +6.0. Its celestial coordinates are RA 05h 16.2m dec +34° 28′] It surrounds the irregular variable star AE Aurigae and is located near the emission nebula IC 410, the open clusters M38 and M36, and the K-class star Iota Aurigae. The nebula measures approximately 37.0' x 19.0', and lies about 1,500 light-years away from Earth. It is believed that the proper motion of the central star can be traced back to the Orion's Belt area. The nebula is about 5 light-years across.

IC 405

By Hewholooks [CC BY-SA 3.0 or GFDL],from Wikimedia Commons

December is great for both viewing and imaging. Spend some time outside with your scope. Winter is here.

For now – Keep looking up.

Random Thoughts
by Chuck Dyson

Astronomer's Vacation and History Lesson

OK. OK it was not an astronomer's vacation but a trip up to the bay area to see my sister-in-law and her husband in Livermore, but I thought that as long as I was in the area I might as well visit the Chabot Science Center and the observatory on Mt. Hamilton and if time permitted, and I made darn sure that time permitted, a day guzzling the wines of the Livermore area.

As usual my forward planning for this vacation trip consisted of thinking about what I wanted to do and not researching what I could actually do in the time frame that I was there. My first shock, upon arriving in Livermore, was to discover that the Mt. Hamilton Observatory was not open to the public until the day after I left the area, bummer. My second shock, a good one, after arriving was to find out that my brother-in-law who works at the Lawrence Livermore National Laboratory, that is its official name or LLNL for short, and works on the lasers of the National Ignition Facility (NIF) had switched from the I cannot talk about what I am doing projects to the Discovery Science Program side of the laser. Now, if you are like me, I didn't even know that the lab had a Discovery Science Program let alone have been working with outside people for decades and "loaning out" some of their unique toys.

In the 1990's the LLNL loaned out its hydrogen gas gun to some researchers who wanted to study hydrogen at high pressures, very high pressures. The reason for studying hydrogen at very high pressures is because the planet Jupiter is much cooler than it should be. Let me explain.

Jupiter is radiating heat at a fairly high rate and it can only do this if much of the hydrogen that Jupiter is composed of is a heat conductor instead of a heat insulator. To become a conductor of heat, hydrogen must first undergo a physical transformation into a state described as metallic hydrogen, now before you go out and start looking for any little bits of metallic hydrogen lying about on the ground around your house you should know that at this time the only way we can get metallic hydrogen is to create it at very high pressures, as in the pressures that we find at the center of the Earth. As nothing in science is straight forward, the conversion of regular hydrogen into metallic hydrogen is also greatly influenced by the temperature that the sample is at as-well-as the pressure. Today metallic hydrogen research is a hot item and; although, LLNL is today using its inertial confinement fusion laser (see fig.1) to create the pressure and temperature conditions necessary to create metallic hydrogen and study it

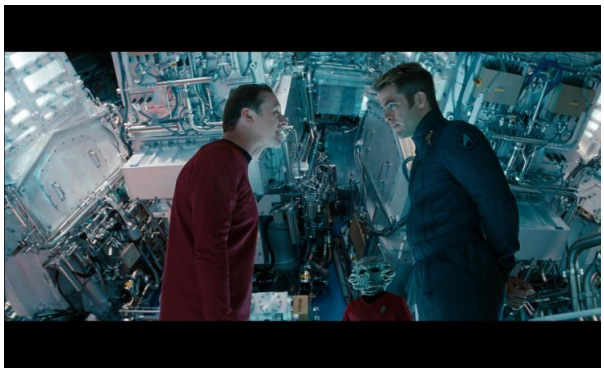


Figure 1: Although for safety and security reasons the lasers of the ignition facility are off limits to the public, if you are filming a Star Trek movie then you can shoot scenes in front of the lasers to simulate the warp drive engines of the Enterprise.

They are not the only game in town, literally. Just across the street from LLNL is Sandia Labs and they have and operate the Z machine (see fig.2) this machine uses an electrical field to compress a plasma field to achieve thermonuclear ignition instead of a laser. The Sandia Lab and LLNL create metallic hydrogen; under different conditions and temperatures and wouldn't you just know it the data sets do not match or agree with each other and make different predictions about the conditions necessary for metallic hydrogen.

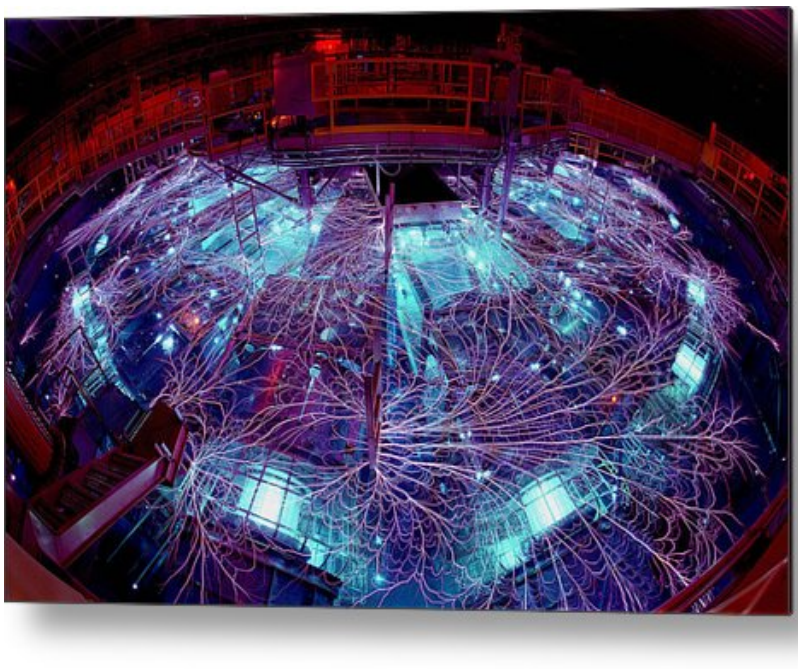


Figure 2: This is the Z machine in action. If you are wearing a watch, have a metal hip, or have a pacemaker, do not go near it when it is in operation as the day will not go well for you.

As if this weren't enough there is a third player in the Metallic hydrogen game and that is the Harvard lab and of course the Harvard lab has to; use yet a different method to create metallic hydrogen; the people at Harvard use diamond anvils (see fig. 3). In this method presses concentrate all of their pressure on the large tops of the two diamonds and the small ends of the diamonds have a slight depression ground into them and this is the sample chamber then, as the pressure is increased, X-rays are pumped through the diamonds and sample and changes in the diffraction patterns tell the researchers what is going on inside the cell. At just about the pressure limit of the diamonds the X-ray pattern of the hydrogen sample indicated a change in the hydrogen to metallic hydrogen.

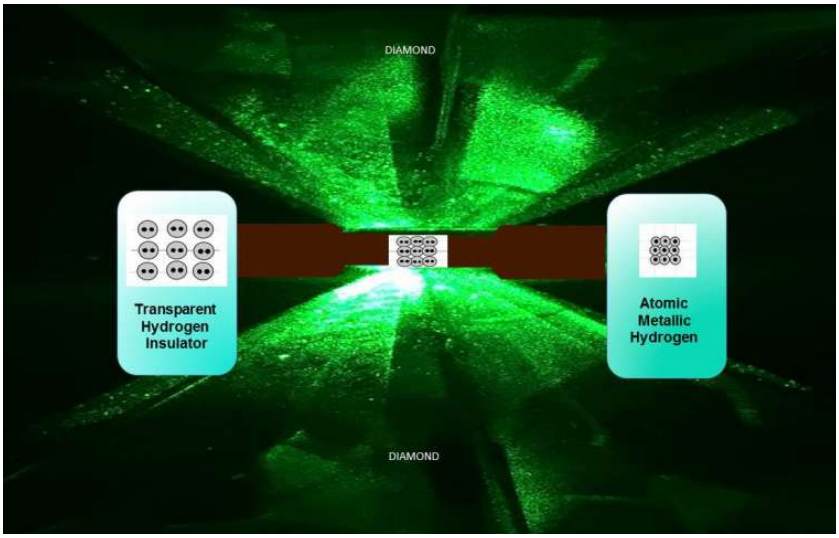


Figure 3: A pair of diamonds setup for a pressure run. The diamonds are small but they can take the pressure.

The Harvard data, at this time, is quite controversial as is everyone's data but not to worry - more testing and better experimental design will improve our understanding of how metallic hydrogen works. As for now, researchers can build a computer model that accurately describes how Jupiter has evolved over 4.5 billion years and get what we see today. The big problem is if we then take

some of those models and apply them to Saturn as we see it today we only get the models to work if Saturn pops into existence 2.5 billion years ago; it appears we have much to learn about hydrogen.

A much bigger concern than a hot Saturn that we cannot explain is the fact that as I write this column in November solar astronomers are announcing that they have just identified the first sunspot of the next solar cycle and the only problem with this is that sunspot has appeared two years after everybody's computer model said it would, We may really have a lot to learn about how hydrogen works - especially in our Sun.

The only two parts of my pre-trip planning that went off pretty much as planned was the tour of the wineries, some excellent wines discovered and some dogs and a day at the Chabot Science Center. First let me explain that because it is French, the word is pronounced SHA BOU not SHA BOT, I just love the way the French have their own way of pronouncing things especially when I am trying to figure out how to pronounce the names of some of the lesser known French wines and although I always get the pronunciation of the wines wrong I still love the taste of them.

Back to the Chabot Science Center. When my brother-in-law, Warren, and I first got there and walked around the place, it appeared well-designed with exhibits that were nicely suited to provide a child's STEM learning experience but not what I was hoping for. The center did, however, have an outdoor solar observing area. So Warren and I went to see it and to find out when the main telescopes would be open so we could at least look at them if not through them. Working on one of the exhibits of the solar deck was an older gentleman who I assumed was a docent and I was also impressed by an incredibly well designed and built horizontal coelostat on one side of the deck.

In order to find out when the telescopes would be open for public viewing I approached the docent and as a conversation starter commented on what a wonderful coelostat they had and was it ever used to do projection images of sunspots? The gentleman turned and pointed a finger at me and said "you are an astronomer" I told him that no I was not an astronomer but just an interested amateur and was hoping that he or another docent could tell my brother-in-law and me when the telescopes would be open for the public to look at. The gentleman then informed me that he was not a docent but the resident astronomer and then asked me what my brother-in-law was and I informed him the Warren was an engineer working on the Lawrence Laboratory laser project.

The staff astronomer who had by now introduced himself as Conrad Jung again pointed his finger at me and said "you are an astronomer, come". Conrad went to the nearest observatory building and, after finding the right key, unlocked the door, ushered us in, and then shut and locked the door behind us. It was obvious to me Conrad wanted only the real astronomers to be on this tour with no curious but untutored public welcome.

The first scope that we look at was the 8 inch Clark and sons (see fig.4). It was built and installed in its Oakland home the same year as the Lick (1887). Now a hundred and thirty years can do a lot to a telescope but this scope had been completely restored along with its mount and original clock drive to the exact condition it had been in 1887. Amazing! The only difference, Conrad told us, was that the scope was powered by stepper motors and not the original mechanical clock drive, but the drive links for the clock drive were also restored and stored next to the scope.

Figure 4: The 8 inch Clark refractor, an object in which art and science merge.

After a suitable amount of awing and oohing, Conrad then took us to the second observatory that housed the 20 inch Brashear refractor. This scope was built and then first delivered to the 1915 San Francisco World's Fair and after the Fair closed was delivered to the Oakland school system for use by the teachers as a part of the science curriculum. As school systems are wont to do minimal possible, the cheapest fixes were performed on the scope and the mount which was cast iron and did not take kindly to the salt air of Oakland. After decades of neglect the telescope was donated to Chabot and the science center went to work on it with the same result as I saw with the 8 inch Clark including the restoration of all of the parts of the rather massive clock drive system.

After going over the scope and mount inch by inch Conrad said "I have a surprise" and went to a corner of the room and came back with an old wooden box. In the box were the eyepieces for the scope including one of the original Brashear manufactured eyepieces. The Brashear eyepiece looked to be larger than the .965 of the day but even stranger it had what looked to be a 2 inch or 2¼ inch diameter and 8 or 10 inch tail on it. I looked in the end of the eyepiece tail and there was a lens in the tail and I realized that this "eyepiece" was actually an eyepiece/ Petzval lens combination and would have reduced the chromatic aberration and have improved the sharpness of the object image. Moral : even a hundred year old telescope can teach you something new.

The third scope that Conrad showed us was a one meter Schmid-Newtonian on a fork mount and as soon as my brother-in-law saw it he said "oh-yes this is the scope that we used at the lab to develop the artificial guide star system for the adaptive optics telescopes". But of course the guy who is a specialist in laser mechanical systems would have worked on the development of laser generated artificial guide stars, how silly of me not to know that. Anyway, Conrad and Warren had quite the conversation on the history and operating quirks of this scope.

With the last scope looked at and discussed it was time for Warren and myself to head back to my in-laws' house and open a bottle of wine and savor both the wine and the day.

Cheers,
Chuck

Observe Apollo 8's Lunar Milestones
By David Prosper

December marks the 50th anniversary of NASA's Apollo 8 mission, when humans first orbited the Moon in a triumph of human engineering. The mission may be most famous for "*Earthrise*," the iconic photograph of Earth suspended over the rugged lunar surface. "*Earthrise*" inspired the imaginations of people around the world and remains one of the most famous photos ever taken. This month also brings a great potential display of the Geminids and a close approach by Comet 46P/Wirtanen

You can take note of Apollo 8's mission milestones while observing the Moon this month. Watch the nearly full Moon rise just before sunset on December 21, exactly 50 years after Apollo 8 launched; it will be near the bright orange star Aldebaran in Taurus. The following evenings watch it pass over the top of Orion and on through Gemini; on those days five decades earlier, astronauts Frank Borman, Jim Lovell, and Bill Anders sped towards the Moon in their fully crewed command module. Notice how the Moon rises later each evening, and how its phase wanes from full on Dec 22 to gibbous through the rest of the week. Can you imagine what phase Earth would appear as if you were standing on the Moon, looking back? The three brave astronauts spent 20 sleepless hours in orbit around the Moon, starting on Dec 24, 1968. During those ten orbits they became the first humans to see with their own eyes both the far side of the Moon and an Earthrise! The crew telecast a holiday message on December 25 to a record number of Earthbound viewers as they orbited over the lifeless lunar terrain; "*Good night, good luck, a merry Christmas and God bless all of you - all of you on the good Earth*." 50 years later, spot the Moon on these holiday evenings as it travels through Cancer and Leo. Just two days later the astronauts splashed down into the Pacific Ocean after achieving all the mission's test objectives, paving the way for another giant leap in space exploration the following year.

The Geminids, an excellent annual meteor shower, peaks the evening of December 13 through the morning of the 14th. They get their chance to truly shine after a waxing crescent Moon sets around 10:30 pm on the 13th. Expert Geminid observers can spot around 100 meteors per hour under ideal conditions. You'll spot quite a few meteors by avoiding bad weather and light pollution if you can, and of course make sure to bundle up and take frequent warming breaks. The Geminids have an unusual origin compared to most meteor showers, which generally spring from icy comets. The tiny particles Earth passes through these evenings come from a strange "rock comet" named asteroid 3200 Phaethon. This dusty asteroid experiences faint outbursts of fine particles of rock instead of ice.

You can also look for comet 46P/Wirtanen while you're out meteor watching. Its closest approach to Earth brings it within 7.1 million miles of us on December 16. That's 30 times the average Earth-Moon distance! While passing near enough to rank as the 10th closest cometary approach in modern times, there is no danger of this object striking our planet. Cometary brightness is hard to predict, and while there is a chance comet 46P/Wirtanen may flare up to naked eye visibility, it will likely remain visible only via binoculars or telescopes. You'll be able to see for yourself how much 46P/Wirtanen actually brightens. Some of the best nights to hunt for it will be December 15 and 16 as it passes between two prominent star

clusters in Taurus: the Pleiades and the V-shaped Hyades. Happy hunting!

Catch up on all of NASA's past, current, and future missions at nasa.gov

Earthrise, 1968. Note the phase of Earth as seen from the Moon. Nearside lunar observers see Earth go through a complete set of phases. However, only orbiting astronauts witness Earthrises; ***for stationary lunar observers, Earth barely moves at all****. Why is that? Credit: Bill Anders/NASA*

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The TVA is a member club of The Astronomical League.