

Live Long & Prosper

International Space Station astronaut Terry Virts (@AstroTerry) tweeted this image of a Vulcan hand salute from orbit as a tribute to actor Leonard Nimoy, who died on Friday, Feb. 27, 2015. Nimoy played science officer Mr. Spock in the *Star Trek* series that served as an inspiration to generations of scientists, engineers and sci-fi fans around the world.

Cape Cod and Boston, Massachusetts, Nimoy's home town, are visible through the station window.

Inside This Issue

Vol.72 No.2* March-April, 2015

Founded in 1945

 $\star \star \star$

Sacramento Valley Astronomical Society

Event Calendar

3

4

- Wayne Lord, Community Star Party Lead
- Kevin's Comet Corner
- 5 Lunar Eclipse, April 4th, by Ralph Merletti
- 6 Supernova in NGC 4666
- 7 Black Butte Star Party, Jack & Beverly Sales
- 9 Jupiter's Elusive Triple Moon Transit
- 10 Visiting the Chabot Telescope Workshop
- 16 Moon, Mars, & Venus
- 17 Black Holes, Space Place
- 18 Dawn Arriving at Asteroid Ceres 20 Giant Filament Seen on the Sun
- 21 Astro Ads
- 22 SVAS Officers, Board, Members , Application

SVAS Observer

1

SVAS Event Calendar



Mar 20, Friday, General Meeting Friday at 8:00pm

Sacramento City College, Mohr Hall Room 3, 3835 Freeport Boulevard, Sacramento, CA. This is our annual election meeting, we hope everyone can attend!



Mar 20, <u>Fri</u> New Moon, next Full Moon called the Pink Moon.



Mar 20, Fri Vernal Equinox.



Mar 21, Sat Blue Canyon, weather permitting.



Apr 4, Sat Total Lunar Eclipse beginning at 2:01 am, Greatest at 5:00 am.



Apr 17, Friday, General Meeting Friday at 8:00pm

Sacramento City College, Mohr Hall Room 3, 3835 Freeport Boulevard, Sacramento, CA.



Apr 18, Sat New Moon, next full Moon is the Flower Moon.





<u>Apr 18, Sat</u> Blue Canyon, weather permitting.

Apr 22-23, Wed-Thurs Lyrids Meteor Shower.





Star-B



Hello, all SVASers! Lonnie gave me a great introduction in the last issue of The Observer, so I just want to fill in a little of the details here. I want to second Lonnie's observation that Perry did an excellent job for years as Star*Party coordinator, and I hope I can carry on from where he left off. I have already had contacts with several local groups who want to use our services, including one who wanted to book a tour of Sea Elephant Rookeries! Somehow they got their wires crossed and found our outreach email address instead of the one they really wanted. However, when I explained who we were and what we do, she said she was interested in hosting a star party too.

It is going to take me a while to settle into this new position, and I am sure there will be some rough spots, but with your help and support I will attempt to muddle through. It would be helpful to me if those who are the core group



who have supported community star parties in the past would contact me (star_geezer@yahoo.com or 916.396.7404) and provide your contact information. And please respond to notices on the Yahoo group of upcoming star parties as soon as you can to let me know I won't be alone on the night of the event! Thank you, and hope to see you soon!

Wayne Lord/Community Star*Party Coordinator







Comet Lovejoy C/2014 Q2 (Lovejoy) by Kevin Heider



Don't miss Comet C/2014 Q2 (Lovejoy)! It is still magnitude 5 (binocular range), up all night in the circumpolar region, and a great target near Cassiopeia. On March 15 Lovejoy will pass Image by Kevin Heider January 19th Comet C/2014 Q2 (Lovejoy) 16" Ritchey Chretien at HGO Canon T3i, 240 second exposure



10 arc minutes (1/6 of a degree) from Delta Cassiopeia (mag 2.7).

I mentioned in the last newsletter, enter "C/2014 Q2" in Sky Safari for Comet Lovejoy, and touch show info and select center to view the current position.



SVAS Observer

Total Lunar Eclipse April 4



by Ralph Merletti

"April's pre-Easter Total Lunar Eclipse"

A total eclipse of the Moon, the third in a series of four consecutive total lunar eclipses visible in full or in part from California during these two years (2014 -2015), will occur during the early morning hours of Saturday, April 4th, 2015. This Saturday morning (Holy Saturday in the Catholic/Christian calendar) follows Good Friday and precedes Easter Sunday. Easter Sunday is after the first full moon and after the spring equinox in the Gregorian calendar. This time, the pre-Easter full moon will get more notice than usual.

The full moon, just a few days past orbital apogee, will appear slightly smaller than av-

Saturday Morning, April 4, 2015, PDT	
1:59 am	Penumbral begins
3:15 am	Partial begins
4:56 am	Total phase begins
5:00 am	Midpoint / Greatest eclipse
5:05 am	Totality ends
6:45 am	Partial ends
8:01 am	Penumbral ends (after Moon sets)

erage. The Earth's umbral shadow will also be slightly smaller than average for the Moon's mean distance. The Moon will move at a tangent through the northernmost portion of the Earth's umbral shadow, and technically will be totally eclipsed from five to ten minutes depending on which reference source is used (the times in the chart at left are taken from the 50 Year Canon of Lunar Eclipses, by Fred Espenak, published by NASA in March 1989 and again by Sky Publishing Corporation in July 1989).

Observable changes will be slow on either side of totality, with the Earth's north polar/arctic region casting the shadow on the Moon during totality. This total lunar eclipse should be brighter than usual (see Danjon scale of luminosity). Some of the Moon is not that close to the umbral center, it will be further away from the Earth than average, which allows more atmospheric-refracted light to reach the Moon during totality. Near the end of the decreasing umbral phase, the edge of Earth's shadow may possibly be visible on both the Moon and in/on our local atmosphere at the same time. However, the edges will not be parallel to each other in the brightening sky, and the Moon will be near the horizon shortly before sunrise.



Type 1a Supernova in Virgo

On December 9th, 2014, astronomers spotted a type 1a supernova, designated ASASSN-14lp, only 12 arc seconds form the core of spiral galaxy NGC 4666. It is located in Virgo just above the double star Porrima. A type 1a is caused when white dwarf companion star pulls matter away from a close by larger star until it begins to collapse and violently explodes. This type explosion can reoccur many times. Astronomers use these nearly equally bright type 1a explosions as candlesticks for distance measurements. NGC 4666 is approximately 80 million light years away shining at







SVAS Observer

magnitude 10.8.

This galaxy looks great visually in HGO's 16" Ritchey. It's called the Superwind Galaxy, because of it's vigorous star formation, which creates a super wind of out flowing gas and dust. It is also thought to interact with NGC 2668 which creates a lot of magnetic disturbance, adding to the superwind.

Kevin Heider, SVAS Board member, took this 300 second exposure photo at left, Jan 22, of the supernova in NGC 4666. You can see the supernova at the 10:00 o'clock position from the galaxies core.

Thanks Kevin!



Last fall once again proved that Black Butte/Buckhorn Recreation Area is an excellent observing site and a stellar camping experience. We hope this spring will be another outstanding experience. Each time new people join us they are amazed just how wonderful the Black Butte Dark Sky experience can be, and the superb creature comforts put icing on the cake.

We were joined by two people from the bay area, Ivor Barker and Ron Guzman. We had previously met Ivor at the Golden State Star Party. Ivor was doing astrophotography and Ron was doing visual. We were also joined for the first time by Peter Chrissanthis, who was doing wide field DSLR photos and some of the best candid's on our web site. We were honored to have Dan and Cindy Duriscoe from the National Parks Dark Sky Team join us to observe and document our location. As always Park Ranger Mary Ann Demming stopped by and we discussed park plans and activities, and ways to promote dark skies and the continued support of astronomy activities.

During the last few years the fall star party has been plagued by smoke from fires near and far, and the Fall of 2014 was no exception. When we arrived you simply could not see the coast mountain range to the south and west. Over the years we have learned to check the mountains towards the SW, to see how many ridges can be seen as a measure of smoke and haze. Dan and Cindy arrived Saturday Evening, and on Sunday the 21st he setup the all sky survey camera on observation hill (I would like to call it Meteorite Hill as it is a perfect location for observing Meteor Showers). That evening, the smoke proved so thick that the system could not even locate Polaris, a reference star required to start the observation session! Needless to say the camp fire was extra popular Sunday night, and I have recently come to realize how important the camp fire is to this star party.

While reading The End of Night, Searching for Natural Darkness in an age of Artificial Light by Paul Dogard, Paul recounts a story told to him; "A Cherokee friend of mine told me about something he was taught as a child, part of traditional Cherokee culture, called 'opening the night'. What you do is find a dark quiet place, it could be on your back porch in the old days, and sit and listen to what's around you in a very close circle perhaps within arm's length. Concentrate on that area, and then double the circle trying to hear everything there. Keep doubling that circle, and at night you could reach a point where you could hear a mile away"!

Each night the campfire serves much the same function, some of us gather round after uncovering the tele-



scopes and getting setup. Here we gather to talk, watch the fire, and now and then look up to check the sky. "I see Sirius or Venus" the shout goes out, but no one moves. Then as more stars appear the crowd dwindles, but not all abandon the fire. We also make the same observations as the Cherokee opening the night; the far off speeding truck, an owl over toward the main camp sites, the pack of coyote pups





apparently excited by the arrival of an evening dinner, and we note just how noisy the quiet can be.

On Sunday night we were finally able to observe and make sky measurements, although not well noted in Dan's report, the lingering smoke in all directions definitely increased the sky brightness. Dan was so impressed with the sky quality that he remained up nearly until dawn. As noted in his narrative at the start of the data set; "Seeing excellent, transparency poor" and "Despite high extinction, an excellent sky near the zenith with

the dark lane in the Cygnus star cloud visible". The report also includes our SQM (sky quality meter) readings. On the night of the 22nd we measured SQM 21.44 at 9:30 PM (Sales), and 21.77 at 12:30 AM LMT (Duriscoe) (for reference, Sacramento is ~18.66, Blue Canyon averages ~21.47 in 2008, and GSSP is ~21.70). Previously at Black Butte we have measured on average SQM 21.69, and at one





learn more about the NPS Night Sky Program

air/lightscapes/monitorData/lavo/

IP20040716.cfm.

visit, http://www.nature.nps.gov/night/indes.cfm Lassen Volcanic NP, and Night Sky Quality

Dan and his outstanding 12" binocular

are few quotes from his visual observations on

had a special night. Saturn, only 10 degrees above the horizon, showed very smooth long-

period turbulence. Double stars were next; al-

point in 2009 we observed SQM 21.81. In the 2004 survey of Lassen Volcanic National Monument.

the "Zenith" (mag/sq arc-sec) brightness varied between SQM 21.36 and 21.44, and measured 21.52 to 21.72 for the "Darkest" region.

In the photometry plot below, you can see how even the Sunday night the stars extended to the horizon. You can also see how unobstructed the horizon is from this vantage point (a perfect spot observe meteor showers). Although the light domes seem ominous, they are mostly blocked by the buttes in the telescope's observing field.

The data collected will become a part of the National Park Service Night Sky Program, and be use as reference data. To



pha Her, eta Cas, zeta Cas, beta Cyg, epsilon Lyr all looked perfect. Epsilon Lyre both pairs separated at 70x." ... "Up to the Veil, very nice, Pickering's Triangular Wisp just barely there, but the knots and filaments in the main loop looked quite detailed. North America boundaries easily traced, good dynamics in the "Mexico" area, and the Pelican Nebula easily visible."

As luck would have it, Dan and Cindy had to return to Bishop on Tuesday, and it proved to be an outstanding night. We stood in the center of the observing field (main parking lot) and watched the stars of Scorpio disappear behind the mountain ridges to the south west. It was truly an awesome night and we observed stars all the way to the horizon, where only a few days before even the hills were invisible. We are looking forward to this April's event!

As we noted in a previous report, we have been observing here for seven years, and during that time the lighting and facilities have improved. The group camp gained a new restroom and hot shower in 2010, and our group of observers has grown. As always you are invited to join us, and experience the exceptional dark skies for yourself.

There are a limited number of camping spots available, so please RSVP to Jack or Bev. The dates for this SPRING are APRIL 17-20. Even if you can't stay overnight, you are welcome to visit for the day, park fees apply. More information can be found at our Black Butte Star Party web site, http://www.jimstar11.com/bblsp.html

Jupiters Rare Tripple Moon Conjunction

Jupiter . January 24, 2015

We waited for the last minute weather report to plan a special star party at Blue Canyon, trying to catch a glimpse of Jupiter's rare triple moon conjunction. By Wednesday, the weather report looked like a go for Friday, clear with 8mph winds. Perry P. Porter, Kevin Heider, Tom Braun, and I, rolled off the roof at HGO getting ready for the rare event. At dusk, Venus and Mercury shone brightly high above the horizon, and Mars and Uranus were right behind. We has some great views of the planets in the 16" Ritchey.

As the evening progressed, the wind increased to 35 mph gusts that moved the roll off roof around. By nine we decided to close the roof and retire to the protection of the dome, and view the event in the new 14" Celestron. After enjoying a hot dog and soft drink in the warm up room, we fired up the C14 and aimed at Jupiter. The wind continued to blow, and the views were marginal at best. As the conjunction started, we could just barley make out an occasional fleeting shadow on the surface because of the turbulent air currents.

We decided to wrap up around midnight, the wind persisted to degrade the views. On the trip home we encountered extremely heavy fog in Auburn, and it covered the Sacramento valley. It occurred to us that the valley could have had better views than HGO, but the fog confirmed that wasn't the case. It would have been really irritating to travel all that way and fail to see the event, when we could have enjoyed the conjunction by simply staying at home!

Observer Editor



Hubble

9

NASA and ESA + Hubble Space Telescope + WFC3/UVIS + STScI-PRC15-05a

Firing off a string of snapshots like a sports photographer at a NASCAR race, NASA's Hubble Space Telescope captured a rare look at three of Jupiter's largest moons zipping across the banded face of the gas-giant planet: Europa, Callisto, and Io. Jupiter's four largest moons can commonly be seen transiting the face of the giant planet and casting shadows onto its cloud tops. However, seeing three moons transiting the face of Jupiter at the same time is rare, occurring only once or twice a decade. Missing from the sequence, taken on January 24, 2015, is the moon Ganymede that was too far from Jupiter in angular separation to be part of the conjunction.

SVAS Observer



Bill Thomas and I were on the road again early last year, promoting the ATM Connection. This time we visited the 86,000 square foot Chabot Space & Science Center in the hills of Oakland and specifically the famous Chabot Telescope Makers Workshop. Bill contacted Richard Ozer, the lead for the telescope workshop there, and he gra-

ciously agreed to show us around. We contacted our mirror making friend Jeff Baldwin, hailing from the SAS (Stockton Astronomical Society), and ask him to ioin us. He invited Eric Holland (SAS President), and mirror maker (optometrist) Mike Lavieri. This promised to be a really fun trip, and indeed is was!

We made our way to Oakland in the middle of a heavy rainstorm, which slowed us



Jeff Baldwin, Lonnie Robinson, Bill Thomas, Eric Holland, Rich Ozer, Mike Lavieri

down considerably. When we finally arrived, Jeff and company were already there to greet us. The mirror workshop was most impressive, it's conducted in a upstairs science classroom with numerous lab style tables that are perfect for grinding and polishing mirrors. A small storage area in back makes a great dark room for testing mirrors.

The current location is the third one for Chabot. It was originally called the Oakland Observatory built in 1883, and located within the city limits. Anthony Chabot donated the money for the fabrication of the 8" Clark telescope and later the Meridian Transit Telescope. When he passed away, the name was changed to Chabot Observatory. In 1915 it was determined that a higher location was necessary to avoid city lights. Skyline Blvd was

their first choice, but the access roads back then were so poor that it wasn't an option, so Mountain Boulevard was selected. Later in 2000, a third move was prompted because Chabot was located right on the creep zone of the Hayward earthquake fault, and state law forbid hosting school events there. Because of ever encroaching city lights and the school restrictions they decided to move again, and this time there were acceptable access roads to the higher present Skyline Blvd. location. It is now called the Chabot Space & Science Center.

Rich gathered us all together and we were off for a



Eric, Mike, & Jeff, taking photos of the Transit Telescope





tour of the famous Chabot telescopes. Our first stop was the library where we took the group photo on the beginning page. From there we began our tour with the Fauth Transit Telescope located in the main building, near the exit leading to the telescope domes. The smaller dome on the left houses the 8" Alvin Clark refractor called Leah, the large center dome hosts the Warner & Swasey 20" refractor named Rachel, and the roll off roof observatory contains the giant 36" reflector named Nellie. Leah and Rachel were named after the Biblical story of Jacob, who was married to Leah and had to wait seven years to marry the woman he really wanted, her sister Rachel. Chabot's first director, Charles Burckhalter, had to wait 27 years for Rachel. Merrill and Lillian Martin donated half a million dollars towards making Nellie a reality. Nellie is named after their youngest daughter and Merrill's mother.

I found the Fauth transit most intriguing, having never seen such an instrument before. This telescope is mounted securely on two piers and is only able to move along the Meridian. It is called a transit scope because it's function was to record the exact times stars would cross the Meridian. These crossings were used to create accurate right ascension and declination addresses for stars, and accurately locate longitude and latitude locations on

Earth. Before the invention of the atomic clock they were used to verify accurate time. The operator would record the exact transit of a star, and then calibrate a nearby clock. The transit time was also used to send an electronic signal ringing a bell in the Oakland City Hall, twice each day, to reset their clocks by. Ships in port used the accurate transit time to note the drift of three onboard chronometers, which the ships required for accurate celestial navigation. The accuracy



of the mount was critical, and extreme precision was elusive. There always seemed to be a mount error left over after all the alignment efforts were made. A lifting jack screw mounted on a stand, moved on rails, with a cradle to hold the



telescope, was used to dismount the scope, reverse it, and install it again averaging out the errors between the two positions! The two piers were pointing exactly east to west, exactly level with each other, and fine tuned. Check out the detailed photo of the setting circles, and notice the magnifying glass used to increase the read accuracy. We are really spoiled with atomic clock supported satellites!

Our next stop was to see Leah, the 8" Alvan Clark & Sons refractor in the smaller dome. It was constructed in



1883, and was so interesting to see the fine workmanship they achieved back then. The brass parts are simply amazing, and the clock drive mechanisms are a watchmakers dream! It was still stormy outside, so we didn't get to view any celestial objects. After all, we were there to experience the ATM part of finely crafted observatory class telescopes.

Next came the 20" Rachel refractor located in the largest dome. It seemed really huge when looking from the eyepiece end, especially after just enjoying the 8". It was constructed in 1914 by Warner & Swasey / John Brashear, and has a 28' focal length! Yes, I said 28 feet. At the time of the second observatory move, this state of the art scope was constructed to bring Chabot up to date. The workmanship and attention to detail is phenomenal! Check out the photo of the drive mechanism below, look closely towards the top and you will see the mechanical flyweights used to control the telescope's RA drive speed. It looked like the inner workings of a grandfather clock.

Next, for our final telescope on the tour, we walked a short distance to the roll off roof observatory housing the newest and



greatest Chabot telescope named Nellie. The roll off roof provides a 180 degree view of the heavens. The telescope is a 36" Classic Cassegrain type reflector built by the Chabot Space & Science Center staff and volunteers, debuting in 2003. It has a focal length of 24 feet. I asked Richard Ozer if he could tell us any stories about Nellie's construction, specifically about the main mirror. He referred me to Gerald McKeegan who works very closely operating Nellie. Here is his story:

"Kevin Medlock, who was working for the Chabot Space & Science Center in the late 1990's and early 2000's, designed the telescope OTA for Nellie. (He now works for DFM Engineering located in Colorado. DFM Engineering also custom designed and fabricated the control system, installed

the drive motors, and setup the computer controls and software.) His original design was for a 1-meter telescope, but funding issues were making it difficult to acquire the desired mirror.

At some point Kevin learned that a 36-inch mirror was in storage at the Lawrence Livermore National Lab. The mirror had been purchased for a nuclear testing project that had been cancelled, so it was never used and was sitting in a box stored at the lab. Arrangements were made for the Lab to "loan" the mirror to Chabot for as long as needed. Unfortunately, the mirror was not figured correctly for Kevin's telescope design, which called for a primary with a f/3parabolic figure. Chabot then arranged with Tinsley Laboratories in Richmond, California, to do the refiguring. When the mirror was ready, it was sent to the University of Arizona for aluminizing and clear coating. The aluminizing was completed, but it was later learned that the clear coating process had not worked properly. When the mirror was installed in the telescope in 2003, it had no clear coat. Because Nellie is a true Cassegrain telescope, the front is open to the outside air during observing sessions. Without the clear coat, it wasn't long before the aluminizing began to corrode.



Finally, in 2007, the mirror was removed from

Nellie and sent to the UC Santa Cruz Advanced Coatings Lab for recoating. There have been no further problems with the mirror coating since that time." This is such an impressive looking scope with the





massive bearing assemblies and huge optical tube. I asked a silly question about the colorful semicircular objects on the bottom of the scope, I asked if they were used as legs to sit the dissembled mirror cell on? The answer was a polite no they are counterweights. They are the best looking counterweights I've ever seen.

Wrapping up our tour, we headed back to the Telescope Makers Workshop. Dave Barosso was kind enough to demonstrate the mirror tester and describe how they use the wire test for parabolizing. He uses a very impressive test stand with machined parts and high tech stage slides. I expressed how professional it looked, and he said " I made it out of spare parts I had laying around"! I particularly liked the razor blade adjustment screws, used to change the light slit to closely match the thickness of the wire. They also use Ronchi gratings for rough testing as a guide towards the final figure. Notice the optical tubes lined up behind Dave, waiting for someone to add their newly finished mirror.

We all gathered around this gentleman in the photo below, who was rough grinding the back and edge of a huge mirror, getting ready to hog out the center. We discussed the process he would be using to complete the mirror.

It was a fantastic visit and regretfully it was time to for us to head back home with great memories of a destination state of

MAKERS

SHOP

the art science center. It makes for a very enjoyable family day trip to take in all the science displays, not to mention the planetarium and world class telescopes available for public viewing. Bill Thomas and I have been traveling all over California and Nevada, visiting other mirror makers with the hope of staying in touch and sharing our mirror making procedures. We call it the ATM Connection,

connecting other club's telescope workshops to discuss, share, and offer extended expert help for club members projects. The beauty of ATM is sharing our secrets with everyone, and inspiring others to give it a try. If you live reasonably near Oakland, I highly recommend contacting the Chabot Telescope Makers Workshop. You will be in great hands, and this workshop dates back to 1930s!









www.chabotspace.org/telescope-makers-workshop.htm

Moon, Mars, & Venus!

Our last Board meeting was progressing to the hour mark of one and a half hours total, and we had completed all our business. As we were contemplating what to discuss next, Astronomy Professor Liam McDaid announced that it may be our last chance to see the spectacular gathering of the crescent Moon, Mars, and Venus, because they were about to drop below the tree line. SVAS President Walt Heiges adjourned the meeting early so we could enjoy this special conjunction.

It was a bit strange and fun watching all the Board members wandering about in the parking lot, vying for the best spot to peek through the trees at the vanishing trio. We weren't disappointed since it was a sight to behold! Venus and the crescent Moon together are always impressive, and adding Mars was a big bonus.

Mars is currently only 4.2 arc seconds across and easily viewed at 1.3 magnitude. It can grow to 25" across and near –3 magnitude during it's closest approach, rivaling Jupiter and Venus.



Not much to see in a telescope until next years perihelion, when our orbits come together to within .5 Astronomical Units (48 million miles). 2018 should be really spectacular with a close up visit of .385 AU (35.8 million miles)!

Jack and Beverly Sales were on their way to the SVAS General Meeting, to talk about the Dark Sky Network. When they were getting in their car to leave home, Beverly looked to the west and decided they had to pull out their camera and tripod for a quick photo. Thanks for a Great Picture!

Observer Editor

Minor Mergers have Massive Consequences for Black Holes



by Dr. Ethan Sigel

When you think of our sun, the nearest star to our world, you think of an isolated entity, with more than four light years separating it from its next nearest neighbor. But it wasn't always so: billions of years ago, when our sun was first created, it very likely formed in concert with thousands of other stars, when a giant molecular cloud containing perhaps a million times the mass of our solar system collapsed. While the vast majority of stars that the universe

forms-some ninetyfive percent-are the mass of our sun or smaller, a rare but significant fraction are ultra-massive, containing tens or even hundreds of times the mass our star contains. When these stars run out of fuel in their cores, they explode in a fantastic Type II supernova, where the star's core collapses. In the most massive cases, this forms a black hole.

Over time, many generations of stars—



and hence, many black holes—form, with the majority eventually migrating towards the centers of their host galaxies and merging together. Our own galaxy, the Milky Way, houses a super massive black hole that weighs in at about four million solar masses, while our big sister, Andromeda, has one nearly twenty times as massive. But even relatively isolated galaxies didn't simply form from the monolithic collapse of an isolated clump of matter, but by hierarchical mergers of smaller galaxies over tremendous timescales. If galaxies with large amounts of stars all have black holes at their centers, then we should be able to see some fraction of Milky Way-sized galaxies with not just one, but *multiple* super massive black holes at their center!

It was only in the early 2000s that NASA's Chandra X-ray Observatory was able to find the first binary supermassive black hole in a galaxy, and that was in an ultra-luminous galaxy with a double core. Many other examples were discovered since, but for a decade they were all in ultra-massive, active galaxies. That all changed in 2011, with the discovery of two active, massive black holes at the center of the regular spiral galaxy NGC 3393, a galaxy that must have undergone only minor mergers no less than a billion years ago, where the black hole pair is separated by only 490 light years! It's only in the cores of active, X-ray emitting galaxies that we can detect binary black holes like this. Examples like NGC 3393 and IC 4970 are not only confirming our picture of galaxy growth and formation, but are teaching us that super massive relics from ancient, minor mergers might persist as standalone entities for longer than we ever thought!

Check out some cool images and artist reconstructions of black holes from Chandra: http:// chandra.harvard.edu/photo/category/blackholes.html

Images credit: NGC 3393 in the optical (L) by M. Malkan (UCLA), HST, NASA (L); NGC 3393 in the X-ray and optical (R), composite by NASA / CXC / SAO / G. Fabbiano et al. (X-ray) and NASA/STScI (optical).

Arriving at Asteroid Ceres Next March



Discovered on Jan. 1, 1801 by Giuseppe Piazzi of Italy, Ceres is the largest object in the asteroid belt - the strip of solar system real estate between Mars and Jupiter. On March 6, 2015, NASA's Dawn spacecraft will arrive at Ceres, marking the first time that a spacecraft has ever orbited two solar system targets. Dawn previously explored the protoplanet Vesta for 14 months, from 2011 to 2012, capturing detailed images and data about that body. Dawn has entered its approach phase toward Ceres, and the next couple of months promise continually improving views prior to arrival. By the end of January, the spacecraft's images and other data will be the best ever taken of the dwarf planet.

This image of Ceres was taken by the Advanced Camera for Surveys on NASA's Hubble Space Telescope between December 2003 and January 2004. Hubble images of Vesta and Ceres helped astronomers plan for the Dawn spacecraft's tour. Astronomers enhanced the sharpness in the image to bring out features on Ceres' surface, including brighter and darker regions that could be asteroid impact features. The observations were made in visible and ultraviolet light.

The colors represent the differences between relatively red and blue regions. These differences may simply be due to variation on the surface among different types of material. Ceres' round shape suggests that its interior is layered like those of terrestrial planets such as Earth. Ceres may have a rocky inner core, an icy mantle, and a thin, dusty outer crust inferred from its density and rotation rate of 9 hours. Ceres is approximately 590 miles (950 kilometers) across.

Image Credit: NASA/ESA/J. Parker (SWRI), P. Thomas (Cornell U.), L. McFadden (U-Md., College Park), and M. Mutchler and Z. Levay (STScI)

Dawn Approaches: Two Faces of Ceres



These two views of Ceres were acquired by NASA's Dawn spacecraft on Feb. 12, 2015, from a distance of about 52,000 miles (83,000 kilometers) as the dwarf planet rotated. The images have been magnified from their original size.

The Dawn spacecraft is due to arrive at Ceres on March 6, 2015.

Dawn's mission to Vesta and Ceres is managed by the Jet Propulsion Laboratory for NASA's Science Mission Directorate in Washington. Dawn is a project of the directorate's Discovery Program, managed by NASA's Marshall Space Flight Center in Huntsville, Alabama. UCLA is responsible for overall Dawn mission science. Orbital ATK, Inc., of Dulles, Virginia, designed and built the spacecraft. JPL is managed for NASA by the California Institute of Technology in Pasadena. The framing cameras were provided by the Max Planck Institute for Solar System Research, Göttingen, Germany, with significant contributions by the German Aerospace Center (DLR) Institute of Planetary Research, Berlin, and in coordination with the Institute of Computer and Communication Network Engineering, Braunschweig. The visible and infrared mapping spectrometer was provided by the Italian Space Agency and the Italian National Institute for Astrophysics, built by Selex ES, and is managed and operated by the Italian Institute for Space Astrophysics and Planetology, Rome. The gamma ray and neutron detector was built by Los Alamos National Laboratory, New Mexico, and is operated by the Planetary Science Institute, Tucson, Arizona.

Image Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

Giant Filament Seen on the Sun



A dark, snaking line across the lower half of the sun in this Feb. 10, 2015 image from NASA's Solar Dynamics Observatory (SDO) shows a filament of solar material hovering above the sun's surface. SDO shows colder material as dark and hotter material as light, so the line is, in fact, an enormous swatch of colder material hovering in the sun's atmosphere, the corona. Stretched out, that line – or solar filament as scientists call it – would be more than 533,000 miles long. That is longer than 67 Earths lined up in a row. Filaments can float sedately for days before disappearing. Sometimes they also erupt out into space, releasing solar material in a shower that either rains back down or escapes out into space, becoming a moving cloud known as a coronal mass ejection, or CME. SDO captured images of the filament in numerous wavelengths, each of which helps highlight material of different temperatures on the sun. By looking at such features in different wavelengths and temperatures, scientists learn more about what causes these structures, as well as what catalyzes their occasional eruptions.

Launched on Feb. 11, 2010 aboard a ULA Atlas V rocket from Cape Canaveral Air Force Station, Fla., NASA's Solar Dynamics Observatory is designed to study the causes of solar variability and its impacts on Earth. The spacecraft's long-term measurements give solar scientists in-depth information to help characterize the interior of the sun, the sun's magnetic field, the hot plasma of the solar corona, and the density of radiation that creates the ionosphere of the planets. The information is used to create better forecasts of space weather needed to protect aircraft, satellites and astronauts living and working in space. *Image Credit: NASA/SDO*





For sale: A Meade 8" LX90, Schmidt Cassegrain Auto Star. This scope has been lightly used, and improvements have been made. The GO-TO apparatus, with aid of the GPS make it easy to locate your favorite objects. A basic set of eye pieces are included, including a Mars filter. The pictured right angle finder scope saves craning your neck locating targets. I'm asking \$1300 and will accept reasonable counter offers.

Please contact Dave Compton.

Check out Cloudy Nights Classifieds for Astro Stuff

For Sale, Meade 10" f4/5 Newtonian. Completely gone through and modified to make it easier and safer to use. The feet now have leveling adjusters and the drive motor has an on/off switch. The bands that secure the tube assembly are trapped so they can't come off. Both RA and Dec pivots were cleaned and greased, the drive clutch was cleaned and adjusted. The optic's are typical high quality Meade. The original 1.25 plastic focuser has been replaced with a metal 2" Orion with a 1.25" adapter. The mirror's were cleaned and collimated. The scope comes with two



eyepieces, a 1.25/15mm Kellner and a 40mm Scopetronix Maxview 2". A Stellarvue 8x50 right angle correct view finder that accepts 17 to 40mm eyepieces, and a Telrad are included. Designed for visual observations, it works fine with today's fast rate imagers (with careful polar alignment) and quite well with Orion's Deep Space Video Camera. Asking \$1000,00. Contact Manya Tingey

Large Aperture Aluminum Telescopes with SlipStream GoTo Drive System

These all metal telescopes offer extreme durability, precision of movement, ease of use and a pleasing low profile aero-space look. They feature:

- * Highest quality optics
- * Feathertouch focuser
- * Argo Navis DSC's
- * SlipStream Drive with slip clutches on both axes
- * Rigid welded structure
- * Durable powder coating and black anodizing
- * Available in sizes from 16" to 40" and f/ratios from f2.8 to f4.

This is a complete telescope system. It will automatically GoTo and then track any ob-

ject you bring up on the Argo Navis. Or you can move the scope by hand at any time with no clutches to engage or disengage. A wireless hand control also gives you a 3-speed slew for both axes, allowing you to center objects or do fine guiding. Check our website for pricing and details.

EQUATORIAL PLATFORMS 15736 McQuiston Lane Grass Valley, CA 95945 530-274-9113 tomosy@nccn.net www.equatorialplatforms.com



