



Look right in the center to see Comet Neowise surrounded by clouds in this picture from James Smallwood. It was shot with Canon 5D3 camera and 100mm lens.

Because of the COVID-19 crisis and ongoing efforts to reduce exposure to the virus:

- **All in-person club events are cancelled**
- **Use of the Anza site is discouraged**

Please read more about how OC Astronomers has modified its activities on page 2.

Upcoming Events - free and open to the public

Beginner's class	Friday, 1 October at 7:30 to 9:30 PM This is session 2 which covers the different types of equipment used to observe the night sky, including telescopes, mounts, eyepieces, filters, and advantages and disadvantages of different options. Class materials can be downloaded from OCA website. This is presented by David Pearson.	ONLINE
Club Meeting	Friday, 8 October at 7:30 to 9:30 PM "What's Up?": Dr. Doug Millar from OCA Main speaker: Dr. Daniela Calzetti from University of Massachusetts, Amherst whose talk will be "Stars are not Spherical Cows"	ONLINE
Open Spiral Bar	Saturday, 9 October at 10:00 to 11:30 PM Want to socialize? Grab your images, experiences, questions, or none and see your fellow Orange County Astronomers face-to-face.	ONLINE

Please consult the calendar on the OCA website to RSVP (required)

Response to COVID-19 Crisis

COVID-19 continues to affect all our activities. Some in-person club events remain cancelled while others are beginning to occur or are in the process of being scheduled. Cancellation periods for specific events are detailed below. Please see the President's Message for additional information.

Any use of the club's Anza site by members is at their own risk as we have no way of cleaning or sanitizing the site to CDC standards. If you must go to the site, be sure to clean and sanitize surfaces you have contact with and make sure it is cleaner when you leave than it was when you arrived. You must bring cleaning supplies and sanitizer with you as it is not provided at the site. Be sure to take any trash that you generate or find on the site out with you, and please maintain social distancing if anyone else is out there.

If you have any questions, feel free to contact board members or post them to the email groups or through social media. We will do our best to respond, but please bear with us if there is a delay as we all have other responsibilities as well.

We hope you and your families and friends all remain safe and healthy, and best wishes to all of you!

Summary of Cancellations of OCA In-Person Events

Due to the ongoing COVID-19 crisis, all in-person club events are cancelled through at least the following periods:

General Meetings	Cancelled until further notice; please try our virtual meetings instead
Anza Star Parties	May start up again in January. Expect further updates on this.
Orange County Star Party	Cancelled until allowed by Orange County Parks, discussions are underway.
Outreaches	We are scheduling events starting in November.
Beginners Astronomy Class	Cancelled indefinitely, please contact Dave Pearson to attend Zoom classes
SIG Meetings	Astrophysics SIG has resumed meeting in person. Astroimaging remains cancelled indefinitely, depending in part on availability of facilities and when meetings could go forward safely. Some may schedule Zoom events.

Please check the website, email groups and social media for updates.

From the Editor

Sirius wants photograph submissions from club members

Please send pictures to me along with a brief description of the subject, where the image was taken, and the equipment used. For projects made, send an email with a brief description and the editor will work with you to produce an article.

Ideas for Future articles

The newsletter includes articles from members or about subjects suggested by our members. We seek ideas and writers to cover them. To contribute an article or work with the editor to produce one, please contact me at newsletter@ocaastronomers.org.

Due dates for submission of articles, pictures and advertisements

<u>Issue</u>		<u>Due date</u>
November		23 October
December	>>	18 November
January		22 December
February		22 January

President's Message

By Barbara Toy

Unlike past years, more Halloween-themed items than Christmas items seemed to show up in August this year, at least at Costco – though maybe I didn't go down the right aisle to find early displays of dancing Santa Clauses. Dancing skeletons are a bit more in keeping with the current season...

I'm not sure how many neighborhoods still had kids going out trick-or-treating before Covid-19, but I know a number of members over the years set up telescopes in front of their houses on Halloween as special treats for anyone coming by, particularly the kids. It would be nice if this year would see a return to that kind of treat for Halloween. Hopefully our recent surge in Covid infections will have gone down by then.

I know our Outreach Coordinator, Ceci Caballero, has been optimistic enough that conditions will be safe for viewing (with appropriate safety measures) to start scheduling events with schools and other venues starting in November. Judging by the emails we've been getting, there's a lot of interest in having viewing events, and not just for schools. Sharing your love of the night sky and showing them what's up there is a great way to help people see beyond their everyday lives and brighten their days (or nights) as well as your own. We can really use more outreach volunteers – doing outreaches has always been one of our club's most rewarding activities, and if you'd like to help out, please contact Ceci at outreach@ocastronomers.org. If you don't have a telescope to use for outreach – well, John Hoot with our Loaner Scope program can help you out.

Fire and Smoke:

As I write this, we haven't had any major fires in our immediate area, but we have had several (fortunately small) fires in the area of our Anza site, one only a few miles away. Fortunately, firefighters were able to get them all under control quickly, but it's a reminder of how severe the fire risk is this year, and not just for Anza. In past years, we have had to cancel star parties in Orange County because of fires in the surrounding mountains or because the fire danger was so high that our viewing site was closed. Fire can be a problem for us even if we aren't immediately threatened by flames, as smoke, even thin smoke, interferes with viewing or imaging.

A lot of people check various weather sites for expected clouds and other conditions before going out to Anza, to be sure the night is likely to be good enough to make the trip worth taking. The easiest site to get to is the Clear Sky Chart through the link on our website (scroll down on the Home page if you don't see it when the page comes up). It uses information from the Canadian Meteorological Centre to make its predictions, and they have added a line for smoke. There are other sites that forecast where smoke from major fires is likely to go, as well. It's sad that this is a major concern even when fires producing the smoke are hundreds of miles away, but it's good that there are tools out there to help us cope with it.

Covid Response Update:

Per their website, Chapman University is still focused mainly on safely resuming activities for its students, faculty and staff; allowing access to outside groups like us is, understandably, a lower priority for them. We don't yet know when we're likely to have access to Chapman Auditorium again for our general meetings, but we currently don't expect that we will be able to meet there until after the new year. This remains a fluid situation, though, and it's possible that things could change before that. If there is any change regarding our general meetings or affecting our other activities, we'll post the information on the website, so please check there for current information.

The Heritage Museum has continued with its careful reopening to the public and our Astrophysics SIG was able to meet there for its September meeting after a break of a year-and-a-half. Hopefully there won't be any further issues on access – if you're interested in attending the October meeting, please contact the chair, Bob Sharshan, rsarshan@aol.com, before going, as space may be limited.

Dave Pearson is continuing to hold the Beginners Astronomy Class remotely via Zoom instead of live meetings at the museum, though the "How to Use Your Telescope" session in January may be there. The links for attending the monthly sessions are on our website calendar, and information on any change will be put on the website. The Beginners Class, by the way, is open to both members and non-members, and each session of the six-session cycle is independent of the others, so you don't have to attend them in order, and can just attend those on specific topics of interest to you if you don't want to do the full course. Dave is really knowledgeable, and the class is a great way to jump-start your knowledge in areas you may not have much background in yet. The areas covered by each session are also included in the calendar entries. If you have any questions about it, please contact him: p.davidw@yahoo.com.

As I write this, I don't yet have information on whether Steve Mizera has been able to confirm a schedule for resuming the Orange County Star Parties with OC Parks. When we get more information, we'll post it on the website. If you're interested in those star parties, please contact him to be put on his mailing list (mizeras@cox.net).

On the Anza Star Parties, the board has decided that we will formally restart them in January, and if that changes, we'll post that information. Meanwhile, members continue to use the site – as always, using it is at your own risk as to all risks inherent in such a rural dark site. As to Covid in particular, we don't have the ability to sanitize the facility or to monitor people on site for vaccination or disease status, so be sure, if you go out there, to take all appropriate measures to protect your own health and that of anyone around you, including taking any cleaning and sanitizing supplies you might need, and please continue to use masks (particularly indoors) and maintain social distancing.

Election for the 2022 OCA Board

We have an election each year for the OCA board for the following year, and we're now at the start of that process for the 2022 board. Nominations are formally taken at the general meetings in October and November, but you can notify Alan Smallbone that you want to run any time before the end of the November meeting to get on the ballot (asmallbone@earthlink.net). The ballot will be finalized after the November general meeting, and voting starts soon after the ballot is finalized; this year, again, voting will be your choice of electronic voting or paper using the US Mail. The election ends at the end of the general meeting in January, the vote will be tallied and the new board will be installed at the January Board Meeting.

Although, as I write this, it looks like everyone on the current board will run again for 2022, we really do want all of you to consider running for the board. Any member in good standing who has been a club member for at least a year can run for the position of trustee, and any member in good standing who has served at least one year on the board can run for president or vice president. I know there are a lot of you out there who meet these requirements, so if any of you has an interest in administering the club, do consider putting your name on the ballot.

As some basic information on your governing body, our board is 11 people – 7 trustees and 4 officers (president, vice president, secretary and treasurer). We meet six times a year, on Sundays in odd-numbered months (starting in January), though additional meetings can be set if needed, and we communicate by email between meetings and can have email votes if necessary. For about the last two years the board has been meeting via Zoom, starting even before Covid-19 became a problem, because of problems finding good meeting locations. It has proved to be so much easier for all of the board members to meet by Zoom that we expect to continue meeting that way indefinitely. Our current meeting time is 10:30 a.m. and the meetings generally last around 2 to 2 ½ hours (our meeting on September 19 was just under 2 hours).

The people who become board members care about keeping the club running as smoothly as circumstances allow and finding ways to meet the club's objectives – even where there may be disagreements, we share those fundamental values, and that makes it a real pleasure to get to know and work with others on the board. I hope you'll consider joining us and will email Alan Smallbone (our current club secretary) to be put on the ballot.

Clear skies and good health to all of you!

© Barbara Toy, September 2021

AstroSpace Update

October 2021

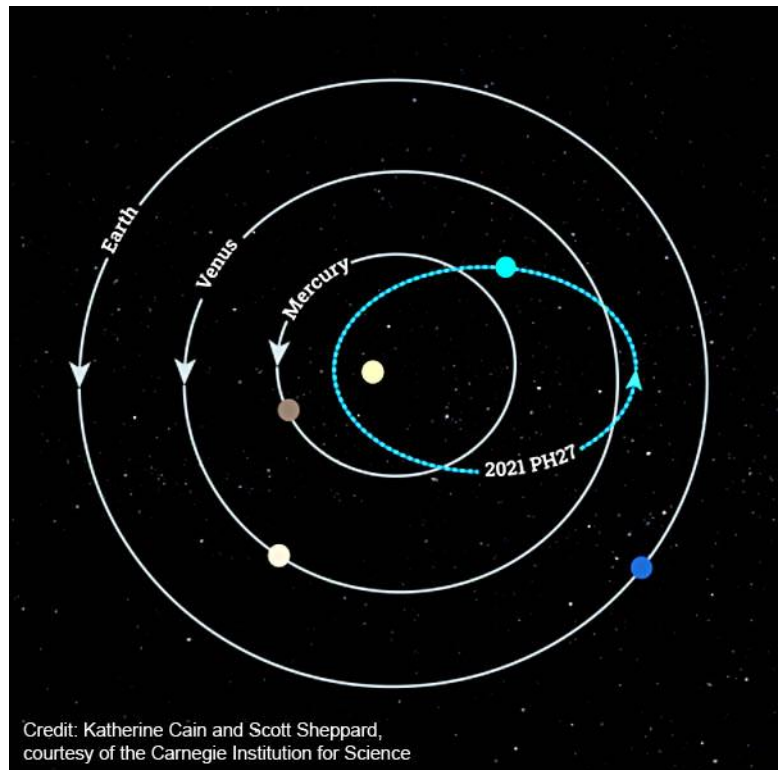
Astronomy and space news summarized by Don Lynn from NASA and other sources

Sampling Mars – After the unsuccessful attempt of the Mars rover Perseverance to store a drilled sample of Martian rock and soil, which was reported here last month, the rover made 2 successful samplings of a flat Martian rock nicknamed “Rochette”. Both are now sealed in titanium tubes for a future mission to return to Earth. The sampling and caching system has over 3000 moving parts, and so is one of the most complex mechanisms ever launched to deep space. Preliminary analysis onboard the rover shows the samples are volcanic with later exposure to water.



Unusual Comet – A newly discovered comet, called Comet Leonard, is going to pass quite close to Venus in December. The closest distance between their orbital paths is only about 30,000 miles and the planet arrives there only about 3 days after the comet. It is possible that the planet will pass through a debris trail from Leonard, which will cause a meteor shower. Unfortunately for anyone who would like visit Venus to see this shower, that planet is always cloudy. It is unlikely that any such meteor shower would be bright enough to see from Earth, even though it would be above Venus’s clouds and therefore unobscured from Earth. Comet Leonard will likely never return to the inner Solar System because gravitational perturbations from the planets are calculated to boost its speed slightly beyond escape velocity from the Sun.

Unusual Asteroid – An asteroid, dubbed 2021 PH₂₇, was discovered, which has the shortest known asteroid period to orbit the Sun, at 113 Earth days. Its quite elliptical orbit takes it well inside Mercury’s orbit and just outside Venus’s. It is about 2/3 mile across. Asteroids that orbit close to the Sun, particularly small ones, are difficult to find because they are always near the Sun’s glare as seen from Earth. It was found using the Dark Energy Camera on the Victor Blanco Telescope in Chile, in images taken near the Sun at twilight. Because the asteroid approaches the Sun so closely, it experiences the largest known precession of its orbit due to General Relativity of any Solar System object. Its surface temperature reaches about 900°F at close approach to the Sun. It is likely that gravitational disturbances from the inner planets will, within a few million years, toss it into the Sun or an inner planet or eject it from the inner Solar System. Likely the object came from the asteroid belt, disturbed from there by gravitational effects, but it is also possibly an extinct comet.



TNOs Discovered – The Dark Energy Camera is surveying a large portion of the sky to use gravitational lensing, galaxy clustering, and other means to constrain what are the effects of dark energy. It finds other stuff in the process. A new analysis of data from this survey has found 461 previously undetected Trans-Neptunian objects (TNOs), that is, bodies in the Kuiper Belt. A similar analysis of earlier years of Dark Energy Camera data discovered 316 TNOs. The new analysis brings the total number of known TNOs to nearly 4000. None of the newly found objects fits the characteristics of Planet 9, the TNO proposed to explain gravitational effects upon the orbits of the most distant TNOs. But the survey is not thorough enough to rule out the existence of Planet 9.

Unusual Brown Dwarf – Brown dwarfs are objects with masses between that of planets and stars. Though they may briefly fuse deuterium or lithium at their cores, they cannot fuse ordinary hydrogen as true stars do. After fusion ends, they just cool off, and therefore grow dim, forever. Brown dwarf masses range from about 13 to 80 times Jupiter's mass. Fewer than 2000 of them have been found, even though theoretically there should be numbers of them very roughly comparable to numbers of stars. Their lack of brightness, particularly in visible light, contributes to few being discovered. A new discovery further contributes to explaining how few have been found. The discovery is a brown dwarf found in data from the NEOWISE infrared space telescope. It had been overlooked in previous searches for brown dwarfs because its spectrum was unlike that of previously known brown dwarfs. That spectrum was bright and dim in different areas than is typical. It probably differs because it appears to have less methane than typical. It is hoped that looking for this type of spectrum will allow many more brown dwarfs to be found.

Earth's Core Growth – As the Earth's core slowly cools off, it crystallizes into solid along the outer edge of the inner liquid core, gaining about a millimeter per year of solid. A new study found that it is doing so unevenly, growing about 60% faster on the side roughly under Indonesia than on the opposite side of the Earth. Gravity has kept the inner core from getting very much out of spherical. Scientists are making guesses as to why the core growth is uneven. One possibility is that it is being affected by the subduction of tectonic plates going on near Indonesia. The uneven growth may affect the direction of the Earth's magnetic field because the growth contains much iron.

Triggered Supernova – Astronomers found evidence that a supernova explosion that occurred in 2014 was triggered by either a black hole or neutron star merging with its companion ordinary star. The star would have exploded at the end of its life of nuclear fusion, but the merging brought on the explosion much sooner. The evidence came from new and archived observations in radio and X-rays, and using the Keck Telescope in Hawaii. The event occurred in a dwarf galaxy 480 million light-years away. The companion stars started out as a pair of ordinary fairly massive stars in a close orbit about each other. Long ago, the brighter star ran out of nuclear fuel and exploded as a supernova, leaving behind either a black hole or a neutron star. About 300 years ago, the black hole or neutron star began dipping into the ordinary star's atmosphere, which eventually led to their merging, in 2014. The black hole or neutron star disrupted the fusion of the companion, which then exploded as a supernova. Jets formed during the merging, which produced X-rays. The supernova blast hit previously thrown off material, which gave off bright radio emission. The astronomers were tipped off to look for all this when a new object showed up in a radio survey.

Intermediate Mass Black Hole – When a star gets too close to a black hole, intense tidal forces tear the star apart, and the parts heat up as they fall into the black hole, giving off intense radiation. This is known as a tidal disruption event. A new paper analyzes the X-rays given off by one such event and determined that the star was consumed by an intermediate mass black hole. Intermediate in this sense means more massive than a black hole formed by a star collapsing, but less massive than the so-called supermassive black holes found in the centers of essentially all large galaxies. This covers a huge range of mass, roughly a thousand to a million times the Sun's mass. Yet only a handful of candidates for intermediate mass black holes have been found, and many of these are disputed. The black hole mass determined in the new paper is roughly 10,000 times the Sun's mass. The new paper also determined the spin rate of the black hole. It was fast enough to show that the black hole did not reach its present size by consuming material falling from random directions, one popular theory for building intermediate black holes.

White Dwarf Aging – White dwarf stars are born when a lower mass star finishes fusing its helium to carbon and oxygen but doesn't have enough mass to force fusion of the carbon. They expel their outer layers leaving a hot core. Theory has it that they just cool off and fade forever. A new study found some white dwarfs that were fusing hydrogen, making exceptions to the generally accepted white dwarf theory. The new study observed globular clusters M3 and M13 in ultraviolet to study the hundreds of white dwarfs in them. 70% of the white dwarfs in M13 showed evidence of fusing hydrogen, but the ones in M3 did not. Astronomers have been using the degree of cooling-off of white dwarfs to determine their ages. This new study says that sometimes they do not cool off normally because the newly discovered hydrogen fusing is occurring, invalidating the age determination. More work is needed to understand when this hydrogen fusing takes place in white dwarfs.

Probable Galaxy Spur – A new study of a few nearby star-forming nebulas has found that they appear to form a spur off the Sagittarius Arm of our Milky Way galaxy. They were found to lie along a line forming a 60 degree angle with the direction perpendicular to the galaxy radius, while that arm forms a 12 degree angle. Thus, they project outward from that galaxy arm. Data to determine these angles came from the Gaia and Spitzer space telescopes.

Galaxy's Halo – The Milky Way's halo consists of rarified gas and a sprinkling of stars. The halo is far larger than the galaxy's disk. A new analysis of spectra of 25 quasars has given astronomers the best picture yet of our galaxy's halo gas. That gas slightly alters the quasar spectra as their light passes through the gas on its way to us. The spectra were archived from the FUSE ultraviolet space telescope. The analysis detected gas 1000 times less dense than that seen in previous work. Because only spectral lines of neutral hydrogen were looked for, only cooler gas was detected. Hotter gas would be ionized, not neutral. Both areas of infalling and outflowing gas were found, though more of it was infalling. The astronomers estimated that the net in-fall amounts to about a half solar mass per year. Such infalling gas supplies the galaxy with new material to build stars and planets.

Gravitational Lensing – A magnified image due to gravitational lensing (bending of the light by gravity) has been found in X-rays using the Chandra X-ray space telescope. The X-rays were emitted by the material surrounding a pair of black holes that are so distant the X-ray light left there only 2 billion years after the Big Bang. It is possible the 2 objects are instead one black hole and its jet. More observations may be able to distinguish. The gravitational lensing magnified and brightened the observation, helping astronomers determine there are 2 separate sources and helping in even detecting such dim and distant objects.

Space Tourists – On September 15, SpaceX launched into orbit for a 3 day sojourn a crew Dragon spacecraft with 4 non-professional astronauts, a first. The mission is known as Inspiration 4. Because the Dragon will not dock with the International Space Station, the docking mechanism was removed and replaced by a cupola window. The tab, believed to be under \$200 million, was picked up by billionaire Jared Isaacman, who chose 3 companions. The plan is to raise millions of dollars for St. Jude Children’s Research Hospital by auctioning space artifacts and other activities. One of the space passengers is a physician’s assistant employed at the hospital, whose life was saved as a child by cancer treatment there. The saga of space tourism unfolds.

Webb Telescope – Launch of the James Webb Space Telescope from the European spaceport in French Guiana is scheduled for December 18. The concerns with the Ariane 5 rockets have been resolved. About 4 weeks later the telescope will arrive at its operating location at the Sun-Earth L2 Lagrange point, about a million miles from Earth, on the anti-sunward side. After testing and calibration, full operation of the telescope is to begin within 6 months of launch. Webb will not make the Hubble Space Telescope obsolete because Hubble has visible light and ultraviolet capabilities that Webb does not possess. Webb will far exceed Hubble in sensitivity and resolution for infrared observations. Webb was designed for infrared because the farthest objects visible in the Universe have their light redshifted into the infrared by the expansion of the Universe.



Credit: Inspiration4/John Kraus via Flickr

Deep Space Network Upgrade – NASA is upgrading its Deep Space Network, the radio dishes in 3 locations around the world (California, Spain and Australia) that communicate with spacecraft. Some of the dishes do planetary radar and radiotelescope functions also. NASA is adding 2 dishes, increasing from 12 to 14 of them. The radio frequencies used by the dishes are being expanded. The control systems are being made to handle multiple communications at once. Laser communications are being added to the radio capability of some antennas. Remote operation is being added so that the day shift of operators, wherever that happens to be around the world at any given time, can run the whole system.



Credit: NASA/JPL-Caltech

ALMA Upgrade – ALMA, a radiotelescope array in Chile, is being upgraded to add a new range of wavelengths which it can receive. The previous range is from 0.3 to 3.6 mm wavelength, while the capability being added is 6 to 8.5 mm. These longer wavelengths are particularly good at detecting certain sizes of dust particles, such as that found in star-forming regions and planet-forming disks, and good at detecting radiation from the epoch of reionization. That epoch is when the first stars in the Universe appeared and their radiation ionized much of the neutral hydrogen of the Universe.

JAMES WEBB SPACE TELESCOPE - The Who, What, Where, When and Why

By Gene Kent

Part 1

Who was James Webb that NASA should honor him by naming the most sophisticated telescope ever conceived, the "James Webb Space Telescope"? He was a man who responded to President Kennedy's September 12, 1962 commitment to put an American on the moon and bring him back. James Webb was the father of the Apollo program. He was the second administrator of the newly created NASA, leading it from February 14, 1961 thru October, 1968. He was not a scientist. He was an attorney who had lived most of his life as an inconspicuous Washington bureaucrat. Assuming leadership of NASA after Dr. T. Keith Glennan, Webb took on a task well beyond the magnitude of anything he had done before.

NASA had been established by President Eisenhower July 29, 1958 in response to Russia's launching of Sputnik in 1957. Dr. Glennan, the first NASA Administrator, saw his task as bringing together the best and brightest minds of America to compete with the Russians. He began with NACA (the National Advisory Committee for Aeronautics). He bought JPL and contracted with California Polytechnical Institute (Cal Tech) to manage JPL. By the time Webb assumed the role of Administrator, NASA had indeed brought together the best and brightest either directly or contractually.

Webb hesitated to accept the job. He felt the position needed a scientist. President Kennedy, through whatever insight he had, judged Webb's abilities up to the task. Kennedy viewed the administration of NASA as a policy job; and he wanted NASA to support Washington's policies. Though Webb, (*a good bureaucrat*) understood the concept of directing NASA to support Washington, it is not clear that he was in lock step with the Kennedy administration. In a taped conference of President Kennedy, Vice President Johnson and James Webb at the vice president's Texas ranch, Webb stated:

"I'm not going to run a program that is just a one-shot program (the "one shot" was in reference to the Apollo program). If you want me to be the administrator, it is going to be a balanced program that does the job for the country..."

Webb was good to his word. Though Webb is thought of as the father of Apollo, NASA launched 75 space science missions not directly related to the Apollo program during his tenure.

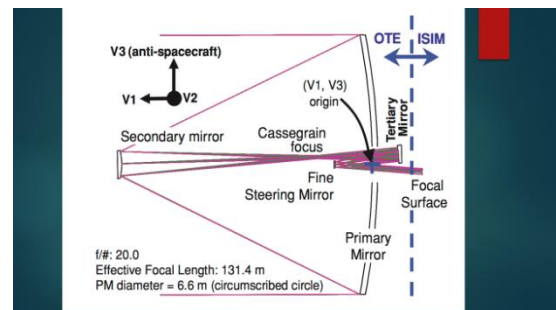
When disaster struck Apollo 1 on February 21, 1967, with the death of Gus Grissam, Ed White and Roger Chaffee, Webb stepped forward accepting all the blame. Investigation revealed three major causes for the deadly fire: One was the use of a highly flammable refrigerant for the air conditioning. Two was the use of pure oxygen as the capsule's atmosphere. Three was placement of the escape portal outside the reach of the astronauts' when strapped into their seats. It would be a stretch to blame these engineering issues on Webb. But investigation after investigation saw Webb accepting blame like a sacrificial goat, allowing the Apollo program to proceed with but a brief moment of hesitation. Neil Armstrong was still able to walk on the moon within the sixties decade. Though the astronauts of the sixties were popular heroes, the cost of Apollo was seen by nearly half of Congress, and the populace generally, as an extreme extravagance with no perceptible benefit beyond international bragging rights. Looking back at the opposition to NASA and the space program, the continuation of Apollo was a much closer call than realized at the time.'

Webb retired in October, 1968 before he could be fired by the incoming Republican administration as the incompetent responsible for the death of three of America's heroes. He watched Neil Armstrong's walk on the moon as an outsider with little or no credit for his seven years as NASA's administrator. Naming a space telescope after him is just recompense.

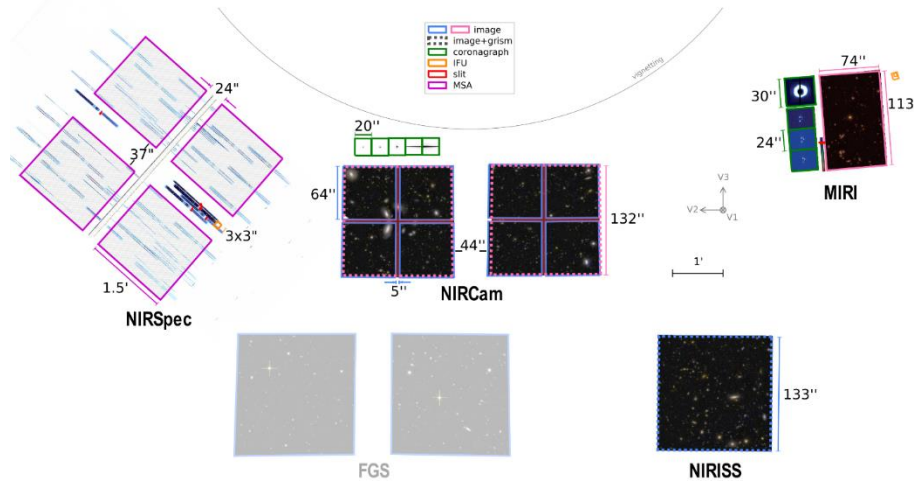
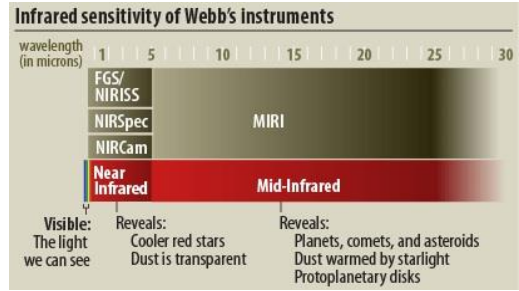
What is the James Webb Space Telescope?

Tis a marvel of human ingenuity. Should it work as planned, it should rank as the 8th wonder of the world.

OPTICS AND CAMERAS: The JWST is a Cassegrain telescope composed of 18 hexagonal beryllium gold plated mirrors fitted together to create one large concave mirror twenty-one feet across. This primary mirror focuses its collected light on a twenty-nine inch diameter gold-plated convex secondary mirror. The secondary mirror directs its light to a concave aspheric oblong tertiary mirror about 18.54 X 13.21 inch which corrects the image of most optical aberrations while reflecting it to the fine steering mirror which deflects it onto the selected camera or spectrometer. The focal length is just over 429 feet and produces a resolution of about 0.1 arc seconds.



The cameras and spectrographs operate in the infrared spectrum from 0.6 μm to 25 μm . There are three cameras and two spectrographs: NIRCam (Near InfraRed Camera), MIRI (Mid InfraRed Imager), FGS (Fine Guidance Sensor), NIRSpec (Near InfraRed Spectrograph imager) and NIRISS (Near InfraRed Slitless Spectrograph). The diagram below illustrates the positioning of the optical instruments and their respective FOV's. These are in units of arc-seconds. Note the five small green boxes above and to the left of the NIRCam fields of view. These represent the stellar coronagraphs available to the NIRCam. The coronagraphs block out the corona of a targeted star making it easier to view any planets that could be orbiting that star.



NIRCam has ten receptors (sensor chips). Each has over 4 million pixels with 18 μm pitch. Eight receptors image in the 0.6 μm to 2.3 μm wave-length band. The other two receptors image in the 2.4 μm to 5 μm wave-length band. The FOV of the of longer wave-length sensor chips is 9.7 arc-min². The eight shorter wave-length sensor chips have a similar FOV when the sensor images are arranged in square patterns of four each.

MIRI has three nearly identical detector chips operating in the band from 5 to 25 μm wave-length. One is for imaging and the other two for spectrometry. The imaging chip must be cooled by the on-board cryo-cooler to -266° C (7 degrees above absolute zero).

NIRISS has one sensor chip with about four million pixels which produce a FOV of about 2.2 arc-min². It operates between 0.6 μm to 5 μm wave-length band.

FGS uses two sensor chips operate in the 0.6 μm to 5 μm wave-length bands. It collects images but not for scientific exploitation. Rather it will use the images for target acquisition and guiding. It produces two fields of view. One 2.3' X 2.3' and the other is 2.2' X 2.2'. One view is of the target. The other is of the guide star. The scope's attitude is adjusted to center the target in the center of the FOV. The FGS places an 8 pixel by 8 pixel box around the guide star and then adjusts the box sixteen times per second to keep the guide star centered inside the box and the target centered in the FOV.

The **STAR TRACKERS** are three relatively small telescopes, each with a 16° FOV. Navigating the sky with the FGS with a 2'x2' field of view would be near impossible. The Star Trackers match their much larger field of view (about 45°) against the onboard star catalog. Once the JWST identifies its position in relationship to the surrounding stars, the Star Trackers send that information to the Attitude Control System which will slew the JWST to within 8" of the target. The FGS is then brought to bear improving accuracy to within 0.1".

The JWST does it's auto-guiding in basically the same way amateur astro-imagers do. The amateur uses her eyes to survey the sky as do the tracker telescopes. Using PhD software or similar software, she picks a guide star relatively close to the target and builds a box around the star as does the FGS. She then directs the software to move the telescope every two to four seconds to keep the guide star centered in the box. The FGS system moves JWST 16 times per second to do the same thing.

The **NIRSpec** spectrograph has two major features: Multi Object Spectrograph, (MOS) meaning that multiple targets can be targeted as once; and the Micro Shutter Assembly (MAS) which refers to the scheme of opening and closing the shutters. It is said that *real astronomers* spend 90% of their time reviewing small multi-colored ribbons and only occasionally get to view the beauty of the of the sky itself. Apparently the JWST won't change that.

The article continues next month.

Advertisements

Buy, Sell or Trade some of your gear? This is where club members can place advertisements. Please contact the editor at newsletter@ocastronomers.org to place an advertisement or to learn more about placing one. There is no cost to club members for non-commercial advertisements in the newsletter.

For Sale contact David Hobbs david_hobbs714@yahoo.com \$2800

- 20" F5 Research grade early Coulter mirror and secondary mirror
- Primary mirror is 2 3/4" thick, Secondary is 4" x 5 5/8"

For Sale contact Ron Choi rongrace2@cox.net \$ 200

- Orion StarShoot AutoGuider

For Sale contact Jerry L Floyd jlfloyd720@gmail.com 562-252-5666 \$ 850

- ZWO Electronic Filter Wheel, 7x36mm
- Includes set of ZWO brand 36mm LRGB, S2, H-Alpha, O3 narrowband (7 nm) filters

This item was originally purchased in May 2020. It has been used a few times (with a ZWO ASI1600MM camera) but is in virtually new condition. I am selling it because I replaced it with a filter wheel that accommodates my 7 1.25" Astrodon filters.

The cost of the items as purchased new from a vendor such as OPT would be \$299 for the filter wheel, \$199 for the LRGB filter set, and \$479 for the SHO filter set, a total of \$977.

I am willing to deliver in person to the OCA Anza site or other Southern California locations.

For Sale contact Robert Fritz bobfritz1@gmail.com

- Vintage Celestron 14 (fork mount)
- Celestron C11 with CG-5 mount
- Meade LX200 10"
- Losmandy G-11 with tripod and Gemini GoTo

If you are interested, please email me for details and to discuss the price. I will consider any reasonable offers.

For Sale contact Stephen Lauro colormaker13@gmail.com 1-714-393-5467 cell
\$ 2100

- Meade LS-8 in excellent condition
- AutoStar 3 handbox controller
- Upgraded Stellarvue 7x50 finder scope
- Meade electronic micro-focuser
- Has the most recent firmware: version 1.6e

I am asking \$2100 but will accept a reasonable offer.

Magazine Subscriptions

Effective this year, the OCA will no longer be accepting renewals or new subscriptions to either **Astronomy** or **Sky and Telescope**. During the last few years the publishers have lost or been unable to provide timely processing of member subscriptions mailed to them. Both **Astronomy** and **Sky and Telescope** allow members to subscribe or renew on-line at the club rate anytime during the year and for multiple years. **Astronomy** also gives product discounts to club members.

Any subscriptions or renewals sent to the club will be returned to you.

E-mail Charlie@OCAstronomers.org for current on-line subscription or renewal information and instructions.

Newsletter Delivery Preferences (Save A Tree)

The Sirius Astronomer Newsletter is available each month on our club website at <https://ocastronomers.org/>
On the Home page one will see a link to the Newsletter in the top banner.

The newsletter is available online earlier than delivery for mailed paper copy, and it is in color!
Electronic delivery also cuts down on printing and postage expenses for the club.

If you would like to stop receiving a paper copy of the Newsletter, please email Charlie with this request at Charlie@ocastronomers.org



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