Southwest Florida Astronomical Society, Inc.
SWFAS

The Eyepiece
January 2020

Contents:

A MESSAGE FROM THE PRESIDENT

I hope everyone is having a good holiday season and a Happy New Year.

December's rain/clouds totally wiped out our star parties that we had planned. Mike McCauley and I were able to do the Lunar Observing event at Carefree Resort while dodging some clouds.

January has several observing events including a Big Cypress event on the 25th.

Michael Downs (Heartland Astro Society) is hosting another Astronomy Swap Meet in Port Charlotte/El Jo Bean area on Sunday the 19th. (This was originally scheduled for the 25th but was rescheduled to the 19th) Noon to 4pm. He has folks coming in from all over south/central Florida, so if you have equipment you want to sell, this may be a good opportunity and you may find some good bargains. No cost to attend, they will be selling hamburgers and hot dogs for a nominal cost. If you plan to go, let me know so I can give him some info on the number to expect so they can plan accordingly. Address is: 5149 Norlander Dr. Port Charlotte 33981

We have had a couple of nice donations in December.

Former member Patrick Agnew donated a 6”F5 newtonian on a vixen dovetail with a 2” focuser.

Member Jim Stout donated a very nice Meade 7” Mak on an LX-200GPS mount with a large number of accessories including a very nice Binoviewer. Jim would like to see this scope get used, so if you are interested in it, let me know as we may consider auctioning it off. It is a heavy scope for its size. I will have it at the meeting Thursday. (I rate it more awkward to carry than the CPC-1100, so it may be best in a more permanent location.)

We are looking for someone to coordinate the meeting programs. This job is basically lining people up to do presentations at our meetings.

It is Annual Dues time again. Dues are $25.00 and can be paid at the meeting or mailed to SWFAS, Inc. PO Box 100127 Cape Coral, FL 33910. If you have any question about whether you have paid for 2020, contact John MacLean or me.

Brian

Program this Month

After thoroughly entertaining our astronomy club at the December meeting with a mixed media slide show of his trip to Chile and the Cerro Tololo Inter-American Observatory, fellow SWFAS member Joe Dermody returns to speak with us at the January 2, 2020 meeting. Joe will speak with us about his recent trip to California and visits to the Mount Wilson Observatory, The Griffith Observatory, and the Riverside Telescope Makers Conference. If you enjoyed last month's presentation you will not want to miss the one. Joe's presentation will begin at 7:30pm on Thursday, January 2, 2020 at the Calusa Nature Center and Planetarium in Fort Myers. The regular monthly meeting of the South West Florida Astronomical Society will follow immediately thereafter.

Michael J. McCauley
VP/Program Coordinator SWFAS

Star Party Schedule 2019/2020

SeaHawk Park –1/18/20, 3/28, 4/18, 5/23, 6/20, 7/18, 8/22, 9/12, 10/10, 11/7
We have scheduled some of the Seahawk Park nights to coincide with the moon being a crescent to 1st quarter stage to allow for lunar observing.

Caloosahatchee Regional Park – 2/15/20, 4/25, 9/19, 10/17, 11/14, 12/12

Big Cypress Preserve – Ochopee Welcome Center 1/25/20, 2/22/20, 3/21/20

Ideas for Using Outreach Funds

SWFAS would like to hear from members for any suggestions for applying outreach funds.

Members' Recommended Reading & News Links

Members are encouraged to submit to the editor links to recommended articles and books that might be of interest to Club members.

Each Weekly Newsletter of S&T has a 60-second news section. The general link for S&T Astronomy News is https://www.skyandtelescope.com/astronomy-news/ .

Sky and Telescope has a new free introductory E-book "Stargazing: Getting Started" if you sign up with your email. https://skyandtelescope.com

"Spitzer's Legacy", by Michael Werner & Thomas Soifer, Sky & Telescope, January 2020, pages 18-25. *Abstract: NASA's premier eye on the infrared sky is shutting down after operating more than three times longer than designed.*

For NASA-JPL News see https://www.jpl.nasa.gov/ .

"The Return to Venus and What It Means for Earth", JPL News – Week in Review, December 11, 2019.

For Astronomy Magazine & News, see https://www.astronomy.com/news

"Isaac Newton: A vindictive, secretive, paranoid genius", By Raymond Shubinski, Astronomy Magazine, December, 2019.

In the Sky this Month

Earth *is at perihelion, closest orbital distance to the Sun, on the 5th, at 0.9832 a.u.*

Moon: Apogee – January 2; 1st Quarter – January 3; Full – January 10; Perigee - January 13; Last Quarter – January 17; New– January 24.

Mercury (dusk -- mid-evening, West) is in superior conjunction on the 10th. It is low on the horizon late in the month, seen about a half an hour after sunset. Its magnitude is -1.0, setting about 70 minutes after sunset.

Venus (dusk -- mid-evening, Southwest) is higher in the sky this month, starting out roughly 20° and a nice -4 magnitude, and ending up at 34°. Over the month, Venus' setting time increases after sunset from 2¾ to 3½ hours, and disk size from ~13"-15". Around the 26th – 28th, Venus and Mercury form a straight line from upper left to lower right in the Southwest sky about ½ hour after sunset. Also, in the last week, its line of sight is close to Neptune, so is a great help in finding the distant gas giant. It's the closest they've been since 1984. *See Astronomy Magazine, January 2020, page 36, Sky & Telescope, January 2020, pages 46-47.* Venus is about 12 magnitudes brighter than Neptune.

Mars (pre-dawn - dawn, Southeast) rises 3 hours before sunrise in January, starting just upper right of the double star β Scorpii. Just after mid-month, Mars passes about 5° northwest of Antares, both being about the same orange-yellow color with Mars at magnitude +1.5 and Antares at +1.0. Mars is almost fully lit, but spans only 4.8".

Jupiter (early morning, Southeast) starts the month in the glare of the Sun, having just come out of late December superior conjunction. In another week, it becomes visible before sunrise. By the end of January, it is at magnitude -1.9 and rises 1 ½ hours before the Sun.

Saturn (early morning, Southeast) is in conjunction with the Sun on the 13th, two hours before Pluto. At the end of January, it is magnitude +0.6 and rises about an hour before the Sun.

Uranus, (evening-South, midnight-West) is around magnitude +6, high in Aires in the Southern sky. See https://is.gd/urnep for a finder chart.

Neptune, (evening, South-Southwest) is only 2" across, and 10' below and right of Venus on the 27th, and around magnitude +8. See https://is.gd/urnep for a finder chart.

International Space Station: The ISS is visible on Jan 10-15 around 5:40-6:30 a.m., and between 7-8 p.m. from the 15th -19th. See this link for specific times and routes for the ISS: http://www.heavens-above.com

Hubble Space Telescope: will be visible early evening (6-8 p.m.) from the 1st-17th , and early morning (5-6 a.m.) from the 26th - 31st. See this link for specific times and routes for the HST: http://www.heavens-above.com

Minutes of the Southwest Florida Astronomical Society – December 5, 2019

The regular monthly business meeting of the Southwest Florida Astronomical Society was called to order at 7:33 pm by president Brian Risley in the Calusa Nature Center Planetarium.

Twenty people were present including 3 visitors.

Brian introduced Joe Dermody, who presented a program on the 2019 solar eclipse which he viewed in Chile, and also the observatories in that area.

At 8:25 pm the business meeting resumed.

The past events listed in the printed agenda were reviewed. $400 was donated to the club from the Forest Country Club event.

Upcoming events listed in the printed agenda were discussed.

Election of officers for 2020 was held. Mike McCauley made a motion, seconded by John MacLean, for Don Palmer to continue as secretary. The motion passed on a voice vote.

Matthew Knight made a motion, seconded by Mary Vilbig, for John MacLean to continue as treasurer. The motion passed on a voice vote.

Tom Segur made a motion, seconded by Mike Moses, for Mike McCauley to continue as vice president. The motion passed on a voice vote.

Mike McCauley presided over the election for president. Tony Heiner made a motion, seconded by Matthew Knight, for Brian Risley to continue as president. The motion passed on a voice vote.

Mike announced that a volunteer is needed to serve as program coordinator.

Mike McCauley volunteered to work with John MacLean to conduct the annual audit.

Mike announced that the Nature Center is seeking a Planetarium docent to oversee the Planetarium and conduct shows. This is a paid position. It is generally 11-4 on Monday through Friday.

The Nature Center is also looking into obtaining new projection equipment and software for the Planetarium, and renovating the facility and replacing equipment.

The Nature Center will be doing fund raising. The website address of the Nature Center is www.calusanature.org.

Phil Jansen donated a Celestron "Sky Scout" for anyone who is interested. Also, Pat Agnew donated a 6 inch Newtonian telescope.

John MacLean made a motion, seconded by Tony Heiner, to approve the minutes of the November meeting as contained in the December newsletter. The motion passed on a voice vote.

Tony Heiner made a motion, seconded by Mike McCauley, to designate $200 out of the $400 received from the Forest Country Club event to the Community Outreach fund. The motion passed on a voice vote.

Treasurer John MacLean reported a November ending balance of $2391.21. Tom Segur made a motion, seconded by Tony Heiner, to approve the report. The motion passed on a voice vote.

Equipment Coordinator Brian Risley reported he is trying to get the Nexstar 6 turned in.

The business meeting was adjourned at approximately 9:30 pm.

Submitted by Don Palmer, Secretary

Southwest Florida Astronomical Society, Inc. Event Schedule for 2020

Date	Event	Location	Time/Note
January 2nd, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
January 11th, 2020	Solar Observing	Bayshore Live Oak Park Port Charlotte	9:00 am - Noon
January 18th, 2020	Monthly Star Party	Seahawk Park	Dusk
January 19th, 2020	Astronomy Swap Meet	El Joe Bean –Charlotte County	Noon – 4pm
January 24th, 2020	Public Observing	FSW Moore Observatory Punta Gorda Campus	Dusk
January 25th, 2020	Big Cypress Observing	Big Cypress Preserve Ochopee	7:00 pm
February 6th, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
February 8th, 2020	Solar Observing	Gilchrist Park	9:00 am - Noon
February 8th, 2020	STEMtastic/Edison Day of Discovery	Lee County Public Ed Center – Colonial/Metro	
Feb 15th, 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk
Feb 21st, 2020	Rotary Park Star Party	Rotary Park Cape Coral	5:30-10:00pm
Feb 22nd, 2020	Big Cypress Observing	Big Cypress Preserve Ochopee	7:00 pm
Feb 28th, 2020	Public Observing	FSW Moore Observatory Punta Gorda Campus	Dusk
Feb 29th, 2020	Burrowing Owl Festival	Rotary Park Cape Coral	10:00am – 4:00pm
March 5th, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
March 14th, 2020	Solar Observing	Ponce De Leon Park Punta Gorda	9:00 am - Noon
March 21st, 2020	Big Cypress Observing	Big Cypress Preserve Ochopee	7:00 pm
March 27th, 2020	Public Observing	FSW Moore Observatory Punta Gorda Campus	Dusk
March 28th, 2020	Monthly Star Party	Seahawk Park	Dusk
April 2nd, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
April 11th, 2020	Solar Observing	Bayshore Live Oak Park Port Charlotte	9:00 am - Noon
April 18th, 2020	Monthly Star Party	Seahawk Park	Dusk
April 24th, 2020	Public Observing	FSW Moore Observatory Punta Gorda Campus	Dusk

April 25th, 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk
May 7th, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
May 9th, 2020	Solar Observing	Gilchrist Park Punta Gorda	9:00 am - Noon
May 22nd, 2020	Public Observing	FSW Moore Observatory Punta Gorda Campus	Dusk
May 23rd, 2020	Monthly Star Party	Seahawk Park	Dusk
June 4th, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
June 20th, 2020	Monthly Star Party	Seahawk Park	Dusk
July 2nd, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
July 18th, 2020	Monthly Star Party	Seahawk Park	Dusk
Aug 6th, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
Aug 22nd, 2020	Monthly Star Party	Seahawk Park	Dusk
Sept 3rd , 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
Sep 12th, 2020	Monthly Star Party	Seahawk Park	Dusk
Sep 19th, 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk
Oct 1st, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
Oct 10th, 2020	Monthly Star Party	Seahawk Park	Dusk
Oct 17th, 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk
Nov 5th, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
Nov 7th, 2020	Monthly Star Party	Seahawk Park	Dusk
Nov 14th, 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk
Dec 3rd, 2020	Monthly Meeting	Calusa Nature Center Planetarium	7:30pm
Dec 12th, 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk

All observing events are Weather Permitting.

If it is cloudy or a chance of rain, we may not setup at all.

There may be no way to provide advance notice of cancellation.

Events may be cancelled several hours before scheduled time based on observed conditions and forecasts at that time and weather may change.

Monthly Star Parties: These are held at either Seahawk Park in Cape Coral or at Caloosahatchee Regional Park (CRP) off SR78 7 miles east of SR31. Other than park fees noted, these are free and open to the public. Those wanting to learn how to use equipment can bring it to the monthly star parties or the monthly meetings. We are always glad to help people learn how to use their telescopes. It is also a great way to learn about different telescopes and try some out before making a purchase.

Seahawk Park is in North Cape Coral off Wilmington Blvd. (Nelson Rd or Chiquita Blvd are the nearest cross streets.) There is a brown sign in the center median at the entrance to the park. (GPS may not get you to the park, as some of the local roads have been closed.) You will make a big J hook before getting to the parking area. Seahawk Park is managed by the *Cape Coral* R/*Seahawks* Club for Radio Controlled Planes and they have priority. They are usually done by sunset but may be there before sunrise. Park in the lot and transport your equipment to the concrete staging area before the runway. This park is handicap capable as there is level concrete leading from parking to the staging area.

CRP has a gate that closes at dusk, you can check the county's website for current gate closing times and the status of the park's Northside entrance as that is where we observe from. (They may close the area if there are issues with the trails.) There is a parking fee of $1/hr or $5/day at CRP. Park in the main Northside parking lot. We sometimes setup down the dirt road that goes to the east. That area is grassy and may not be level, so one should walk on the dirt road as much as possible and watch their step.

Big Cypress: The Big Cypress Visitor Center is located off US41 5 miles east of SR29 about 25 miles east of Naples. Big Cypress has earned a Dark Sky Park designation. They hold observing events down the road that extends south of the Welcome Center during the winter months. This is a real dark sky site. Their observing events are free.

Solar Events: We have daytime solar events where one can safely look at the Sun. Things such as sunspots and prominences may be visible. These are free unless tied to another event that may have an entrance fee. There are seasonal monthly events held at different parks around Charlotte County as well as at other major public events in SW FLA.

Rotary Park Star Party: This is a free public star party held at Rotary Park at the south end of Pelican Blvd in South Cape Coral. Park to the west of the main building and walk to where we are setup to the east of the main building.

Moore Observatory, FSW Punta Gorda Campus: The campus is located off Airport Rd just east of I-
75. Go to the right around the lake and park. The observatory is located down the path along the lake. Besides the telescope in the observatory, additional scopes may be setup around the observatory. This is a free event.

Star Party Etiquette: Bright white flashlights are not welcome. We use red flashlights to preserve our night vision. At the parks, please use just your parking lights if possible. As there may be cords and tripod legs that are hard to see in the dark, we ask that all children be well behaved and cautious around the telescopes. If you need help in moving around in the dark, just ask. Someone will be happy to guide you with a red light. If you have a telescope and need help with it, just ask. Someone will be glad to show you how to use it.

Golden Rules to Telescope Observing: Move your eye to the telescope, don't try to move the telescope to your eye! Ladders/chairs are there for your support, the telescopes do not provide support and should not be touched.

Website: www.theeyepiece.org Check us out on Facebook too.

Membership Photos

Three by Chuck Pavlik

Tadpole Nebula

Cresent Nebula in Hydrogen Alpha

SH2-254-255-256 and 257 in the constellation of Orion. Taken in Hydrogen Alpha.

Two Rovers to Roll on Mars Again: Curiosity and Mars 2020

JPL-News Weekly, December 10, 2019

https://www.jpl.nasa.gov/news

Curiosity won't be NASA's only active Mars rover for much longer. Next summer, Mars 2020 will be headed for the Red Planet. While the newest rover borrows from Curiosity's design, they aren't twins: Built and managed by NASA's Jet Propulsion Laboratory in Pasadena, California, each has its own role in the ongoing exploration of Mars and the search for ancient life. Here's a closer look at what sets the siblings apart.

The Missions

Landing in 2004 to "follow the water," the twin rovers Spirit and Opportunity discovered evidence that the planet once hosted running water before becoming a frozen desert. But when did this happen and why?

NASA launched the supersized Curiosity rover to learn more. Since landing in 2012, Curiosity has been roaming Gale Crater, which, it discovered, contained a lake billions of years ago and an environment that could have supported microbial life. The rover is still hunting for clues related to this environment as it ascends the 3-mile-tall (5-kilometer-tall) Mount Sharp, which sits within Gale Crater and was partially formed by water.

Some 3,760 miles (6,050 kilometers) away, Mars 2020 will also explore a landscape shaped by water: Jezero Crater, the site of an ancient delta. But 2020 will take the next scientific step: It will look for actual signs of past life, or biosignatures, capturing samples of rocks and soil that could be retrieved by future missions and returned to Earth for in-depth study.

The Tools

Mars 2020's chassis, or body, is about five inches longer than Curiosity's. It's also heavier, checking in at 2,260 pounds (1,025 kilograms), compared with Curiosity's 1,982 pounds (899 kilograms). The weight difference has to do with the tools each carries.

Start with the robotic arms: Curiosity's extends 7 feet (2.2 meters) and wields a rotating 65-pound (30-kilogram) turret equipped with a scientific camera, chemical analyzer and drill. The roving science lab pulverizes rock samples and pours the powder into its chassis, where two laboratories can determine the rocks' chemical and mineral makeup.

Mars 2020's arm has the same reach as Curiosity's, but its turret weighs more - 99 pounds (45 kilograms) - because it carries larger instruments and a larger drill for coring. The drill will cut intact rock cores, rather than pulverizing them, and they'll be placed in sample tubes via a complex storage system.

The Eyes and Ears

All of NASA's Mars missions have allowed the public to ride along as scientists and engineers explore the planet. Curiosity has been doing that with 17 cameras on its Mast, or head, and body; four of them are color cameras.

Mars 2020 has 23 cameras, most of them color. The new rover also includes "ears" - two microphones to capture not only the first sounds of a Mars landing, but also Martian wind and the rover's chemical-analyzing laser zaps. Mastcam-Z, an improved version of Curiosity's Mast Camera, has a zoom capability and will take high-definition video and panoramas.

The Wheels

Curiosity has prepared Mars 2020's team for "off-roading" on the Red Planet. When holes began appearing in the veteran rover's aluminum wheels, engineers realized that sharp rocks cemented on the Martian surface exert more pressure on the wheels than expected. Careful drive planning, along with a software upgrade, will keep them in shape for the rest of Curiosity's journey up Mount Sharp.

While Mars 2020's wheels are made from the same materials, they're slightly bigger and narrower, with skins that are almost a millimeter thicker. Instead of Curiosity's chevron-pattern treads, or grousers, Mars 2020 has straighter ones and twice as many per wheel (48 versus 24). Extensive testing in JPL's Mars Yard has shown these treads better withstand the pressure from sharp rocks but work just as well on sand.

The Brains

Mars rovers don't drive themselves. Teams of scientists and engineers beam meticulously programmed task lists to them at the beginning of each Mars day, or sol. Rover drivers on Earth then wait for the vehicle to report back before planning the next drive. The more a rover can do on its own, the more time drivers have to program new commands.

After Curiosity landed, it took an average of 19 hours for the rover's team to analyze a day's data, build and test commands, then send those commands back to the rover. Years of honing operations shrunk the time it takes to develop each day's plan to seven hours, and a limited degree of auto-navigation has enabled Curiosity to take some cautious steps on its own.

But Mars 2020 has even more self-driving smarts, allowing it to calculate a path five times faster than Curiosity can. That self-driving will be key to condensing the amount of time it takes for the 2020 team to plan each day's operations. The new mission intends to eventually condense daily operations to just five hours. The faster pace will allow it to cover more ground and gather more samples over the course of its prime mission. Mars 2020 won't move faster than its older sibling, but

more automation means that it can potentially drive farther and collect more science without having to wait for engineers back on Earth.

The Landing

Curiosity transformed Mars landings with the seemingly radical "sky crane maneuver." Mars 2020 will rely on the same process but also features an important new technology: Terrain Relative Navigation. An onboard computer matches surface images from a camera to a map to keep the spacecraft on target. Meanwhile, the Range Trigger lets the rover get miles closer to an ideal site before firing a parachute.

The Humans to Come

NASA's Artemis program aims to return astronauts to the Moon by 2024, preparing for future exploration of Mars. Helping pave the way for humans, Curiosity carries instruments that study the Martian environment, like surface radiation and weather.

Besides studying the weather, Mars 2020 will carry spacesuit samples, allowing scientists to study how they degrade. An oxygen generator will test technology for astronauts to make their own rocket fuel from the Martian atmosphere. A subsurface radar like the one on the rover could someday be used to find buried water ice.

For more information about Curiosity and Mars 2020, visit:

https://mars.nasa.gov/msl/home/

https://mars.nasa.gov/mars2020/

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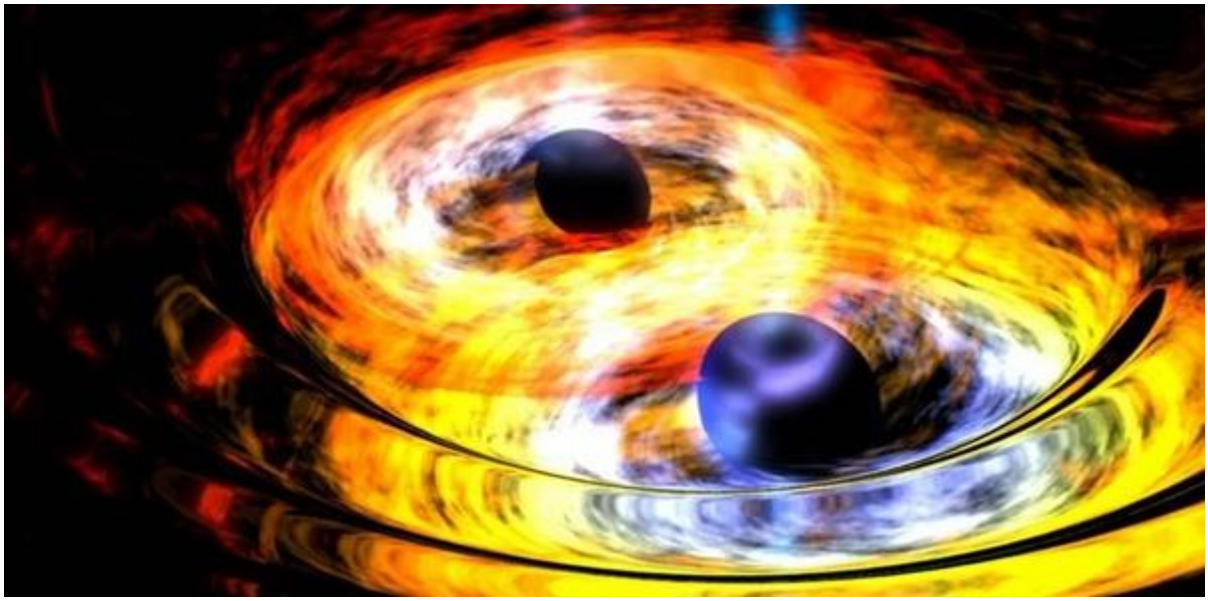
The Milky Way may have two supermassive black holes

By Smadar Naoz, Astronomy Weekly, December 20, 2019

Measurements of stars orbiting our galaxy's core suggest our 4-million-solar-mass black hole, Sagittarius A*, may have another supermassive companion lurking nearby.

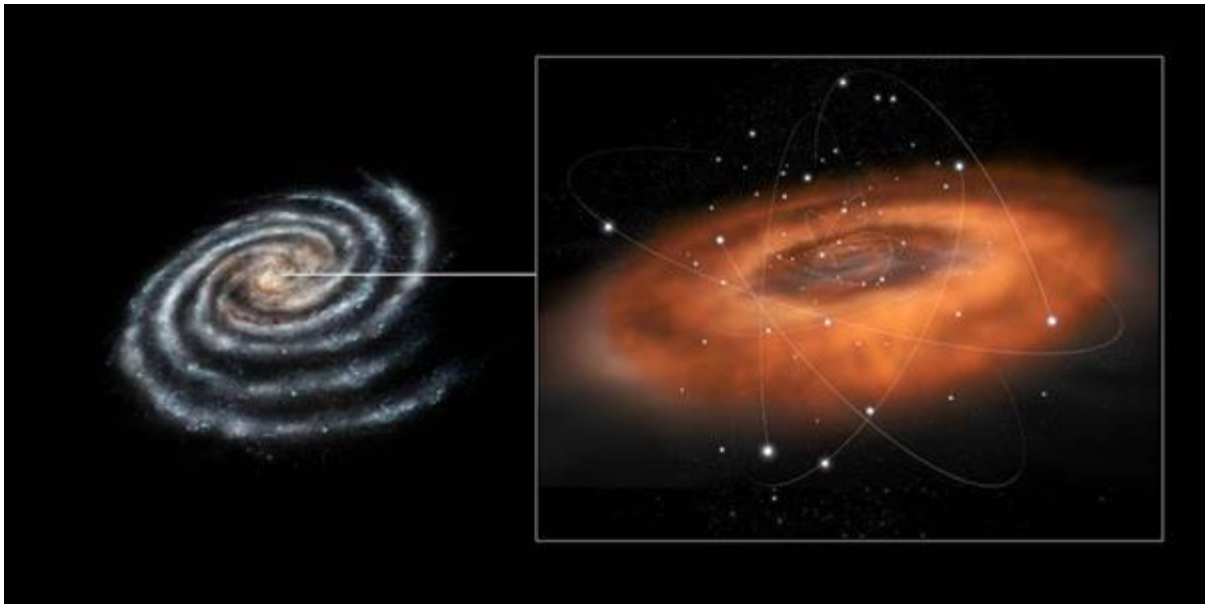


An artist's conception of two black holes entwined in a gravitational tango NASA/JPL-Caltech

Do supermassive black holes have friends? The nature of galaxy formation suggests that the answer is yes, and in fact, pairs of supermassive black holes should be common in the universe.

I am an astrophysicist (http://www.astro.ucla.edu/%7Esnaoz/) and am interested in a wide range of theoretical problems in astrophysics, from the formation of the very first galaxies to the gravitational interactions of black holes, stars and even planets. Black holes are intriguing systems, and supermassive black holes and the dense stellar environments that surround them represent one of the most extreme places in our universe.

The supermassive black hole that lurks at the center of our galaxy, called Sgr A*, has a mass of about 4 million times that of our Sun. A black hole is a place in space where gravity is so strong that neither particles or light can escape from it. Surrounding Sgr A* is a dense cluster of stars. Precise measurements of the orbits of these stars allowed astronomers to confirm the existence of this supermassive black hole and to measure its mass.(https://www.nature.com/articles/35030032) For more than 20 years, scientists have been monitoring the orbits of these stars around the supermassive black hole. Based on what we've seen, my colleagues and I show (https://arxiv.org/abs/1912.04910) that if there is a friend there, it might be a second black hole nearby (https://science.sciencemag.org/content/365/6454/664) that is at least 100,000 times the mass of the Sun.



At the center of our galaxy is a supermassive black hole in the region known as Sagittarius A. It has a mass of about 4 million times that of our Sun

Supermassive black holes and their friends

Almost every galaxy, including our Milky Way, has a supermassive black hole at its heart, with masses of millions to billions of times the mass of the Sun. Astronomers are still studying why the heart of galaxies (https://link.springer.com/article/10.1007%2Fs00159-010-0029-x) often hosts a supermassive black hole. One popular idea connects to the possibility that supermassive holes have friends.

To understand this idea, we need to go back to when the universe was about 100 million years old, to the era of the very first galaxies. They were much smaller than today's galaxies, about 10,000 or more times less massive than the Milky Way. Within these early galaxies the very first stars that died created black holes, of about tens to thousand the mass of the Sun. These black holes sank to the center of gravity, the heart of their host galaxy. Since galaxies evolve by merging and colliding with one another, collisions between galaxies will result in supermassive black hole pairs – the key part of this story. The black holes then collide and grow in size as well. A black hole that is more than a million times the mass of our son is considered supermassive.

If indeed the supermassive black hole has a friend revolving around it in close orbit, the center of the galaxy is locked in a complex dance. The partners' gravitational tugs will also exert its own pull on the nearby stars disturbing their orbits. The two supermassive black holes are orbiting each other, and at the same time, each is exerting its own pull on the stars around it.

The gravitational forces from the black holes pull on these stars and make them change their orbit; in other words, after one revolution around the supermassive black hole pair, a star will not go exactly back to the point at which it began.

Using our understanding of the gravitational interaction between the possible supermassive black hole pair and the surrounding stars, astronomers can predict what will happen to stars. Astrophysicists like my colleagues and me can compare our predictions to observations, and then can determine the possible orbits of stars and figure out whether the supermassive black hole has a companion that is exerting gravitational influence.

Using a well-studied star, called S0-2, which orbits the supermassive black hole that lies at the center of the galaxy every 16 years, we can already rule out the idea that there is a second supermassive black hole with mass above 100,000 times the mass of the Sun and farther than about 200 times the distance between the Sun and the Earth. If there was such a companion, then I and my colleagues would have detected its effects on the orbit of SO-2.

But that doesn't mean that a smaller companion black hole cannot still hide there. Such an object may not alter the orbit of SO-2 in a way we can easily measure.

The physics of supermassive black holes

Supermassive black holes have gotten a lot of attention lately. In particular, the recent image of such a giant at the center of the galaxy M87 opened a new window to understanding the physics behind black holes.

The Astronomical League

As a member of the Southwest Florida Astronomical Society you are automatically also a member of the Astronomical League, a nationwide affiliation of astronomy clubs. Membership in the AL provides a number of benefits for you including receipt of The Reflector, the AL's quarterly newsletter, use of the Book Service, through which you can buy astronomy related books at a 10% discount. You can also participate in the Astronomical League's Observing Clubs. The Observing Clubs offer encouragement and certificates of accomplishment for demonstrating observing skills with a variety of instruments and objects. These include the Messier Club, Binocular Messier Club, the Herschel 400 Club, the Deep Sky Binocular Club, and many others. To learn more about the Astronomical League and its benefit s for you, visit http://www.astroleague.org

Introduction to the Astronomical League Observing Programs

There are some 50 formal Observing Programs available to choose from covering the whole gamut of object types accessible to the amateur astronomer. In addition there are from time to time additional programs set up for special targets including comets, eclipses, transits and so forth. Certificates and pins are awarded for successful completion and submission of the required observations for a particular program. There is no time limit for completing observations. The programs are categorized by level of difficulty (Novice, Intermediate, and Advanced) and each program is also categorized by recommended equipment ranging from the naked eye through binoculars and telescope aperture. There are programs for Imagers and also for solar observers using H-alpha scopes. Visit http://www.astroleague.org/observing to obtain full details. Starting in February 2019, we will highlight one or two programs each month in the Newsletter.

Reflector Magazine

The email distribution system for the quarterly Reflector magazine is still not resolved. However they can be downloaded by going to the Astronomical League homepage https://www.astroleague.org/ and scrolling down the left hand side and clicking on the Reflector link. The direct link is: https://www.astroleague.org/reflector

The Astronomical League Hydrogen-alpha Solar Observing Program

We are currently at a very low level of solar activity in terms of sunspots and flares as the sun transitions from Solar Cycle 24 into the new Solar Cycle 25. At the time of writing there have been 279 days without sunspots in 2019. However, the first sunspots of cycle 25 have just appeared. We know that they are from the new cycle since their magnetic polarity is opposite to those for cycle 24. Cycle 25 is expected to be similar to cycle 24 with maximum solar activity occurring in 2025-2026.

From the solar activity standpoint this is certainly not the optimum time to complete the H-alpha observing program. However it is also true that observing the sun over the next 5 years or so will allow the observer to experience the buildup in solar activity from the minimum to the maximum of a solar cycle.

The League's Hydrogen-alpha Observing program can be accomplished either visually or by imaging and the use of a hydrogen-alpha scope is required. An instrument as small as the 40mm Coronado PST is appropriate although double stacking of filters is highly desirable to bring out detail.

To obtain the observing award, submission of three sets of drawings or images is required:

1. A set of 20 or more sketches or images of the whole solar disk during two solar rotations (one rotation is about 30 days.) The main features need to be shown: filaments, plages, flares, and sunspot umbra.
2. The second set consists of detailed sketches or images of the different forms that solar prominences take on the limb of the sun. Examples of 15 different types are shown including various forms of arches, pillars, mounds, etc.
3. The third set consists of detailed sketches or images of individual features on the disk of the chromospheric sun. Six of nine designated features are required including filaments, spicules, flares, plages, etc.

The included overview is quite comprehensive and includes sample drawing submissions.

A recommended Reading List includes:

Jenkins, J. L., **The Sun and How to Observe It**, Springer-Verlag
Jenkins, J. L., **Guidelines for the Observation of Monochromatic Solar Phenomena**, A.L.P.O. downloadable
Pugh, P.. **Observing the Sun with Coronado Telescopes**, Springer-Verlag
MacDonald, L., **How to Observe the Sun Safely**, Springer-Verlag

This article is distributed by NASA Night Sky Network

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Spot the Young Stars of the Hyades and Pleiades

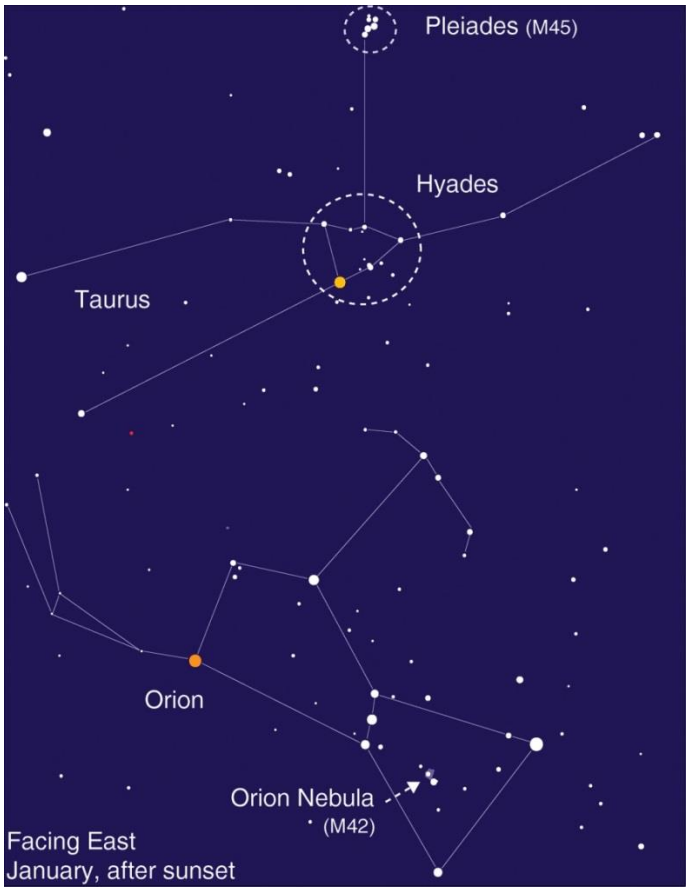
David Prosper

Orion is the last of a trio of striking star patterns to rise during the late fall and early winter months, preceded by the diminutive Pleiades and larger Hyades in Taurus. All three are easily spotted rising in the east in early January evenings, and are textbook examples of stars in different stages of development.

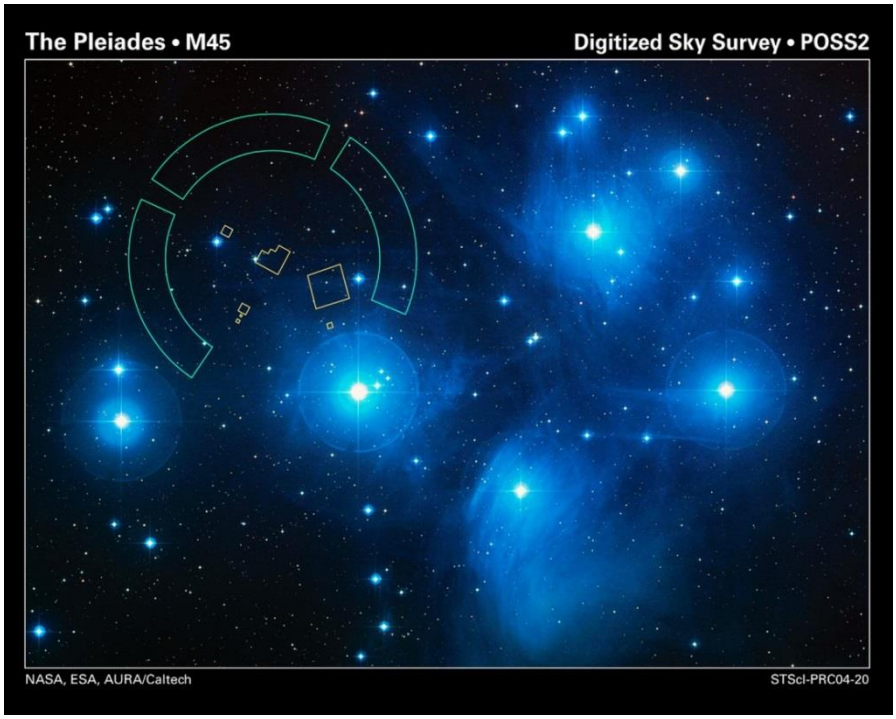
As discussed in last month's Notes, the famous Orion Nebula (M42), found in Orion's "Sword," is a celestial nursery full of newly-born "baby stars" and still-incubating "protostars," surrounded by the gas from which they were born. Next to Orion we find the Hyades, in Taurus, with their distinctive "V' shape. The Hyades are young but mature stars, hundreds of millions of years old and widely dispersed. Imagine them as "young adult" stars venturing out from their hometown into their new galactic apartments. Bright orange Aldebaran stands out in this group, but is not actually a member; it just happens to be in between us and the Hyades. Traveling from Orion to the Hyades we then find the small, almost dipper-shaped Pleiades star cluster (M45). These are "teenage stars," younger than the Hyades, but older than the newborn stars of the Orion Nebula. These bright young stars are still relatively close together, but have dispersed their birth cocoon of stellar gas, like teenagers venturing around the neighborhood with friends and wearing their own clothes, but still remaining close to home - for now. Astronomers have studied this trio in great detail in order to learn more about stellar evolution.

Figuring the exact distance of the Pleiades from Earth is an interesting problem in astrometry, the study of the exact positions of stars in space. Knowing their exact distance away is a necessary step in determining many other facts about the Pleiades. The European Space Agency's Hipparcos satellite determined their distance to about 392 light years away, around 43 light years closer than previous estimates. However, subsequent measurements by NASA's Hubble Space Telescope indicated a distance of 440 light years, much closer to pre-Hipparcos estimates. Then, using a powerful technique called Very Long Baseline Interferometry (VLBI), which combines the power of radio telescopes from around the world, the distance of the Pleiades was calculated to 443 light years. The ESA's Gaia satellite, a successor to Hipparcos, recently released its first two sets of data, which among other findings show the distance close to the values found by Hubble and VLBI, possibly settling the long-running "Pleiades Controversy" and helping firm up the foundation for follow-up studies about the nature of the stars of the Pleiades.

You can learn more about the Pleiades in the Universe Discovery Guide at bit.ly/UDGMarch , and find out about missions helping to measure our universe at nasa.gov.



Caption: Locate Orion rising in the east after sunset to find the Orion Nebula in the "Sword," below the famous "Belt" of three bright stars. Then, look above Orion to find both the Hyades and the Pleiades. Binoculars will bring out lots of extra stars and details in all three objects, but you can even spot them with your unaided eye!



Caption: Close-up of the Pleiades, with the field of view of Hubble's Fine Guidance Sensors overlaid in the top left, which helped refine the distance to the cluster. The circumference of the field of view of these sensors is roughly the size of the full Moon. (Credit: NASA, ESA and AURA/Caltech)

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