



THE BLUE MOON OBSERVER

APRIL 2019 VOLUME 21, NUMBER 4



Door Peninsula Astronomical Society

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www.doorastronomy.org

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The April general meeting will be held at the Astronomy Center at 7 PM on Tuesday, April 2. Gary Henkelman will review the Early Apollo Program, and the monthly Apollo series will continue until the 50th Anniversary of the moon landing on July 20, 2019. This will be followed by a slide presentation by Jim O'Reilly. Refreshments will be served.

Meeting Notes from the March 5 general meeting

Dave Lenius opened the meeting, welcomed guests, and presented the main program, part of our series leading up to the Apollo Lunar Landing: Project Gemini.

Project Gemini was one of the stepping stones to the moon. It operated from 1961 through 1966. The Gemini program looked to accomplish 6 major objectives:

1. It looked to prove that humans could withstand long duration flights in space.
2. NASA wanted to perfect the Rendezvous and Docking procedures that would be needed for a successful moon program.
3. The Re-entry and Flight Path Control that would allow safe return of astronauts from space.
4. The ability to work safely outside the spacecraft via Extra Vehicular Capability
5. Test proficiency of the Flight and Ground Crews
6. Conduct Scientific Experiments.

The complete program cost 1.3 billion dollars in 1967 which translates to nearly 8 billion dollars today.

The astronauts for the Gemini program was comprised of the original Mercury Seven, the New Nine, and

the 1963 Astronaut Class. During the program three astronauts died in air crashes during training including the prime crew for Gemini 9 which was flown by the backup crew.

The Gemini Capsule looked much like the Mercury Capsule only it was larger to accommodate two astronauts. The capsule had 16 thrusters that allowed for control in all three perpendicular axes and attitude control. The Gemini Capsules used fuel cells for the first time instead of batteries which allowed for longer missions without the need to recharge. The capsule was designed to dock with the Agena target vehicle so docking maneuvers could be practiced and procedures put in place. Spacewalks could be done as well due to the Gemini capsule being designed to allow extra vehicular travel.

The launch vehicle for the Gemini program was the Titan II modified ICBM. It was used for all of the flights without incident.

In total there were 12 Gemini flights that accomplished all of the objectives originally planned for the program. The things learned allowed for the next step in the quest for the moon.

Nobody had signed up to provide
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Who We Are

DPAS is a local club and chapter of the Astronomical League. We are also a club member of the International Dark-Sky Association and the Night Sky Network, teaching arm of the Astronomical Society of the Pacific. We meet on the first Tuesday of every month, with rare exception. Meetings are held at the Ray & Ruthie Stonecipher Astronomy Center unless otherwise announced. We operate and maintain the Leif Everson Observatory which houses a 16" Ritchey-Cretien telescope on a sophisticated tracking mount controlled by computer, and a new Maksutov-Cassegrain telescope for planetary viewing. A weather station is housed in the observatory. Current weather readings are shown on our web site:

www.doorastronomy.org

The StarGarden near the observatory is used for viewing the sky with unaided vision, binoculars and members' telescopes. There are also binocular mounts set in concrete which allow viewers of different heights to view the same object through the same binocular.

The Ray & Ruthie Stonecipher Astronomy Center provides for storage, projects, meetings, warm-up and toilet facilities. It also housed a StarLab, an inflatable planetarium with a sophisticated projection system. The planetarium was used for group presentations. See announcements page 6.

An Analemmatic Sundial was dedicated on October 20, 2012.

The "astronomy campus" as described here is reached by taking Utah Street east to the stop sign and turning left through the gate onto Stargazer Way. Or you can set your GPS to 2200 Utah.

Correspondence

From Brian Welsch:

Albion College's Prof. Nicolle Zellner, one of the American Astronomical Society's Shapley Lecturers, will give three astronomy/geology talks in Green Bay next week [this week] that might be of interest to your members— so please spread the word!

Topics:

1. "50 Years Since Apollo: What We Learned About the Moon and Why We Should Go Back," Neville Public Museum Astronomical Society meeting, Wednesday, 3/6, 6:30pm, room 122/123 (free and open to the public)

2. "Space Rocks: To the Moon – and Beyond!", UWGB Geology Club Meeting, Thursday, 3/7, 6:30pm, Mary Ann Cofrin (MAC) Hall, room 208 (free and open to the public)

3. Natural & Applied Sciences Seminar, "Impacts in the Earth-Moon System: What, When and Why Should We Care?", Friday, 3/8, 3:10pm, Env. Sci. (ES) building, room 301 (free and open to the public, refreshments at 2:40pm)

*This article is distributed by NASA
Night Sky Network
The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach.*

Mars the Wanderer

By David Prosper

April's skies find Mars traveling between star clusters after sunset, and a great gathering of planets just before sunrise.

Mars shows stargazers exactly what the term "planet" originally meant with its rapid movement across the evening sky this month. The ancient Greeks used the term *planete*, meaning wanderer, to label the bright star-like objects that travelled between the constellations of the zodiac year after year.

You can watch Mars as it wanders

through the sky throughout April, visible in the west for several hours after sunset. Mars travels past two of the most famous star clusters in our night sky: the Pleiades and Hyades. Look for the red planet next to the tiny but bright Pleiades on April 1st. By the second week in April, it has moved eastward in Taurus towards the larger V-shaped Hyades. Red Mars appears to the right of the slightly brighter red-orange star Aldebaran on April 11th. We see only the brightest stars in these clusters with our unaided eyes; how many additional stars can you observe through binoculars?

Open clusters are made up of young stars born from the same "star nursery" of gas and dust. These two open clusters are roughly similar in size. The Pleiades appears much smaller as they are 444 light years away, roughly 3 times the distance of the Hyades, at 151 light years distant. Aldebaran is in the same line of sight as the Hyades, but is actually not a member of the cluster; it actually shines just 65 light years away! By comparison, Mars is practically next door to us, this month just a mere 18 light minutes from Earth - that's about almost 200 million miles. Think of the difference between how long it takes the light to travel from these bodies: 18 minutes vs. 65 years!

The rest of the bright planets rise before dawn, in a loose lineup starting from just above the eastern horizon to high above the south: Mercury, Venus, Saturn, and Jupiter. Watch this month as the apparent gap widens considerably between the gas giants and terrestrial planets. Mercury hugs the horizon all month, with Venus racing down morning after morning to join its dimmer inner solar system companion right before sunrise. In contrast, the giants Jupiter and Saturn move away from the horizon and rise earlier all month long, with Jupiter rising before midnight by the end of April.

The Lyrids meteor shower peaks on April 22nd, but sadly all but the brightest meteors will be washed out by the light of a bright gibbous Moon.

DPAS BOARD

John J. Beck, President *pro tem* and Editor
editor@doorastronomy.org

David Lenius, Vice President

Thomas Minahan, Outreach
Coordinator

Susan Basten, Secretary,
Membership Chairperson, and
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Jacque Axland, Membership
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Secretary of the Board

John W. Beck, Past President
and Webmaster

Dennis Sundin, Member at
Large

Tom Gwilym, Member at Large

Ray Stonecipher, in spirit

Barbara Henkelmann serves as
the DPAS Archivist.

Coggin Heeringa serves as
acting school coordinator in the
absence of that board position.

The business of the DPAS is
largely conducted at the Board
meetings to leave the general
meetings open for programs.
The Board meetings are held at
the Astronomy Center at 7 PM
on Monday, 8 days prior to the
following general meeting.

Members of DPAS are invited to
attend Board meetings.

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refreshments, so after a brief break
he introduced the video program.

The second program was “Gravitational Lensing”, a continuation of the Great Courses series, “Dark Matter, Dark Energy: The Dark Side of the Universe” by Professor Sean Carroll. He reminds us that this is further evidence that there is more dark matter in the universe than known matter. Light is deflected by gravity, and “nothing escapes the curvature of space”. Light passing a gravitational field is bent. For example, if a quasar is far beyond a galaxy cluster which is between the observer and the quasar, the light bends around the gravitational field of the cluster and can appear as two images to the observer. How do we know that the two are actually dual images of the same object? One way is to check the redshift of each. If they are the same, the two images must be the same distance from the observer. More evidence to confirm the fact that they’re both images of the same object comes from spectroscopy.

Before Einstein knew about galaxies and galaxy clusters, he wondered how he would be able to test his theory of general relativity and came up with the idea that perhaps the observed orbit of the planet Mercury deviated from the calculated orbit as a result of gravity from the sun bending the light. But of course the sun is too bright to test this except during a total eclipse of the sun. So to test this, Sir Arthur Eddington of the UK (despite being from a country at war with Einstein’s country) led an expedition to observe a total solar eclipse and took images of the stars during totality, comparing the positions of the stars from their positions on the nights before and after. Indeed, the positions were displaced and confirmed both gravitational lensing and the calculated orbit of Mercury.

Gravitational lensing can be used to “weigh” galaxy clusters. Also, of more importance in seeking dark matter, is that dark stars can at times appear as

transits as a result of “micro-lensing”. This may help astronomers to understand at least some sources of “dark energy”.

He reminds us that we don’t know how much light bending has occurred when we detect an object by gravitational lensing; we don’t know where it is because we can’t see it with the “lens” present and removed. Two methods are used to determine the position of the lensed object and thus the amount of light ray deflection. One, strong gravitational lensing, occurs when two images of the object are detected. The angle between those images from the observer allows one to determine the location of and distance to the lensed object, assuming that the distance to the lensing galaxy cluster is known.

The second method, weak gravitational lensing, is much more common. In this case, gravity from a large cluster of galaxies distorts the light from distant galaxies changing the apparent shape of those galaxies into arcs, and a systematic pattern of arcs become parts of a broken circle. From this, scientists can calculate the total amount of mass of the distorting, or lensing, cluster of galaxies.

He goes on to use the Bullet Galaxy to demonstrate how two galaxies, at common redshifts and therefore about the same distance from us, contain most of their ordinary matter in areas that do not coincide with the centers of the gravitational fields of each galaxy. The implication, then, is that much of the matter responsible for the gravitational fields is actually dark matter.

In addition, this tends to support what scientists believe they know about gravity as defined by Einstein’s Theory of General Relativity.

We left the meeting relieved to know that there’s much more to be learned.

Astronomy Quiz

1. By far the highest resolution images of Pluto were obtained by a flyby mission
 - a. What was the name of the mission?
 - b. What was the time interval from launch to flyby?
 - c. What was the closest distance between the spacecraft and Pluto?
 - d. How fast was the spacecraft traveling as it passed Pluto?
 - e. Where is the spacecraft now?
2. List the 8 planets in order by diameter.



The Blue Moon Observer

A Woman Discovered How to Measure the Distance to Galaxies

Most major scientific discoveries throughout history have been attributed to men, geniuses they may have been. But there have been glaring examples of tremendous intelligence and effort by women working in the sciences who were not given their due credit during their lifetimes and in many cases had their work “appropriated” by the men running the science show. When Henrietta Swan Leavitt made a monumental discovery early in the 20th century, her finding was in one case plagiarized but eventually astronomers recognized the significance of her discovery and in 1924 a member of the Swedish Academy of Sciences tried to nominate her for the Nobel Prize. This was not possible because she died in 1921 and the Nobel is not awarded posthumously. It is notable that Edwin Hubble, discoverer of the expanding universe and namesake of the space telescope, was known to say she deserved a Nobel.

Hubble’s discovery of the existence of other galaxies and accurate distances to them relied heavily on the contributions of women astronomers and “computers”. But it was Leavitt who discovered and published a crucial finding on Cepheid Variables [1777 Variables in the Magellanic Clouds (1908) Annals of Harvard College Observatory, vol. 60, pp.87-108.3] which allowed the deductions Hubble made. Before we travel to the galaxies, let’s learn how astronomers, old and more recent, have inferred the distances to the Moon, Sun, planets and stars.

An accurate measure of the distance from the Earth to the Moon was first calculated by Hipparchus in 189 BCE. To do this, one needs to know the diameter of the Earth. Fortunately, Eratosthenes deduced the size of the (round!) Earth in 240 BCE. On the day the Sun shone on the bottom of wells in Syene (Aswan) he measured the Sun to be 7 degrees from the zenith in Alexandria, Egypt, hence Syene must be 7 Earth degrees away. Apply some geometry using the distance

between the sites (how many steps is that?) and voilà the diameter of the Earth is 80,000 stadia! Well, they knew how long it was. By comparing the timing of the movement of the edge of the Moon’s shadow during a solar eclipse (when the Moon blocks the Sun) taken at distance sites Alexandria and Heliopolis, Turkey, Hipparchus used geometry to calculate that the Moon is 35 - 41 Earth diameters distant - amazing he used margin of error back then. It’s actually about 30 Earth diameters, but not bad.

Whatever some may have speculated, the ancients did not know the Sun is at the center of the solar system and it was widely believed the moving players in the celestial orb occupied adjacent spheres. Because both the Sun and the Moon have the same angular size of $1/2^\circ$, they probably thought the Sun was the same size of the Moon, at least during a total solar eclipse. But ever since astronomers of the Renaissance generally agreed that the Sun was the center of the solar system - first purported by Polish mathematician and astronomer Nicolaus Copernicus - calculating the distance to the Sun and planets and stars was a coveted goal. However, to calculate distances to objects in the solar system using geometry, one needs to accurately describe the relative sizes of their orbits and the distance to at least one of them. Johannes Kepler (1571 - 1630 CE) deduced his laws of planetary motion, two of which are 1) the planets follow elliptical orbits with the Sun at one of the foci, and 2) “the square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit.” The latter says there is a precise mathematical relationship between the orbital period of a world (well known since ancient times for the 5 known planets and Earth) and the physical size of its orbit. This is true for all orbiting bodies, including asteroids, moons and comets. This geometry of the solar system would then allow one to decipher the distances between the Sun and all orbiting bodies if one only knew the distance to just one of them.

Aristarchus (died 230 BCE) was the first *continued on page 5*

Poetry Corner

*'Twas noontide of summer,
And mid-time of night;
And stars, in their orbits,
Shone pale, thro' the light
Of the brighter, cold moon
'Mid planets her slaves,
Herself in the Heavens,
Her beam on the waves.
I gazed awhile
On her cold smile;
Too cold- too cold for me-
There pass'd, as a shroud,
A fleecy cloud,
And I turned away to thee,
Proud Evening Star,
In thy glory afar,
And dearer thy beam shall be;
For joy to my heart
Is the proud part
Thou bearest in Heaven at
night,
And more I admire
Thy distant fire,
Than that colder, lowly light*

Edgar Allan Poe, 1827

Distances from page 4

to try to triangulate the distance to the Sun by estimating the angle between the Sun and Moon with his eye and some kind of protractor or sextant (no telescopes back then) when the Earth-Moon-Sun form a right triangle. That is, when the Moon is exactly half-illuminated as viewed from Earth. But the angle was a little off and the moment of semi-illumination fuzzy and he was off by a factor of a thousand. It wasn't until Giovanni Cassini (1625 - 1712 CE) accurately measured the distance to Mars using parallax that astronomers finally had a grip on the size of the Solar System. Subsequent precise measurements during the 1761 and 1769 transits of Venus across the face of the Sun (use a filter!) enabled French astronomer Jérôme Lalande to calculate a value of the Sun-to-Earth astronomical unit (AU) within 2% of its actual value - 149,597,871 km as the mean distance.

Parallax: measure the position of a closer foreground object (e.g. planet) against the background of fixed stars at different times 1/2 year apart - when the observer (on Earth) has moved 2 AU over. The more the target moves against the background between the two observations, the closer it is. Parallax has been used to estimate the distance to nearby stars, but they move so little against the celestial star map (arcseconds) that accurate distances can be inferred out to a mere 100 lightyears (LYs) or so. In comparison, our Milky Way galaxy is about 106,000 LYs in diameter and on average 1000 LYs thick. From an interest sparked in college at Radcliffe, Henrietta Leavitt became a volunteer assistant at the Harvard Observatory in 1895 and received a permanent staff appointment in 1902. She soon advanced to lead the photographic stellar photometry department, which was an effort to catalog and standardize values for star magnitudes, i.e. their apparent relative brightnesses. Using photographs supplied from observatories around the world, she was a key figure in the production of the Harvard Standard Regions of the sky. This

work on stellar magnitudes led her to discover 4 novas and some 2400 variables stars - stars whose brightness varies periodically. But her pivotal discovery in 1908 was that, in a certain class of variable stars called Cepheids, the period of fluctuation in brightness is highly regular and is determined by the actual (maximum) luminosity of the star, or its intrinsic magnitude. This gives a strict relationship between a Cepheid's period of variability and its inherent brightness (see Figure). Because the period of variability in a Cepheid reveals its intrinsic brightness, by measuring its (dimmer) apparent brightness as seen from Earth one can estimate its distance. The Cepheid variable stars provide a standard candle by which we can measure vast distances.

Edwin Hubble determined that the Universe is expanding by correlating the recession speeds of then recently-postulated other galaxies (see spectroscopy) with their distances from Earth. Because Cepheid variables are observed in other galaxies out to about 20 millions LYs, the distance to them can be accurately determined thanks to Leavitt's discovery. In addition to abetting the discovery of the expanding Universe, Cepheids have allowed astronomers to make 3-Dimensional maps of local galactic clusters. They also have been used to calibrate the inherent brightness of Type Ia supernovae, which are used as a standard candle to determine the distance to galaxies billions of LYs away. Leavitt's discovery was a portal to knowledge which has been used to describe the expanding Universe in great detail and astounding scope. The Peninsula Players will stage a production of *Silent Sky* August 21 - September 1, 2019. From peninsulaplayers.com: "With warm-hearted wit and infectious joy, *Silent Sky* tells the riveting true story of Henrietta Swan Leavitt, a pioneering scientist in an age when women couldn't even vote."

The preceding article by Tom Minahan was published in the Peninsula Pulse and used by permission of the Peninsula Pulse and doorcountypulse.com. See graphics on page 6.

Astronomy Quiz Answers

1. a. New Horizons.
- b. 9 years and nearly 6 months.
- d. 7750 miles or 12,500 km.
- e. 26,700 mph or 43,000 km/h.
- f. In the Kuiper Belt about 44 astronomical units from the sun.
2. Jupiter – 1,120% the size of Earth
- Saturn – 945% the size of Earth
- Uranus – 400% the size of Earth
- Neptune – 388% the size of Earth
- Earth
- Venus – 95% the size of Earth
- Mars – 53% the size of Earth
- Mercury – 38% the size of Earth

Viewing Nights

The following is the tentative list of viewing nights for 2019. Changes will be posted here and at www.doorastronomy.org

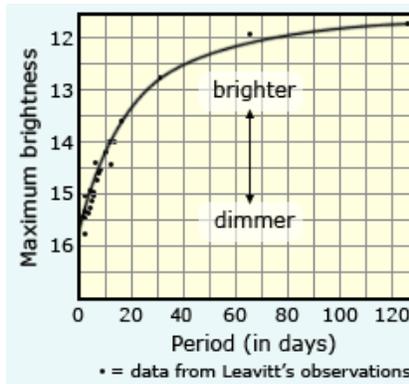
April 6
 May 4
 June 1
 July 6
 August 3 (and/or 28)
 September 28
 October 26
 November 23
 December 28

Note: If skies are cloudy, a program will be presented at the Astronomy Center.

Some summer viewing may be cancelled because it gets dark so late.



Henrietta Swan Leavitt
www.cfa.harvard.edu



Messier Marathon Invitation

The Neuville Public Museum Astronomical Society (NPMAS) has invited us to join them for their 31st Annual Messier Marathon on Saturday, April 6th at the Brillion Nature Center. DPAS members have participated with them some previous years. We have also held our own at Newport State Park in the past.

All members of the NPMAS, NEW-STAR, and Door Peninsula Astronomical Society are invited. The Brillion Nature Center is located at W1135 Deerview Road, Brillion, WI 54110. BNC has a beautiful 100 seat room in their facility that is a perfect venue for our event. There is a kitchen with numerous outlets and a sink, folding chairs and tables, lots of room and a large stone fireplace. You can download a map from their web site: <http://www.brillionnaturecenter.net/about/maps> It's a bit off the beaten path: once you turn off of Cty. PP onto Deerview Road you will travel past a

farmer's yard and continue on a small, winding gravel road until it dead ends at the nature center. There are several parking areas on the property and plenty of places to set up telescopes near the buildings. If you have any questions, you can call Bill Hennessy at 920-323-3307.

Notice that this event is on the same night as our DPAS viewing night. April 6th is a bit late in the year for best Messier Marathon viewing, but the event is social as well as challenging.

Board Activity

The new inflatable planetarium, projector, and software have been ordered and should be shipped this month. Already the board has committed to several outreach presentations utilizing this significant upgrade from our previous planetarium.

Gary Henkelmann has taken a 3 month leave of absence from the board but continues to honor his outreach commitments. John J. Beck will serve as president *pro tem* and election of officers will take place this summer.

Two new members have joined DPAS
 Mario Alonzo
 Bob Konezal

Note: this will be the last Blue Moon Observer mailed to those who have not renewed their membership by April 25, 2019.

Mike Egan, Jim Maki, and Susan Basten will serve as the Scholarship Committee. Each year, through the generosity of the late Dr. Ray Stonecipher, DPAS offers scholarships to promising students.

DPAS will have an information table at TAP on April 4th. Donations received will be directed to the DPAS Scholarship Fund.

Coggin Heeringa will provide a display and educational materials for the April 2 Sunrise School STEAM Night. Other **members are invited to assist**. Time is 5 PM to 7:30 PM.

The new telescope is awaiting adjustments to alignment and collimation.

A HUGE THANK YOU TO JACQUE AXELAND FOR TAKING OVER THE PRINTING OF THE ADDRESS LABELS FOR THE BLUE MOON OBSERVER!