http://www.raclub.org/

The StarGazer

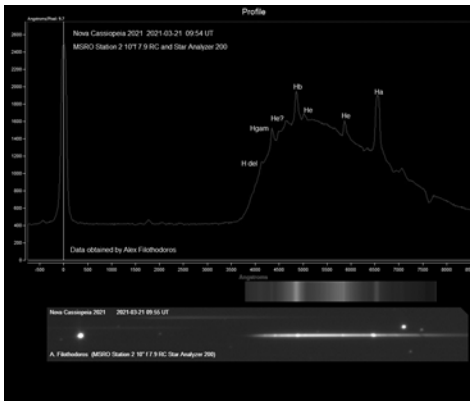
Newsletter of the Rappahannock Astronomy Club No. 4 Vol. 9 February 2021–April 2021

Star Light, Star Bright—How Many Supernovae Will We See Tonight?

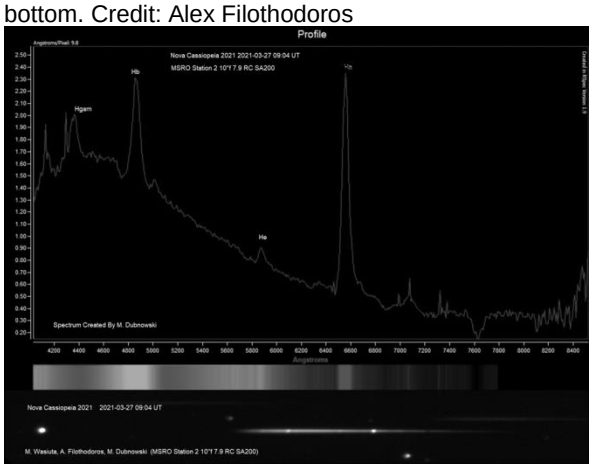
By Myron Wasiuta

The past few months have seen a flurry of activities at the Mark Slade Remote Observatory (MSRO), with observation sessions nearly every clear night and morning. Currently, all three stations are operational, with Station 2 seeing the most use in recent months. The MSRO is a resource for members of the RAC, and I would again like to extend an invitation for club members to feel free to contact me to learn how to use the telescopes. Time and training are free and a benefit of membership! Don't miss the opportunity to use one of the premier remote observatories in Virginia!

A Classical Nova Erupts in Cassiopeia



Spectra for nova near star cluster M52, March 18, 2021. A strip of the raw image is included at the bottom. Credit: Alex Filothodoros



Spectra for nova near star Cluster M52, March 27, 2021. Credit: Myron Wasiuta, Alex Filothodoros, and Max Dubnowski

Discovered on March 18, 2021, a relatively bright nova has appeared near the star cluster M52. Using the 10-inch f 7.9 TPO RC in Station 2 and its Star Analyzer 200 diffraction grating and photometric filters, Alex Filothodoros captured photometry and spectral images of the new nova just as the sky was brightening in morning twilight. The wavelength-calibrated spectra clearly show hydrogen and helium emission features characteristic of a nova expansion shell.

A few days later, we obtained spectra for the same object, to which our high-school student Max Dubnowski was able to add instrument response calibration! Max has been using MSRO over the past year for his Capstone Project on RR Lyrae variables, and he used this experience to create the wonderful spectral analysis presented here.

Because observations at MSRO have continued each clear morning, as of this writing we have obtained hundreds of observations in three photometric bands (B,V,R), which will be combined to produce a light-curve of the nova as it fades. If anyone in the club is interested in helping with this—please contact me because we do need help with all the data we are accumulating!

Star Light, Star Bright—How Many Supernovae Will We See Tonight?!

SN2021gmj in NGC 3310—It started innocently enough with Alex reporting that a supernova (SN2021gmj) had just been discovered in the unusual starburst galaxy NGC 3310 in Ursa Major. It became a target of MSRO observation, and we quickly obtained images, photometry, and ***(Continued on page 4)***

How to Join RAC

RAC, located in the Fredericksburg, Virginia, area, is dedicated to the advancement of public interest in, and knowledge of, the science of astronomy. Members share a common interest in astronomy and related fields as well as a love of observing the night sky.

Membership is open to anyone interested in astronomy, regardless of his/her level of knowledge. Owning a telescope is not a requirement. All you need is a desire to expand your knowledge of astronomy. RAC members are primarily from the Fredericksburg area, including, but not limited to, the City of Fredericksburg and the counties of Stafford, Spotsylvania, King George, and Orange. We also have several members who live outside Virginia and have joined to have the opportunity to use the Mark Slade Remote Observatory (MSRO)—one of the benefits of joining the club.

RAC offers you a great opportunity to learn more about the stars, get advice on equipment purchases, and participate in community events. We meet once a month and hold regular **star parties** each month on the Saturday closest to the new Moon. Our website, www.raclub.org is the best source of information on our events.

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Website: www.raclub.org
Groups.io: Members-only group. When you join RAC, you will receive an invitation to join from the RAC President.

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Options for Dues Payment

RAC annual membership is $20 per family. Student membership is $7.50. You can now pay your dues in two ways. (For reference, the RAC membership year is January–December.) If you join anytime in the last quarter, your membership covers the upcoming year. Astro League dues run July to June.

- **By Mail:** Make out a check to RAC Treasurer and send it to Matthew Scott, RAC Treasurer, PO Box 752, Fredericksburg, VA, 22404-0752. Both new and renewing members should also print out the membership application here, fill it out, and return it with their payment to keep our records up to date.
- ***By PayPal***: You can also pay your dues online. Simply go here, scroll down, and select the appropriate membership type from the dropdown box and click *Pay Now*. You do not need to complete an application because the notification the club receives of your payment will contain all the additional info needed. NOTE: If you pay using PayPal, your actual charge (including the PayPal usage fee) will be: Single/Family $20.91, Student $8.03, Single/Family & AL $28.63, Student & AL $15.76, AL Only $8.03.

Upcoming Events*		Recent Events Completed	
Our public events are cancelled until further notice. However, to attend a RAC meeting via Zoom, email president@raclub.org for an invitation.		Star Party, Caledon State Park	March 13, 2021
Star Party, Caledon State Park	May 8		
Star Party, Caledon State Park	June 5		
Star Party, Caledon State Park	July 17		

*Owing to varied and changing restrictions, please check the website raclub.org for updates.

President's Corner

Dear Members,

RAC will continue to conduct its business meetings via Zoom Video Conferencing for the foreseeable future. I send Zoom meeting invitations to all RAC members via BCC eMail. Non-members may also participate by sending me a request at president@raclub.org.

RAC is once again actively soliciting guest speakers so that we can have an informative or entertaining presentation before each business meeting.

You can order Rappahannock Astronomy Club embroidered gear online. Just go to www.rockytoponline.com. Under "Shop," click "RAC." You can purchase embroidered polos, t-shirts, and hoodies. Orders will be processed on the last day of each month to be ready for the next General Meeting.

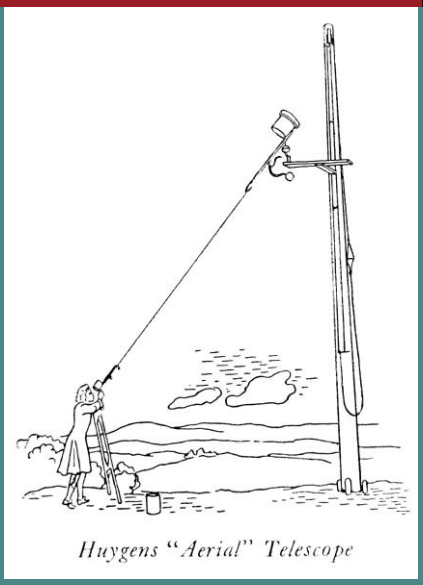
May God bless you with transparent skies and excellent seeing.

Glenn Faini
President

Did You Know? by Scott Busby

Even the great Sir Isaac Newton concluded—wrongly as we now know—that no lens could ever overcome the problem of chromatic aberration. But in 1663, a Scottish mathematician, James Gregory, had suggested a telescope which employed a concave mirror to gather light from the object observed instead of an "objective" glass. His plan called for the use of a second concave mirror to reflect the image to the eyepiece. In theory, this overcame chromatic aberration and suggested further advantages, but no one at the time could produce mirrors with curvatures sufficiently exact. Newton, examining Gregory's drawings, saw how his telescope could be simplified. He eliminated the second curved mirror and replaced it with a flat one. He proceeded to build a model of such a telescope, employing speculum metal, a white brittle metal, for the reflecting mirror. In 1671, he made a second model, which he presented to the Royal Society. The telescope stood about 15 inches high and employed a mirror one inch in diameter. But nearly half a century was to lapse before opticians acquired the knowledge and skill necessary to make accurate mirrors for this type of telescope.

The first successful reflecting telescope was made, in about 1722, by John Hadley, who became the inventor of the sextant. Tests conducted by the Royal Society of London showed that Hadley's reflector with a tube six feet long did better work than the Society's 123-foot Huygens "aerial refractor." The demand for reflecting telescopes became great all over Europe.



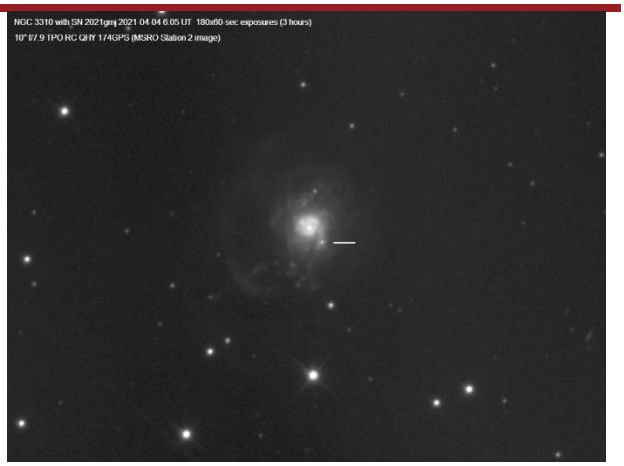
Huygens "Aerial" Telescope

Source *(including the drawing)*: *The McDonald Telescope, Commemorating the Dedication and the Formal Opening of the McDonald Observatory of the University of Texas May Fifth, 1939*, The Caxton Company Cleveland, The Warner Swasey Company 1939.

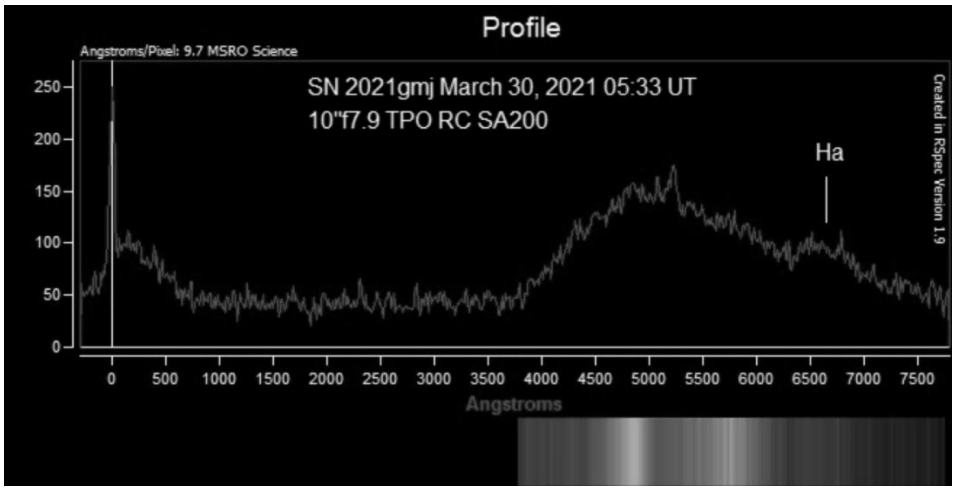
Star Light, Star Bright—How Many Supernovae Will We See Tonight? (from page 1)

even spectroscopy of this 15th magnitude Type II supernova. A type II supernova results from the core collapse of a massive star and leaves in its place a neutron star, pulsar, or stellar mass black hole.

We have more than 600 photometric observations over 14 nights on this object and will be constructing a light curve once we get all the data completed.

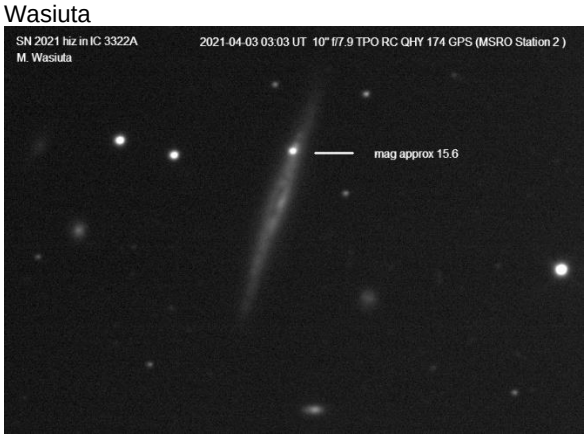


NGC 3310 with supernova SN2021gmj, April 4, 2021. Credit: Alex Filothodoros and Myron Wasiuta



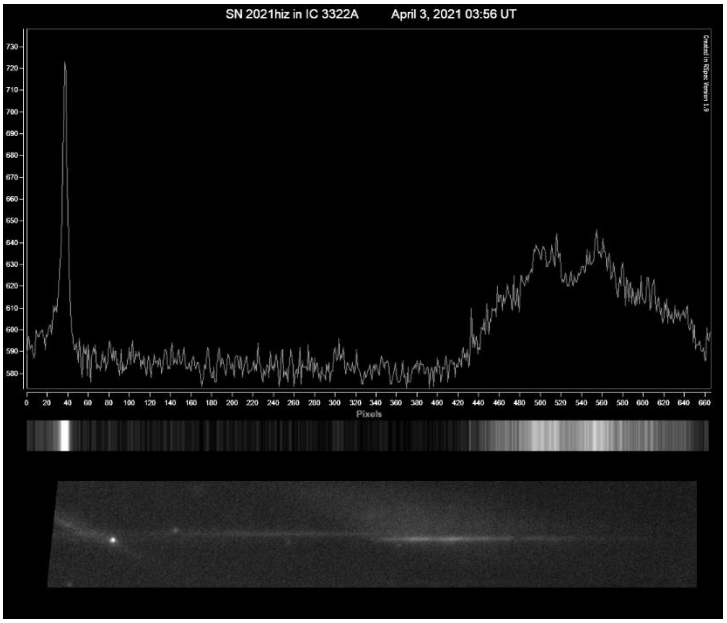
Spectra for supernova SN2021gmj, March 30, 2021. Credit: Alex Filothodoros and Myron Wasiuta

SN2021hiz in IC 3322A—A couple nights later, we learned of the type Ia supernova in a faint galaxy in Virgo. Type Ia supernovae result when a white dwarf explodes as a result of mass transfer from an orbiting companion star—usually a main-sequence late-stage star that is in its red-giant phase and has swollen to fill its Roche-Lobe, is being tidally disrupted, and is transferring mass into an accretion disk around the white dwarf. Eventually, the white dwarf reaches critical mass, and a runaway nuclear fusion explosion results in a supernova.



Super nova SN2021hiz, April 3, 2021. Credit: Myron Wasiuta

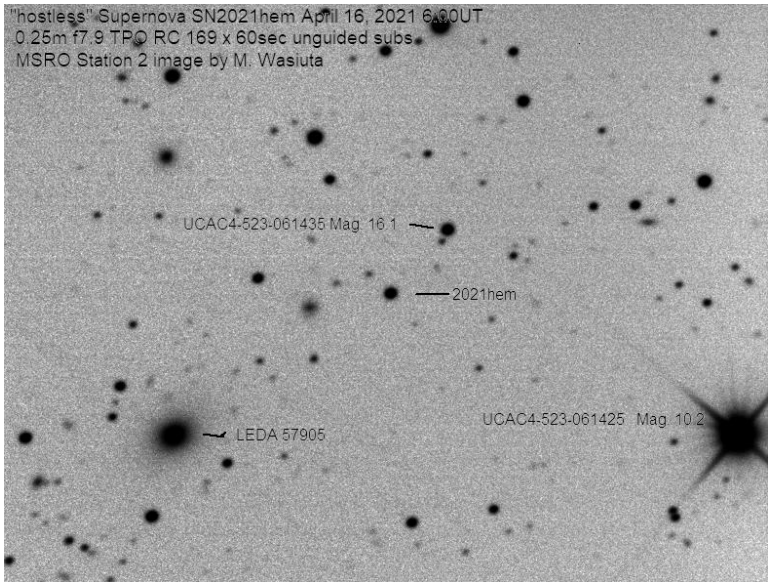
So far, we have observed this supernova on 12 nights between April 2 and April 27. Because it is brighter than 15th magnitude (our lower limit for spectroscopy with the Station 2 telescope), we have not only been getting BVR photometry, but spectroscopy as well. Theoretically, it is possible to distinguish between a type II supernova and a type Ia by both comparing their spectra and their light curves. Hopefully, we will be able to demonstrate this with our data once complete.



Spectra for supernova SN2021hiz, April 3, 2021. Credit: Alex Filothodoros and Myron Wasiuta

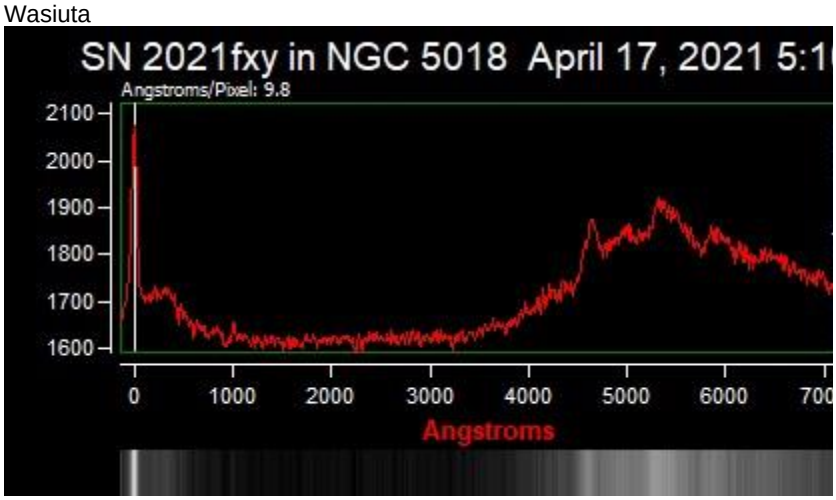
"Hostless" super nova SN2021hem, April 5, 2021. Credit: Alex Filothodoros, Max Dubnowski, and Myron Wasiuta

"Hostless" Supernova 2021hem in Hercules—Seems like very unusual object—this type Ia supernova is not associated with a detectable host galaxy! However, review of the literature shows they are not that uncommon. Apparently, these supernovae are part of an intra-galactic cluster population of stars or part of the "dark matter" that is the predominate type of matter in our universe. Because this object is fainter than our limit of spectroscopy, so far, we have only been able to obtain BVR photometry for a light curve, as well as a very deep image to see whether our telescope could detect any host object. Despite our efforts, we are unable to see any host object in our images. However, we have obtained hundreds of images over 10 nights and will continue to follow this object until it fades beyond our imaging capabilities. We should be able to demonstrate that it is a type Ia supernova using just the shape of the light curve.



Deep image of "hostless" SN2021hem, April 16, 2021. Credit: Myron Wasiuta

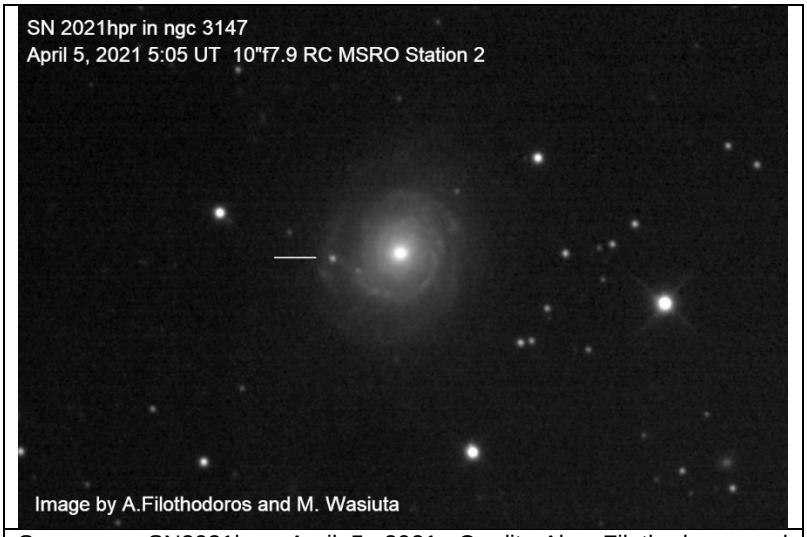
Supernova SN2021fxy, April 17, 2021. Credit: Alex Filothodoros and Myron Wasiuta



Spectra for supernova SN2021fxy, April 17, 2021. Credit: Alex Filothodoros and Myron Wasiuta

SN 2021fxy—Another recent supernova brought to our attention by Alex is another type Ia in the galaxy NGC 5018. Because this object has a southerly declination, our observing opportunity lasts only about an hour long each night. Nonetheless, we have obtained not only BVR photometry but spectroscopy as well! Alex has been very helpful in getting data on this object.

SN2021hpr in NGC 3147—SN2021hpr in NGC 3147 is another type Ia supernova located in a nice spiral galaxy—but again just too faint for our spectroscopic capabilities. However, we have obtained hundreds of BVR images, which again, will be used to construct a light curve.



Supernova SN2021hpr, April 5, 2021. Credit: Alex Filothodoros and Myron Wasiuta

Conclusion

As you can see, not all is science—sometimes we just take pretty pictures!

Lest readers think that all we do is stare at faint exploding stars—the last two images shown below are recent results using the MSRO telescopes for astrophotography during training sessions. (The photo of NGC 3079 was taken by Eric Goforth during a training session. Eric is a local observer who wants to undergo training to become a full MSRO Observer.)


M51. April 22, 2021. Stack of sixty 60-sec unguided subframes taken using Station 2. Credit: Myron Wasiuta

Galaxy NGC 3079 in Ursa Major. April 27, 2021. Stack of sixty 60-sec unguided subframes taken using Station 2. Credit: Eric Goforth

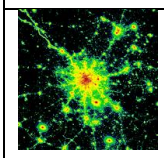
Typically, a training session lasts about 1.5 hours, and depending on the observer, we might discuss basic astrophotography, image capture, stacking, and calibration frame use. In addition, the skills needed to operate the observatory are mastered. Once this is done, and the student shows competency to the Director and Assistant Director, the student becomes a full MSRO Observer. This means the telescopes can be used by the observer without online, real-time supervision by either the Director or Assistant Director. It is hoped that after reading this summary of activity at MSRO, you will be interested enough to participate as a user of MSRO. Please feel free to email me at mwasiuta@msroscience.org for information on how you can get started on the grand adventure of observing the universe using MSRO.

Helpful Software, Websites, and Mobile Apps for Amateur Astronomers

By Glenn Faini

During our February business meeting, we discussed computer software, websites, and mobile apps that might be beneficial to amateur astronomers. I have found the following short list of Android apps, Windows programs, and websites particularly useful for planning and observing.

	Google Sky Map is a free app (open sourced) that provides a quick and easy way to identify an unknown celestial object. It is the first Android astronomy app I ever downloaded. It is simple and easy to use. Just hold your phone or tablet up to the sky, and it will show you a chart, which you can zoom in or out, identifying celestial objects in the part of the sky your mobile device is framing.
	SkEye, also free, is more advanced than Sky Map, with finer graphics, catalogs from which you can choose objects to view, visual and voice guides to help you locate celestial objects, and a list of the best objects to look at today. I think this is the best phone app to use out in the field to find any celestial object you want to view.
	Celestron's SkyPortal™ is a powerful planetarium program that comes bundled with NexStar telescopes. Powered by SkySafari 5, it was my preferred app to help me locate objects with binoculars or a non-GoTo telescope. It can also be used to control NexStar telescopes from a phone or tablet. Unlike Sky Map and SkEye, SkyPortal really needs the large screen of a tablet because it displays a lot of information. I now use SkySafari 6 Plus because it has more features and a larger database of objects than SkyPortal.

	SkySafari 6© is more robust than SkyPortal. It is a full-featured planetarium program for use out in the field. It is useful if you need stars dimmer than SkyPortal's Mag 8.5 to help you find an object. The Basic version came with my NexStar SE, but I upgraded to Plus for only $5. It has a far more extensive catalog of objects and can be used for telescope control.
	Planet's Position (free) is the app I use to determine which planets are visible and when they rise, transit, and set. It provides real-time RA, Dec, Alt, Az, distance, and magnitude. It also lists solar and lunar eclipses and lunar occultations.
	Light Pollution Map is an app that I would like to recommend, but I have found it to be too buggy. I use the Light Pollution website (www.lightpollutionmap.info) instead, which works great. I find it more useful than the Clear Sky Chart website for evaluating light pollution. I used it a lot when house hunting to evaluate how dark the sky is at each location by using the GPS feature to locate my position.

I use the following planetarium programs on my Windows computers.

	I have used TheSky for longer than I can remember and have been using TheSky6 Professional for nearly 20 years. It is one of the most powerful planetarium programs on the market. TheSky is up to version X, but I have not had a need to upgrade from version 6.
	An alternative to TheSky is Starry Night. I have Starry Night SE 7, which came bundled with my NexStar SE telescope. It seems very good, although I have more experience with TheSky. Which one is better? It is probably just a matter of personal preference.

Finally, I have to mention Mike Swanson's NexStar Resource Site. Every Celestron NexStar owner should have this website bookmarked and Mike's books *The NexStar User's Guide*, *NexStar Hand Control Version 4 User's Guide*, and *The NexStar User's Guide II* on his/her shelf. These are vital resources to help you get the most out of your NexStar telescopes. Mike Swanson also wrote the NexStar Observer List software, a free Windows program for planning your observing sessions and controlling your NexStar telescope.

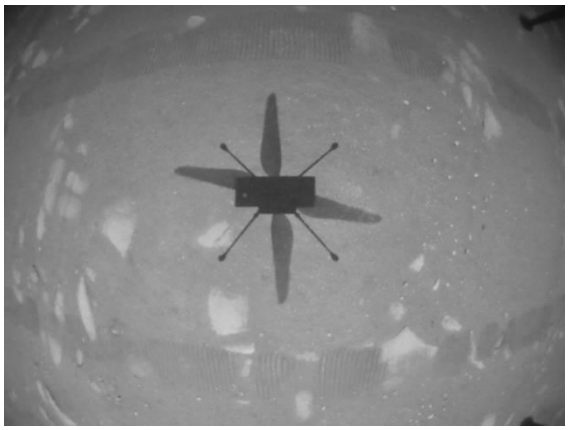
Helicopters on Mars?...Yes Indeed!

By Linda Billard

In the last issue of the *StarGazer,* I told you about NASA's plans to fly its Ingenuity helicopter on Mars.

With four flights now completed, the "little helicopter that could" continues to meet new challenges. The first flight was delayed several days (to April 19) owing to concerns about the software that controls the transition between "preflight" mode and "flight" mode. The problem was corrected by adding a few commands to the transition sequence, and the first flight—39.1 seconds total—included a maximum altitude of 10 feet and maintenance of a stable hover for 30 seconds. It then descended back to the surface of Mars.

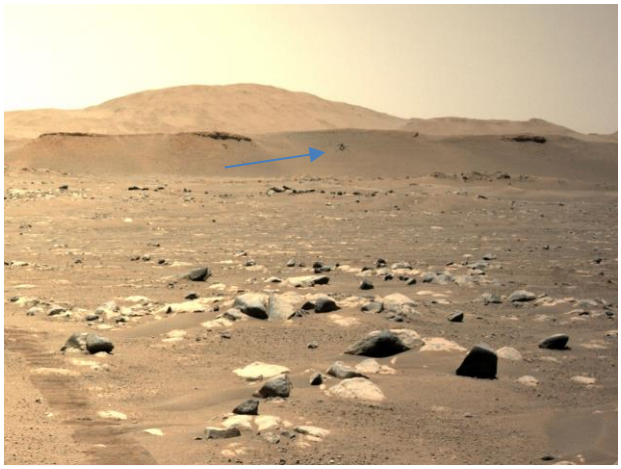
The second flight was a bit more ambitious. It too occurred on the dusty Martian plain now officially dubbed Wright Brothers Field. It was successfully completed on April 22—the 18th Martian day of its experimental flight test window. Lasting 51.9 seconds, the flight involved several new challenges, including a higher maximum altitude, longer duration, and sideways movement.



NASA's Ingenuity Mars Helicopter captured its own shadow as it hovered over the Martian surface on April 19, 2021. It used its navigation camera, which autonomously tracks the ground during flight. Credits: NASA/JPL-Caltech

Photo of Ingenuity's second flight by NASA's Mars Perseverance rover. This is one still frame from a video sequence This image was acquired on April 22, 2021. Credits: NASA/JPL-Caltech/ASU/MSSS

"For the second flight, we tried a slightly different approach to the zoom level on one of the cameras," said Justin Maki, Perseverance project imaging scientist and Mastcam-Z deputy principal investigator at JPL. "For the first flight, one of the cameras was fully zoomed in on the takeoff and landing zone. For the second flight, we zoomed that camera out a bit for a wider field of view to capture more of the flight."



NASA's Ingenuity Mars Helicopter can be seen (see blue arrow) hovering during its third flight on April 25, 2021, as seen by the left Navigation Camera aboard NASA's Perseverance Mars rover. Credits: NASA/JPL-Caltech

Because the data and imagery indicated that the helicopter had not only survived its second flight but also flew as anticipated, the Ingenuity team considered how best to expand the profiles of its next flights to acquire additional aeronautical data.

The craft's third flight, on April 25, continued to set records, flying faster and farther than in any tests it went through on Earth. The helicopter took off at 4:31 a.m. EDT, or 12:33 p.m. local Mars time, rising 16 feet—the same altitude as its second flight. Then it zipped downrange 164 feet, about half the length of a football field, reaching a top speed of 6.6 feet per second (4.5 mph).

The successful fourth flight occurred April 30. It was longer (117 sec) and covered a total distance of 872 feet. This flight captured many more photos (60). According to MiMi Aung, Project Manager, the team will "use these images to study the surface features of the terrain. Some of our black-and-white images were taken as stereo pairs, allowing us to test our ability to make 3D imagery of the surface and study the elevation of different sites below us. Adding this dimension to future missions could offer a broad range of scouting possibilities across regions that rovers can't roam, close-ups that orbiters can't provide, or ways to extend the reach of future human explorers."

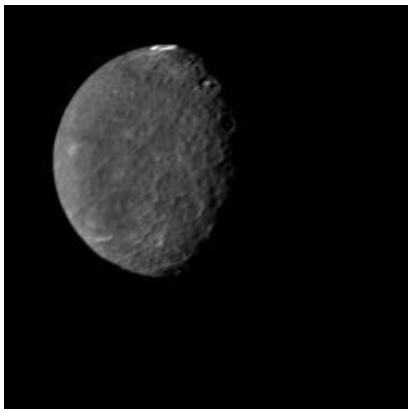
The fifth flight will transition Ingenuity to the next phase. The craft will go on a one-way mission to land at a new site. If it remains healthy after this flight, the operations demonstration phase will begin in about 2 weeks with the helicopter's sixth flight. The cadence of flights will slow from once every few days to about once every 2 or 3 weeks and will be scheduled to avoid interfering with Perseverance's science operations. With the Perseverance rover expected to take short drives in the near term, Ingenuity may execute flights that land near the rover's current location or its next anticipated parking spot. The helicopter can use these opportunities to make aerial observations of rover science targets, potential rover routes, and inaccessible features, while also capturing

stereo images for digital elevation maps. The lessons learned will benefit the efforts of future mission planners. These scouting flights are a bonus and not a requirement for Perseverance to complete its science mission. Stay tuned….

For an entertaining 3D model of the little helicopter that you can manipulate yourself, go here.

Faint Moon of Uranus Eclipses a Star

By Linda Billard with Myron Wasiuta and Bart Billard

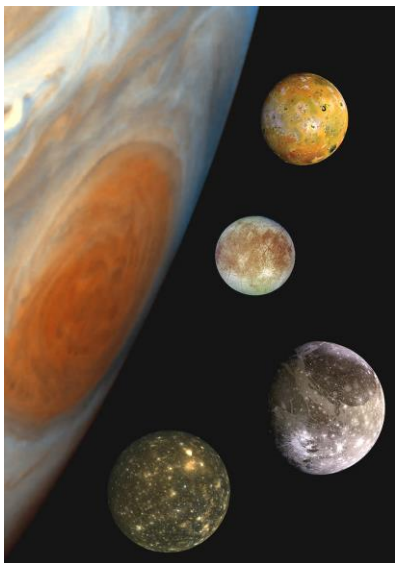


Voyager 2 image of the southern hemisphere of Umbriel, Jan. 24, 1986, from a distance of 557,000 kilometers (346,000 miles). This frame, taken through the clear-filter of Voyager's narrow-angle camera, is the most detailed image of Umbriel, with a resolution of about 10 km (6 mi). Its diameter is about 1,200 km (750 mi), and it reflects only 16% of the light striking its surface. Credit: NASA/JPL

Back in October 2020, Bart Billard and Myron Wasiuta observed the occultation (eclipse) of a 13.5 magnitude star by Umbriel, one of Uranus's moons—difficult-to-see even under optimum circumstances. They became aware of the opportunity to see this rare and barely perceptible event when David Dunham, of the International Occultation Timing Association (IOTA), sent them a notification. Bart and Myron determined that they had a chance of seeing it, and so set up Station 3 at the Mark Slade Remote Observatory (MSRO) to do so. They were able to successfully detect an approximately 50-second event using Station 3's telescope (Explore Scientific 102mm F/7 APO) and camera (QHY 174 GPS CMOS). They captured ninety 4-second exposures at prime focus (714 mm fl). Myron thought it might be interesting to animate those images. He did so by cropping in tightly on Uranus and scaling the images to reduce the glare of the planet. Because the images were taken with no guiding, they wobble back and forth slightly, caused by the periodic error of the CGE PMC-Eight mount. The animation compresses 6 minutes of data into about 18 seconds. Umbriel is so faint it can only be seen just before the star reappears after being occulted. In the video, the target star is the object very close to the lower left of Uranus' over-exposed disk. The other two moons visible to the lower left are Oberon (farthest out) and Titania. Bart and Myron also believe that another Uranian moon can be glimpsed touching the image of the planet at upper right. They thank Dave for giving them a heads-up about this most unusual and rare event!

It's "Mutual Event Season" on Jupiter

By Linda Billard



Family Portrait of the Jovian System Source: NASA

It's likely you have seen Jupiter's four major moons (Io, Europa, Ganymede, and Calisto) disappear and reappear from behind the planet's disc. These events are frequent and easily observable using an amateur telescope. But this year, something less common is occurring—it's "mutual event season"!

At 6-year intervals, the orbital plane of Jupiter's four Galilean moons is edge-on with the Sun and Earth, creating the conditions for the season of mutual phenomena—Jupiter's moons occulting and eclipsing *not just the planet, but each other.* This enthralling "dance of the moons" began January 3, when Europa partially eclipsed Io. As Jupiter and its accompanying satellites climb higher and higher in the sky, many more of these mutual events can be viewed—192 of 242 occultations, eclipses, and partial eclipses will be visible from some location(s) on Earth through November 16. No fewer than 40 have been/will be visible from our own MSRO, according to the Institut de Mécanique Céleste et de Calcul des Ephémérides (IMCCE).

If you access IMCCE's *Natural Satellites Ephemeride Server* application and enter "W54" (*the* observatory number for MSRO), you will see

dates/times etc. for all the Jovian mutual events for 2021 that can be seen from our location. The largest number of events for the MSRO (8) (and, by extension, for the Fredericksburg area), will occur in May. Bart Billard is hoping to view and record several of these events.