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The StarGazer

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How Observing Supernova SN 2022ewj Led to "Discovering" Two Asteroids

By Myron E. Wasiuta OD, Director-Mark Slade Remote Observatory (MSRO)

On the night of March 19, 2022, Japanese amateur astronomer Koichi Itagaki discovered a Type II supernova (core collapse of a supergiant star)—SN 2022ewj—in the galaxy NGC 3367. Ten nights later, I was able to secure our first observations at MSRO—thanks to a tip from Alex Filothodoros, RAC member and MSRO colleague. Using the Station 2 telescope (10-inch f7.9 TPO RC) (Figure 1), I obtained many B,V, and R band photometric images, as well as spectroscopic images. I used the photometric images to determine the magnitude of the supernova and to create a nice color image showing the bluish color of the supernova (Figure 2). However, the spectroscopic images were not useful because the orientation of the grating and position of the supernova caused the spectra of the supernova to overlap those of the galaxy's nucleus. This rendered the spectra useless for analysis. Nonetheless, I decided I would continue to follow the supernova as it faded so I could create a nice animation showing the star fading into obscurity.

Figure 1: MSRO Station 2 Telescope (Courtesy: Myron Wasiuta)

Another opportunity to image the galaxy came on the evening of June 22, 2022. By then, the host galaxy, which is in Leo, was dropping low in the southwestern sky at dark. I had to capture the image as soon as it got dark, before the galaxy, with its fading supernova, was lost in the trees in

Figure 2: Supernova SN2022 ewj (Courtesy Myron Wasiuta)

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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. Most RAC members are 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 membership.

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**. 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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Myron Wasiuta Mark Slade Remote Observatory (MSRO)

Options for Dues Payment

RAC annual membership is $20 per family. Student membership is $7.50. You can 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 $21.23, Student $8.28, Single/Family & AL $29.00, Student & AL $16.05.

Upcoming Events*		Recent Events Completed	
Star Party, Caledon State Park	August 6	Star Party, Caledon State Park	May 30
Star Party, Caledon State Park	September 3**	Star Party, Caledon State Park	June 4
Star Party Caledon State Park	October 1	Star Party, Caledon State Park	July 30

*Our Caledon star parties are public but please check our website for updates. Anyone can attend a RAC meeting via Zoom, just email president@raclub.org for an invitation.

**Star Party on September 3 will be preceded by RAC's *members-only* picnic. Non-members are welcome to come to the star party (beginning early evening), weather permitting. Please be sure to check the website for updates.

President's Corner

Dear Members,

RAC's meetings are 8 o'clock on the third Wednesday of each month. Attendance has not been stellar. Please consider joining us and participating. If a presentation is scheduled, it will begin at 7 o'clock and will be announced in advance. If a presentation is not scheduled, a social hour will begin at 7 o'clock so that members can chat, ask questions, exchange tips, and socialize before the meeting.

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. The invitation will specify the meeting time and if there is a presentation.

The club meetings are far more interesting when they begin with a presentation. In the past, members have given the presentations. Please consider giving a presentation on a topic that interests you or on a new piece of astronomical equipment. Perhaps some of you can dust off and update a presentation you gave years ago that many of our new members haven't seen.

There will be a Members Only picnic at Caledon State Park preceding the September 3 Star Party.

May God bless you with transparent skies and excellent seeing.

Glenn Faini
President

Did You Know? by Scott Busby

As described by Associated Press reporter Wallace B. Clausen on February 4, 1931, a "gasp of astonishment swept through the library of the Mount Wilson Observatory here today" when the Berlin professor Albert Einstein, "with a few simple words made this revelation." His original concept of the universe, as well as that of Professor Willem de Sitter, Dutch astronomer and friend, is no longer valid. The new concept of the universe—the expanding universe—hinges on the work of two great California scientists, the astronomer Dr. Edwin P. Hubble of Mount Wilson Observatory and physicist Dr. Richard Tolman of Caltech. New observations by Hubble and his associate Milton Humason concerning the redshift of light in distant nebulae make the "presumption near" that the general structure of the universe is not static. Theoretical investigations undertaken by Tolman confirm Lemaitre's findings, which fit "well into the general theory of relativity."

Source: *Edwin Hubble—Mariner of the Nebulae,* Gale E. Christianson, Farrar, Straus, and Giroux (New York), 1995.

July 30 Star Party a Success

According to Glenn Faini's follow-up report, RAC's star party at Caledon on July 30 was a surprise success. Although the humidity and dew were heavy, the cloud cover wasn't bad. A varied group of about 20 visitors dropped by, along with 5 RAC members with family members. Attendees and members brought 5 telescopes of varying sizes and capabilities. One guest who was an employee of NASA offered to help the club get speakers for future presentations. Glenn indicated that in response to questions, he would also be sending some articles to attendees who requested information on choosing a suitable telescope for their needs. So, despite the somewhat iffy weather, this was great outreach event. Our next star party is scheduled for August 6.

How Observing Supernova SN 2022ewj Led to "Discovering" Two Asteroids *(Continued from page 1)*

the distance. As luck would have it, the scope and software performed perfectly, and I was able to obtain a nice image of the galaxy. Although the supernova was not visible on the raw frames, the magic of calibrating and stacking those raw frames produced a clean image of the galaxy. Just barely visible—shining feebly at about magnitude 18.5—was SN 2022ewj! I knew I would have a pretty cool animation when blinked with the image taken in March. What I didn't know at the time was I would also "discover" two Main Asteroid Belt asteroids—(8107) 1995 BR4, and (8029) Miltthompson!

Now…if I had paid more attention to the surrounding stars in the March 29 image once I created my stacked final image used for photometry—instead of being so focused on the supernova—I might have noticed something unusual. I failed to notice that two of the "stars" in the image, which was created by stacking 29 60-second exposures (hence covering a time span of 29 minutes), were not round but had short trails (Figure 3). After taking the June 22 image, I created a nice animation showing how the supernova had faded during the time between the two observations. While it was interesting to see the supernova blink, I again failed to notice that the animation also showed two "stars" also blinking in and out of visibility—two objects in the first image taken on March 29 were not in the second image taken on June 22. I did not notice this even as I posted the animation to the Mark Slade Remote Observatory Face Book page late that same night! (Click here to watch this animation showing the supernova blinking with the asteroids.)

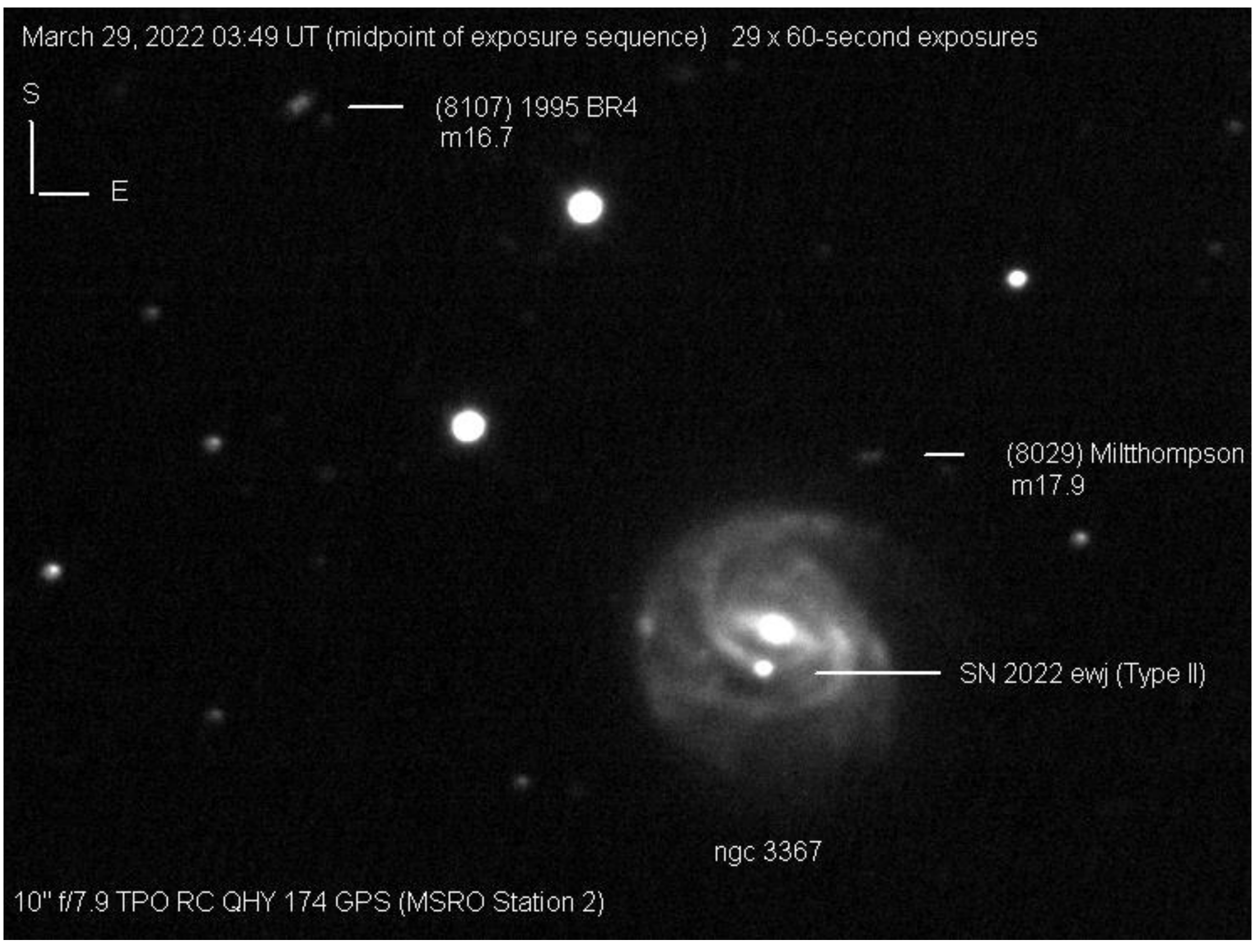


Figure 3. Annotated Supernova Image Showing Two Asteroids (Courtesy Myron Wasiuta)

It wasn't until mid-July that I looked at the images again in preparation for writing this article (which was originally going to be about the MSRO work on supernovae) and spotted the presumed asteroids in the FB animation. Going back to the original images taken on March 29, I knew that if these objects were asteroids, then I should be able to create an animation over 29 minutes that showed the motion. That would confirm that these were asteroids and not image defects. So, by stacking five images from the beginning of the March 29 session and then five images from the end of the session, I was able to blink these and was pleasantly surprised to see not one, but two asteroids jumping back and forth! (Click here to watch this animation showing motion of asteroids during the March 29 observing session.)

Now that I had "discovered" two asteroids, I needed to identify them. Although I knew that asteroids as bright as these would already be known, I was interested in knowing which ones I had imaged. The place to go when you want to identify asteroids, of course, is the Minor Planet Center (MPC). One of the tabs on the site is "Observers", and under subtab "Other Observers Services" is a tool called the MPChecker (Minor Planet Checker). If you know the date and time of your image and can estimate the RA and Dec of the suspected asteroid, you can plug these parameters into the MPChecker tool. You can then specify a search radius (I used 10 arc-minutes) to produce a list of all known asteroids within that defined radius. My search turned up two asteroids—(8107) 1995 B4, which was at magnitude 16.7, and (8029) Miltthompson, at magnitude 17.9. In the image, it was clear that one was brighter than the other. This helped me identify which was which. I also used the tool to show the relative motion in declination—and with this additional information—I was able to positively identify each asteroid with its trail on the March 29 image.

So, what can we find out about the properties of these asteroids? Again, the MPC is a resource. All that I found out about (8107) 1995 BR4 is that it is a Main Asteroid Belt asteroid with an orbital period of about 3.35 years. It was discovered January 31, 1995, by Yoshihada Shimizu and Takeshi Urata of the Nacikacura Observatory in Japan. It is only 4.5 km in diameter (about 2 miles). MPC describes it as not needing any further observations at this time.

There was more information on (8029) Miltthompson. It was named after NASA test pilot Milt Thompson (1926–1993). He was the ninth pilot to fly the X-15 and first to fly the M2-F1 and M2-F2 lifting bodies—the latter test plane was made famous by the opening sequence crash for "The Six-Million Dollar Man." This plane was used to prove that an aircraft could glide back from high altitude (and even space) and land safely without engines. It was used to test the concept of the Space Shuttle.

The asteroid itself is another Main Asteroid Belt object and was discovered on September 15, 1991, at Palomar. It orbits the Sun in 5.59 years at a distance that varies between 2.74 and 3.56 AU. There have been 2,839 observations (2,840, if you count mine) of this asteroid between November 12, 1964, and June 3, 2022. MPC also describes this one as not needing any further observations at this time. To the MPC, I guess both of my "discoveries" are not very interesting after all. However, I found this exercise interesting and learned the importance of carefully documenting the time and date of all images. After all, you never know when you might find that one of those images includes a "discovery"!

Astronomy Math—The Next Level (TNL)

By Scott Busby

Kepler's three laws formed the basis of Isaac Newton's theory of gravitation. Newton was able to show that Kepler's harmonic law, as originally stated (Equation 1), was only an approximation. To make it really exact, Newton had to account for the masses of the Sun and the planets. Equation 1 (see my October–December 2021 newsletter TNL article) would have to be written as:

$$(M+m_1)\ P_1^2/(M=m_2)\ P_2^2=D_1^3/D_2^3 \qquad \text{(Eq. 6)}$$

where, as before, P_1 and P_2 are the periods of revolution of planet-1 and planet-2; D_1 and D_2 are their respective distances; and the new symbols m_1 and m_2 are their respective masses. The symbol M represents the Sun's mass.

As it happens, the mass of the Sun is overwhelmingly greater than the mass of any of the planets. Even the largest planet, Jupiter, has only 1/1000 the mass of the Sun. Consequently, the sum of M and m_1 or of M and m_2 can be taken—without significant inaccuracy—to be equal to M itself. Equation 6, therefore, can be written as follows:

$$MP_1^2/MP_2^2=D_1^3/D_2^3 \quad \text{(Eq. 7)}$$

The M's cancel, and we have Equation 1.

Newton's correct form works out to be just about exactly that of Kepler's approximate form—so why not stick with Kepler? Because Newton's form can be applied more broadly.

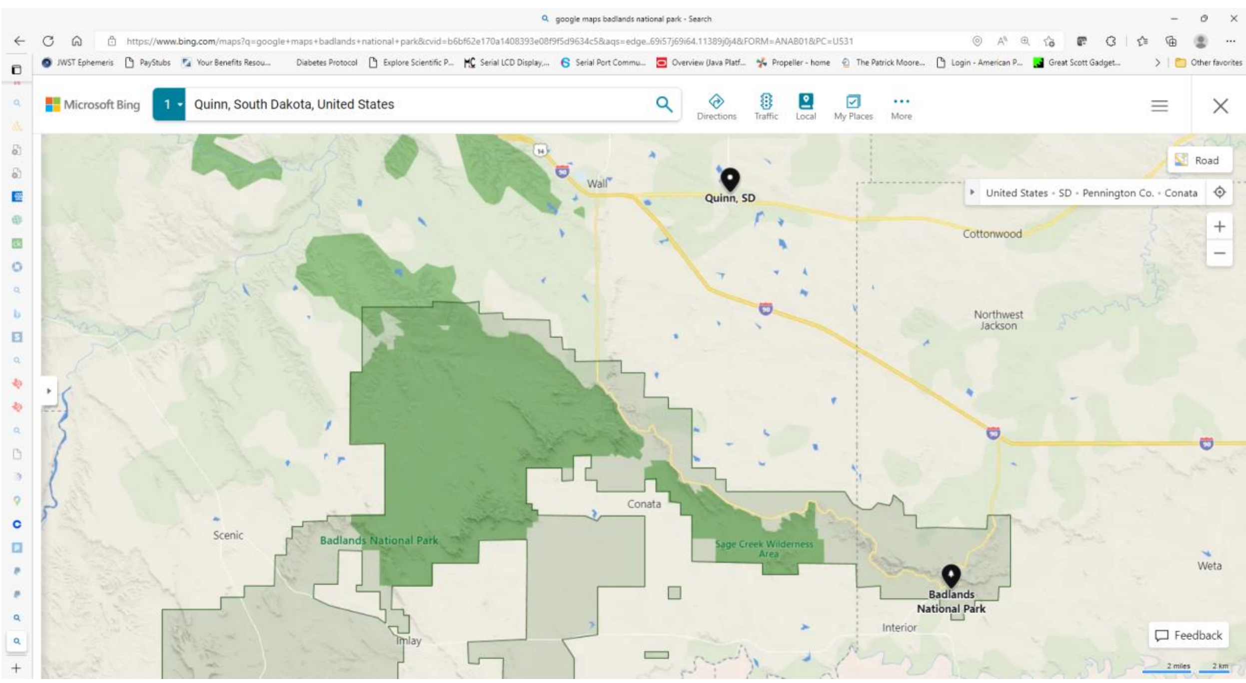
Jupiter's satellites had been discovered 9 years before Kepler announced his harmonic law. Kepler had worked out that law entirely from the planets, yet when he studied Jupiter's satellite system, he found that it applied to that, too.

Newton was able to show from his theory of gravitation that all three of Kepler's laws would apply to any system of bodies moving about some central body, and his form of the harmonic law could be applied to two or more different systems at once.

Upgrading the Badlands Observatory in Quinn, South Dakota

By Jerry Hubbell

There is a wonderful observatory in Quinn, South Dakota, called the Badlands Observatory, located on the edge of the Badlands National Park. Quinn is a very small town that was founded in 1907 and currently has a population of 63 residents.



Quinn, South Dakota near the Badlands National Park. (Microsoft Maps)

In 1999, Ron Dyvig constructed the Badlands Observatory to do asteroid astrometry and photometry. He built the observatory structure on top of an abandoned hospital facility. The homebuilt dome houses a 26-inch f5.8 Newtonian reflector. Ron built both the telescope and mount himself. The telescope achieved first-light in May 2000. During the years following its construction, Ron made significant contributions to the discovery of asteroids. He is credited with discovering 25 minor planets using his home-built telescope. Today, Ron and his partner Teresa Hofer run the observatory as a tourist destination and entertain guests on every clear night. Teresa is the official observatory photographer. Her beautiful astrophotography is here; you can also see Teresa's amazing photos of the landscape and wildlife here.

Back in January of this year, Ron contacted me (in my role as VP of Engineering for Explore Scientific, LLC) to inquire about the Explore Scientific PMC-Eight™ as a possible control system to upgrade the old original mount controller:

> "I am writing to explore the possibility of using your PMC-8 system to upgrade our telescope drive system at Badlands Observatory located in Quinn, SD USA. "

I immediately wrote back saying that yes, I could do that. This would be the first large telescope that we would retrofit the PMC-Eight™ system to, but I wasn't going to let that deter me. An additional twist in this upgrade was that it would be the first time we would put into production a PMC-Eight™ system installed on a fork mount. A major part of the upgrade involved installing much larger stepper motors than those used on the typical PMC-Eight™ mount system. This change required an external electronic drive system to support the larger motors.

Badlands Observatory 26-inch f5.6 Newtonian Telescope (Courtesy Ron Dyvig and Teresa Hofer)

I designed the system configuration to interface with the current PMC-Eight controller by bringing out the motor driver control signals to a discrete driver module. There are modules for both the Right Ascension (RA) and

Declination (DEC) axes. The configuration also uses separate power supplies to power the motors and the PMC-Eight™ controller. All the modules are housed in a standard NEMA style enclosure and mounted next to the base of the telescope mount.

Badlands Observatory PMC-Eight™ Mount Control System (courtesy Ron Dyvig and Teresa Hofer)

The design was completed in March of this year, and the system was constructed at the Explore Scientific headquarters in Springdale, Arkansas. Once the control system was constructed by Alex Sanchez of Explore Scientific, factory testing and troubleshooting were performed. In the meantime, Ron was installing the large new stepper motors onto the telescope mount and working on getting the couplers to the drive worm modified for the new motors. I am pleased to say that the initial design and configuration of the system worked the first time. Pretty amazing. The system was ready to ship out to Quinn in May.

Once the system arrived in Quinn (which was another story and took a while), Ron and Teresa installed the control system enclosure at the base of the telescope mount. The initial startup included verifying proper connectivity between the motors and the controller, making sure everything powered up correctly, and getting all the communications between the system and the computer working. Initial commissioning of the control system took 4 days. During that time, Wes McDonald and I made tweaks to the firmware and software used to run the control system. Wes is a long-time friend and customer of Explore Scientific and my partner in working on the control system firmware and software. It was a bit of a challenge getting the system commissioned, but it operates both more smoothly and more accurately than the system it replaced. I think both Ron and Teresa are pleased with its operation.

I want to thank Ron and Teresa for giving me this opportunity to upgrade their large 26-inch Newtonian mount, challenging both my engineering skills and ability to make new products. This prototype system will be the model for future upgrades to large telescopes located all over the country.

News Item: Kitt Peak Fire

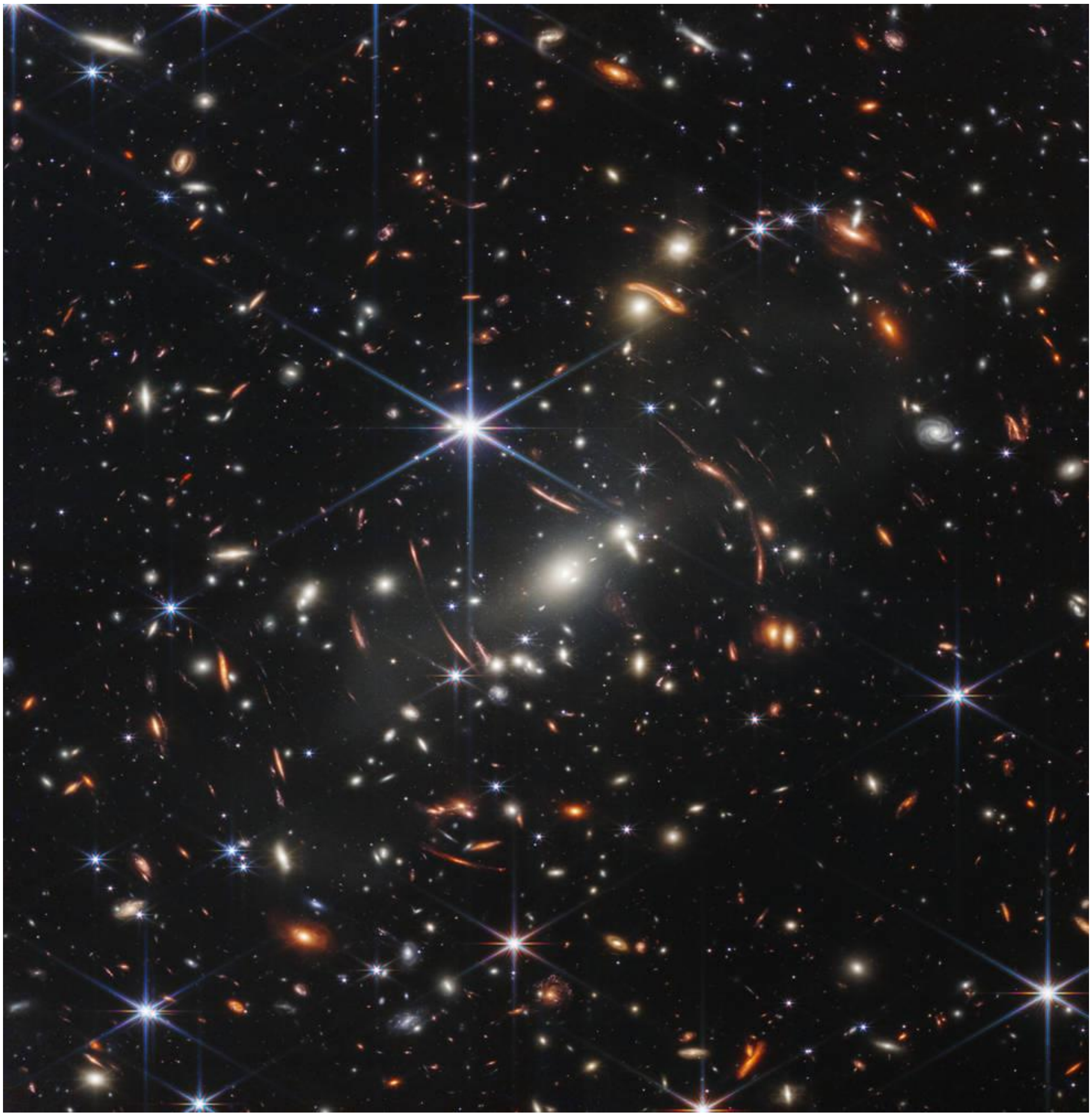
Because I have kept contact with former RAC member Ron Henke, who now lives in Tucson. I learned that a nasty forest fire was threatening Kitt Peak National Laboratory (KPNO). By June 21, four non-scientific buildings had burned to the ground, and all vegetation was gone. At a media briefing, a fire official said of the crews assigned to the observatory, “Heroic action was taken...they were able to save all the telescopes.” The fire was declared 100% contained on June 24. Ron, of course, was relieved to hear that the scientific facilities were saved but lamented the loss of the landscape. He and his wife Jane had gone there often to visit the facilities and picnic.

The latest KPNO update reads: “Update on the Contreras Fire, 21 July: We are now moving beyond the immediate safety and damage assessment at KPNO into restoring the site sufficiently to enable return of operations, and science teams. While SR 386, the access road to Kitt Peak, controlled by the AZDOT, remains closed to the public, they have allowed our essential crews use of the road to travel to the summit. Grid power has not been restored and will not be restored for several weeks.” Sounds like a very close call to some of the most valuable astronomy equipment in the world. —Editor

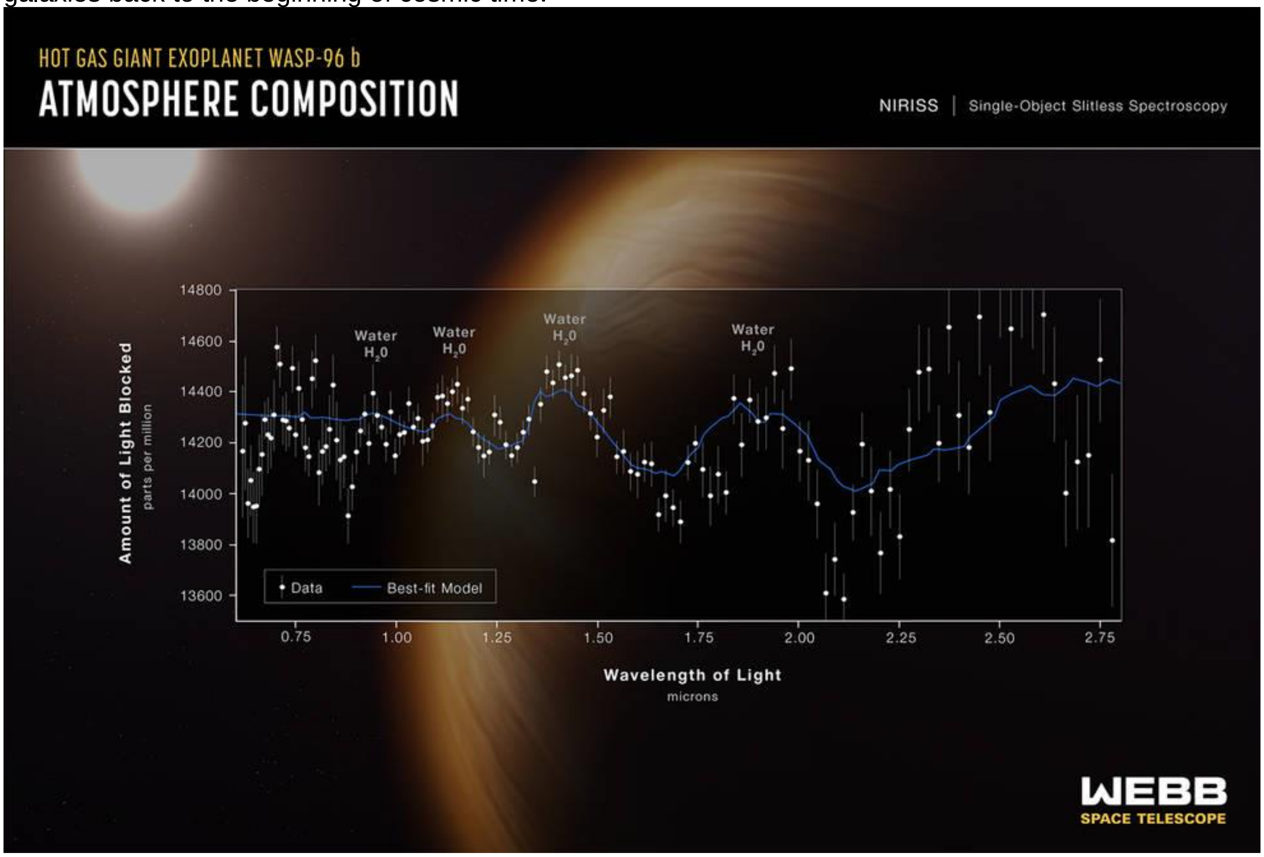
First Images From the James Webb Space Telescope (JWST)

By Linda Billard

Even if you live in a cave, you probably know that NASA released the first images taken by the JWST. As expected, they were phenomenal. These images are the results of observations selected by representatives of the primary participating organizations (NASA, ESA, CSA, and the Space Telescope Science Institute). Why these particular images? They were selected to demonstrate the capabilities of JWST's four scientific instruments. The descriptions below explain what you are looking at and their importance to the JWST mission to study every phase of the history of our Universe. (*Credit for all photos in this article: NASA, ESA, CSA, STScI.*)



SMACS 0723—The deepest and sharpest infrared image of the distant universe. From Earth, this new image, a color composite of multiple 2-hour exposures, has a tiny field of view—about the size of a grain of sand held at arm's length. This composite contains shots taken at various wavelengths and was delivered in just 12.5 *hours*. For comparison, in 1995, the Hubble Space Telescope looked at the same spot in the sky, and its composite image took 10 *days*. The combined mass of this galaxy cluster acts as a gravitational lens, magnifying more distant galaxies, including some seen when the universe was less than a billion years old. This image is just the beginning of JWST's capabilities in studying deep fields and tracing galaxies back to the beginning of cosmic time.



WASP-96b (spectrum)—Results of a detailed observation of a hot, puffy planet outside our solar system. This spectrum reveals the clear signature of water, as well as evidence of haze and clouds that previous studies of this planet did not detect. This detection of water in the atmosphere of an exoplanet is the first study in a line of research to investigate hundreds of other systems in an attempt to understand the atmospheric composition of other planets.

Southern Ring Nebula—Two images of an expanding cloud of gas surrounding a dying star, taken with two JWST cameras. This planetary nebula is about 2,500 light years away. The dimmer star at the center of this scene has been sending out rings of gas and dust for thousands of years in all directions, and JWST has revealed for the first time that this star is cloaked in dust. This demonstrates JWST's capability to explore the expelling shells of dust and gas of aging stars that may become a new star or planet.

Stephan's Quintet—This view of a compact group of galaxies, located in the constellation Pegasus, was taken through the shroud of dust surrounding the center of one galaxy, to reveal the velocity and composition of the gas near its supermassive black hole. It demonstrates how JWST allows scientists to see, in unprecedented detail, how interacting galaxies trigger star formation in each other and how the gas in these galaxies is disturbed.

Carina Nebula—A look at the "Cosmic Cliffs" in the Carina Nebula, showing the (previously hidden) earliest, rapid phases of star formation. Looking at this star-forming region in the southern constellation Carina, as well as others like it, Webb allows researchers to see newly forming stars and study the gas and dust that made them.

For additional information about these photos, visit https://www.nasa.gov/content/goddard/webb-telescope-image-galleries-from-nasa where you will find a NASA slide show with more details.

Image of the Quarter: Swan Nebula (NGC 6618)

By Corey Dallmeyer

Taken June 10, 2022

Equipment: Orion Skyquest XX16G Dobsonian telescope (1800 mm FL), H-alpha filter, Tele Vue Panoptic 35mm eyepiece, Tele Vue adapter, PVS-14 night vision (NV) device, cellphone camera

Cory said: This photo is a handheld 1-second exposure using a cheap android phone. The photo is a pretty accurate reproduction of what you see visually through the NV device. For a discussion/demonstration of the setup, the following YouTube video explains all: https://youtu.be/qbRDRyl3LZg