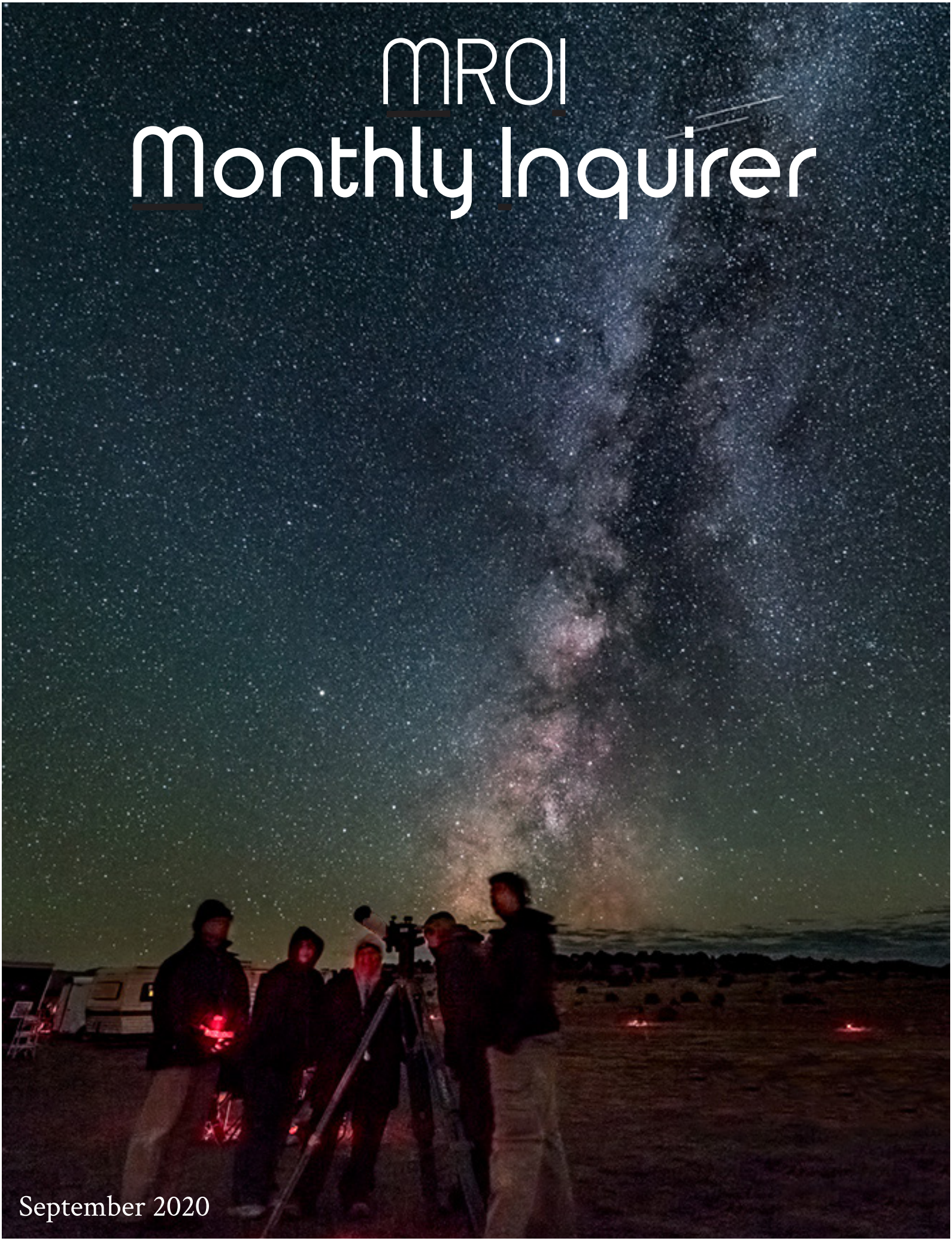
MROI Monthly Inquirer



September 2020

Stay up to date with all of MROI's monthly newsletters at http://www.mro.nmt.edu/news/newsletter/.
Click the links below to access new content being uploaded across all our platforms!

Comet Neowise taken by Shelbi Etscorn

Want to be the first to know all the news and updates coming out of the MROI with early access to our monthly e-newsletter? Want our exclusive yearly newsletter mailed straight to your door? How about a private dinner and tour at the Observatory for you and seven of your friends? Or maybe you'd just like to support the advancement of science and astronomy in your community?

Do all of this and more by joining the Friends of the MRO. Go to our website to find out more: http://www.mro.nmt.edu/support-mro/

The MROI is excited to announce the creation of the AstroDaily! A daily blog website where you can find information on happenings at the MROI, current events in the world of astronomy, tips and tricks on viewing the night sky, and much much more! Content is being added every day at http://astrodaily.mro.nmt.edu/!

Front Cover: Enchanted Skies Star Party attendees, taken at the ESSP dark sky site "Star Village" outside of Magdalena, New Mexico. M. Colleen Gino

Back Cover: Milky Way during this year's Perseid Meteor Shower in San Antonio, New Mexico. Shelbi Etscorn

Astronomy along New Mexico's Route-60 Dark-Sky Corridor

John Briggs

Comet NEOWISE, "C/2020 F3 (NEOWISE)" in its full and formal designation, was recorded in both the morning and evening Magdalena sky by resident Eric Toops. The morning shot shows the object above lights that are far to the northeast and generally not directly seen by the village. The evening image (found on next page) shows the comet framed by clouds, and a fleeting meteor trail, or "shooting star." It's interesting to contemplate how many meteors in our atmosphere are caused by small particles ejected from comets that are hardly larger than sand grains. The meteor appearing to the left of comet NEOWISE was caused by a grain ejected from an unknown comet or asteroid, most likely very long ago.

Starting near the shadow of the Magdalena Mountains and New Mexico Tech's Magdalena Ridge Observatory, Route 60 is becoming increasingly recognized across the country, and even internationally, as a special region for people interested in dark skies and a sense of astronomical community. The iconic Very Large Array radio telescope that went into operation in 1980 first drew particular attention to the area, although innovative astronomy and physics had already been long underway by New Mexico Tech on North Baldy. Today, amateur astronomers and private observatories – some of them operating as a business – are increasingly common along New Mexico's Route 60, all the way to the Arizona border. And, very appropriately, the area is being described as a "dark sky corridor." The widely traveled Mr. Yann Lehmans of Switzerland, who has visited the area twice for the annual Enchanted Skies Star Party, refers to his time here as "the best astronomical experience of his life."

The 40-inch telescope with builder Mike Zammit of StarStructure Telescopes, Iverness, Florida. The 40-inch f/3.5 primary mirror was produced by Lockwood Custom Optics of Philo, Illinois. The Magdalena Astronomical Society is currently assembling a similar 37-inch Dobsonian telescope. Unless otherwise credited, photos are by John W. Briggs.

Among the most significant recent developments is the establishment of a new observatory by James Totoritis, a frequent visitor from California. His vacation home in Pie Town is equipped with a very large roll-off-roof observatory housing a computer-controlled 40-inch f/3.5 reflecting telescope optimized for visual observing. The instrument saw "first light" on the evening of June 21, and a number of local astronomers, including members of Magdalena Astronomical Society, were present to assist and enjoy the first views.

Although large-aperture private telescopes are becoming more common, the Totoritis 40-inch is one of the largest in the country and is certainly among the most fortunate in its pristine dark-sky environment. The views on its first night of objects like Messier 51, the Whirlpool Galaxy – showing considerable detail in the spiral-arm structure of the galaxy – became unforgettable and cherished memories even for very experienced observers who were present. The telescope was built by Mike Zammit of StarStructure Telescopes in Florida, and the optical parts were by Mike Lockwood in Illinois. The observatory building was designed and built by True Blue Construction of Magdalena.

Nearby the Totoritis facility is SkyPi Online Observatory run by John Evalan. SkyPi allows celestial photographers to operate robotic telescopes to record images that, only a short time ago, were beyond the imagination of earlier astronomers. Like other "online" observatories around New Mexico, for example New Mexico Skies in Mayhill and Deep Sky West in Rowe, Evalan's business has been expanding. This seems consistent with the fact that, perhaps surprisingly, a number of astronomy vendors and suppliers are reporting very good business during the current COVID-19 crisis. It appears that interest in astronomy, and in the outdoors in general, is significantly expanding.

The large roll-off observatory was designed and built by True Blue Construction of Magdalena, New Mexico, using SteelMaster components. It was based upon the excellent example at Deep Sky West Remote Observatory in Rowe, New Mexico

Astronomy along New Mexico's Route-60 Dark-Sky Corridor cont'd.

John Briggs

Milky Way star clouds over the 40-inch telescope, recorded by Magdalena's Eric Toops.

Magdalena Astronomical Society has recently installed a 16-inch f/10 computer-controlled telescope behind a facility we call the Astronomical Lyceum on Main Street. The instrument was donated by Ephraim Gildor of Aspen, Colorado, who has since visited Magdalena to observe with his new portable 15-inch telescope. The 16-inch is an equatorially mounted Schmidt-Cassegrain design made by Meade and will be very convenient for public education. Originally equipped with a heavy tripod, the 16-inch telescope proved too large for portable use by Mr. Gildor. Magdalena Society members consequently designed a steel pillar weldment to support the instrument. It was locally fabricated and allows permanent installation with necessary adjustment for computerized pointing and tracking. As the virus situation clears, the Society looks forward to expanded education and outreach activities using the fabulous new resource.

FOAH Observatory north of Magdalena has recently expanded its volunteer program to include remote operation by students. Like the operation of SkyPi sixty miles west, the FOAH telescope is a robotic "astrograph." It was originally specified by the late Rick Thurmond, a Magdalena visitor from the Albuquerque Astronomical Society, for electronic imaging. This spring, it was used by an undergraduate class in Observational Techniques led by Professor Al Harper of University of Chicago. Following the success of this, the Summer Science Program for high school students (SSP) – an unusual program started in 1959 in California sponsored by Caltech – scheduled time at FOAH as part of its 2020 curriculum. Normally SSP operates at University of Colorado, New Mexico Tech, and other institutions, but of necessity it ran virtually this summer. As the virus situation resolves, SSP should return to its annual operation in Socorro that includes tours and lectures at the Astronomical Lyceum. The recent donation of the 16-inch telescope to Magdalena Astronomical Society was facilitated by Dr. Douglas Duncan of University of Colorado, a close associate of SSP.

Please see comet image on previous page for image caption.

In this outline we can only touch upon some of the amateur astronomy activities currently underway along Route 60. Other projects include the photography of award-winning Magdalena resident Eric Toops; photometric observations of Starlink satellites by Dr. Robert Q. Fugate; a new Magdalena Astronomical Society news forum managed by Dr. Mark Copper (who plans to build a new observatory in the area); and the increasing involvement of Dr. Mark Cornell of Mountainair, who is retired from McDonald Observatory in Texas. Retired professional optician Michael Mattei formerly of MIT Lincoln Labs, well known nationally for his telescope making, recently relocated to Magdalena from his prior home in Massachusetts. We also have the ongoing core involvement of the founding members of the Magdalena Astronomical Society who have in recent years conducted the increasingly successful Enchanted Skies Star Party. Principal among MAS members was the late Dr. Daniel A. Klinglesmith, for whom a memorial observatory at Magdalena's Kids Science Café is under construction. We carry our memories of "Dr. Dan, the Astro Man" and his long professional association with Magdalena Ridge Observatory as ongoing motivation.

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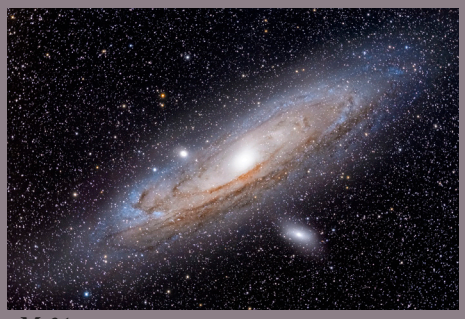
The Messier Catalogue: A Masterpiece in the Mess

Shelbi Etscorn

Pictured below (from top to bottom): the Andromeda Galaxy, the Pleiades, and the Orion Nebula. All photos were taken by Colleen Gino and Dylan Etscorn and all are objects found in the Messier Catalogue.



M 31

M 45

M 42

Have you ever searched for something in a cluttered purse or backpack and found that your hands seemed to be predisposed to grab every object except the one you're looking for? You dig and dig, and your impatience grows with every passing second. If you're like me, your frustration and agitation will eventually lead to you pulling out items one by one just to get them out of the way while you focus on finding the one thing you're looking for. For most of us, the outcome of this labor is simply the retrieval of the object in question and perhaps a sense that you might want to consider cleaning out your bag. But when French astronomer, Charles Messier, applied this same concept to his hunt for comets, he ended up creating one of the most famous lists of astronomical objects ever compiled.

During the 17th century, Messier became the first astronomer to dedicate himself wholly to searching the night sky for comets. It proved to be a pursuit he was very adept at, earning him the title of the Comet Ferret by King Louis XV.

While scanning the sky searching for new apparitions, Messier came across the Crab Nebula, a supernova remnant in the constellation Taurus. His excitement at finding what he initially mistook as a comet, quickly turned to frustration when he realized his error. To avoid being hoodwinked again, Messier jotted down the location of the object. He was effectively pulling the Crab Nebula out of the night sky and setting it to the side so it would not disturb his quest, much like the clutter pulled out of the bag.

It wasn't until Messier added his third entry to his list of objects to disregard, that he began to actively search for these objects in the same way he had previously searched for comets. What he once saw as a mess was quickly becoming his masterpiece.

By 1771, Messier had compiled a list of 45 objects that had been discovered by himself and by his contemporaries. This initial catalogue was published in 1774 in the journal of the French Academy of Sciences.

By 1780, the catalogue had grown to include 80 objects.

By 1781, Messier published his final version which held 103 celestial objects.

The Messier catalogue as it is known today contains 110 objects. After his death, astronomers were guided by Messier's notes to find the final seven contributions to the catalogue, the most recent of which wasn't added until 1967. Among the catalogue can be found examples of all five types of deep-sky objects: diffuse nebulae, planetary nebulae, open clusters, globular clusters, and galaxies.

While Messier's catalogue only includes objects visible from the European latitudes (being the objects which Messier could observe), it is still an extremely popular list for amateur astronomers and researchers alike owing to the fact that all of these objects are among the brightest, nearest, and most easily found objects in the sky. Messier was able to find them all using a 4-inch refracting telescope. Today, even basic telescopes available to amateur sky enthusiasts are capable of observing these objects with great detail.

Because of this, they have become some of the most popular objects observed during star parties, shot by astrophotographers, and researched by scientists. Even if you know very little about astronomy, chances are you've heard of at least one of these objects: The Andromeda Galaxy, the Orion Nebula, the Pleiades, and the Whirlpool Galaxy just to name a few. All of the heavy hitters of the astronomical world make the list. It reads like the who's who of astronomical objects.

The next time you look up at the night sky, take a look at Messier's catalogue and see if you can't find a few. You'll inevitably find yourself looking at some of the most beautiful objects in the night sky. The story of Messier and his catalogue is an excellent reminder to not become so focused on the task at hand that you are unable to see what beauty may lie in the road bumps along the way. You never know when the pebble in your shoe might prove to be gold. Unfortunately, at the time of writing this, the clutter found in the mayhem of my purse remains: clutter.

Instrumentation Station:
Focus on Delay Lines
Chris Haniff, MROI System Architect

In June's MROI Enquirer, MROI Project Scientist, Michelle Creech-Eakman, described the role of the MROI delay lines. This month we focus on a few of their special features.

As Michelle explained, the delay lines' task is to make sure the light from each of the MROI's unit telescopes has travelled exactly the same distance before it's combined with all the other telescopes' beams and recorded. To make this happen the distance each light beam travels is adjusted continuously as the telescopes track their target, and as in all interferometers like the MROI, this is done using a so-called "optical trombone" (Fig. 1).

The core of such a trombone comprises three key elements. First, an optical part – the "cat's eye" – that takes the light and reflects it back in the same direction it's come from. Second, the part that changes the location of the cat's eye. This means both a moveable "carriage" and a track for it to run on. And thirdly, a ranging system to tell the user where the cat's eye is, so that we know how far each light beam has actually travelled. At the MROI, the 15kg cat's eye and its 65kg carriage are known as a "trolley" and this moves inside a long vacuum pipe, the inside surface of which acts as the track (Fig. 2). The ranging device lives in the Beam Combining laboratory and is an off-the-shelf laser metrology system, similar in function to the total stations used in surveying and construction, but able to measure distances ten thousand times more accurately. It shoots a beam of light towards the cat's eye (parallel to the starlight beam) and by basically timing how long it takes to come back, computes how far away it is.

The decision to use the inside of the vacuum pipes as the delay line tracks was an ambitious one for the MROI, because the track, in principle, needs to be flat to about 250 microns over 200 metres at the MROI. Fortunately, by adjusting the tip and tilt of the cat's eye secondary mirror while the trolley moves, much looser tolerances on the flatness of the track are allowed. So, we were able to use low-cost extruded vacuum pipe sections and install them with much less effort than might have been expected.

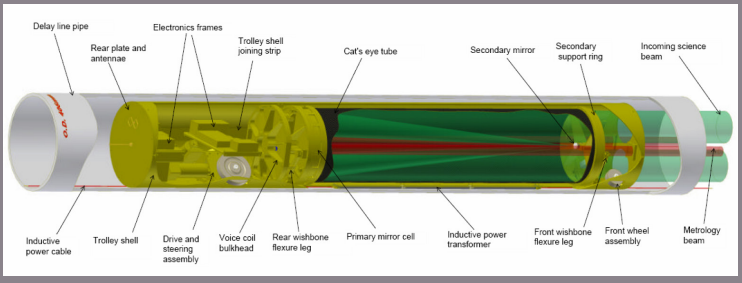


Fig. 2: A cartoon identifying the main elements of an MROI delay line trolley inside its vacuum pipe. Incoming starlight (green) and laser metrology (red) beams enter from the right and are returned in that direction by the cat's eye. The electronics, drive, and communication payloads are mounted to the left of the parabolic primary mirror (at center). The trolley is 2.3m long, has an outside diameter of 0.35m and a mass of 80kg.

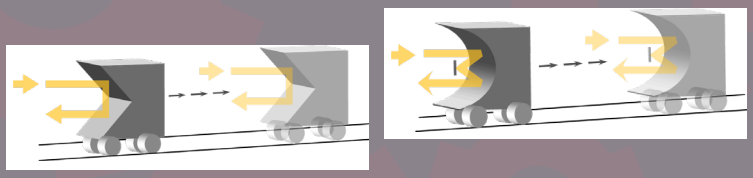


Fig. 1: Two cartoon examples of an optical trombone. In each case the light from the associated telescope enters from the left and is reflected back, in exactly the same direction but displaced in height. If the tracks are not flat, the height of the returned beam changes, and this can cause major problems. The MROI delay lines use the right-hand design where a large parabolic mirror reflects the incoming light onto a small flat secondary mirror, which then sends it back to the parabola a second time to be sent off towards the science instruments.

.Another interesting feature of the MROI trolleys, is that each cat's eye assembly is only loosely attached to its motorised carriage. Instead, the carbon fibre tube that holds the cat's eye optics is supported on "floppy" flexures in an "inverted pendulum" arrangement. This isolates the cat's eye from disturbances caused by bumps in the track but needs a system to make sure the cat's eye doesn't wobble back and forth as the carriage moves. To manage this we sense where the rear of the parabolic mirror cell is, and push and pull it so that it always remains in the same position relative to the carriage. Non-contact magnetic devices are used to both sense the position of the mirror cell and apply the necessary forces on it, so the cat's eye appears to be held "magically" in place once the trolley is energised and the carriage moves back and forth inside the vacuum pipe.

Although the delay line trolleys move only fractions of a centimetre a second when we are observing astronomical sources, when moving between targets the trolleys may have to be repositioned by many tens of meters. In these cases, we can drive them at up to 0.7m/s which is quite exciting to see and hear given their mass is 80kg! To stop the trolleys spiralling inside the vacuum pipes as they move – like shells in a cannon barrel – a sensor measures any rotation and a servo-system uses one of the four carriage wheels to steer them appropriately. And even when slewing at high speed, the exact position of each cat's eye is measured to about 5nm – that's 10,000 times less than the width of a human hair. When tracking stellar targets the light paths from each telescope are usually matched to about 20nm because of irregularities in the pipe surfaces, wheels, and motor drives in each trolley. So, the next time you try and thread a needle, you might want to ask yourself, could you move the thread as smoothly through the eye of the needle as we move our delay lines?

Spargo's Sky Report

September Skies

Jupiter and Saturn spend most of September high in the southern sky being visible just after sunset. At the beginning of this month they will be only 8 degrees apart. You can verify this by making a fist and holding it at arm's length. Your fist will cover an angle of about 10 degrees and the separation between the two planets should be slightly less than the width of your fist.

As the month progresses, the separation between the two will shrink slightly as the two planets begin to narrow the gap separating them as they head for a very close encounter in December. Both planets are well placed in the evening sky for hunting surface features and moons with binoculars and small telescopes. Saturn's rings are still wide open at 23 degrees from the horizontal.

Mars becomes even more imposing rising two hours after sunset at the beginning of September and less than one hour after sunset at month's end. While doing so, its apparent brightness improves from magnitude -1.8 to -2.5, causing it to appear slightly brighter than Jupiter. This will be the time to break out your telescopes and go hunting for surface features. The southern polar ice cap should be visible.

Venus now rises about 3.5 hours before sunrise and achieves a position of about 40 degrees above the eastern horizon. Check it out with your fist as described above. At magnitude -4.1, brilliant Venus reveals almost 72% of its cloud-covered surface.

The Moon will be full on the 2nd, last quarter on the 10th, new on the 17th, and first quarter on the 24th. Looking east on the night of September 5th, around 11 p.m., the Moon will pass within ½ degree of the red planet Mars. Looking east on the morning of the 14th, about an hour before sunrise, the crescent Moon will be below and to the left of brilliant Venus. On the evenings of the 24th and 25th, about 45 minutes after sunset, look south to see the Moon visit first Jupiter and then Saturn.

On the 22nd we can be thankful that summer is over as the autumnal equinox brings us the first day of fall for the northern hemisphere at 7:31 a.m. MDT.

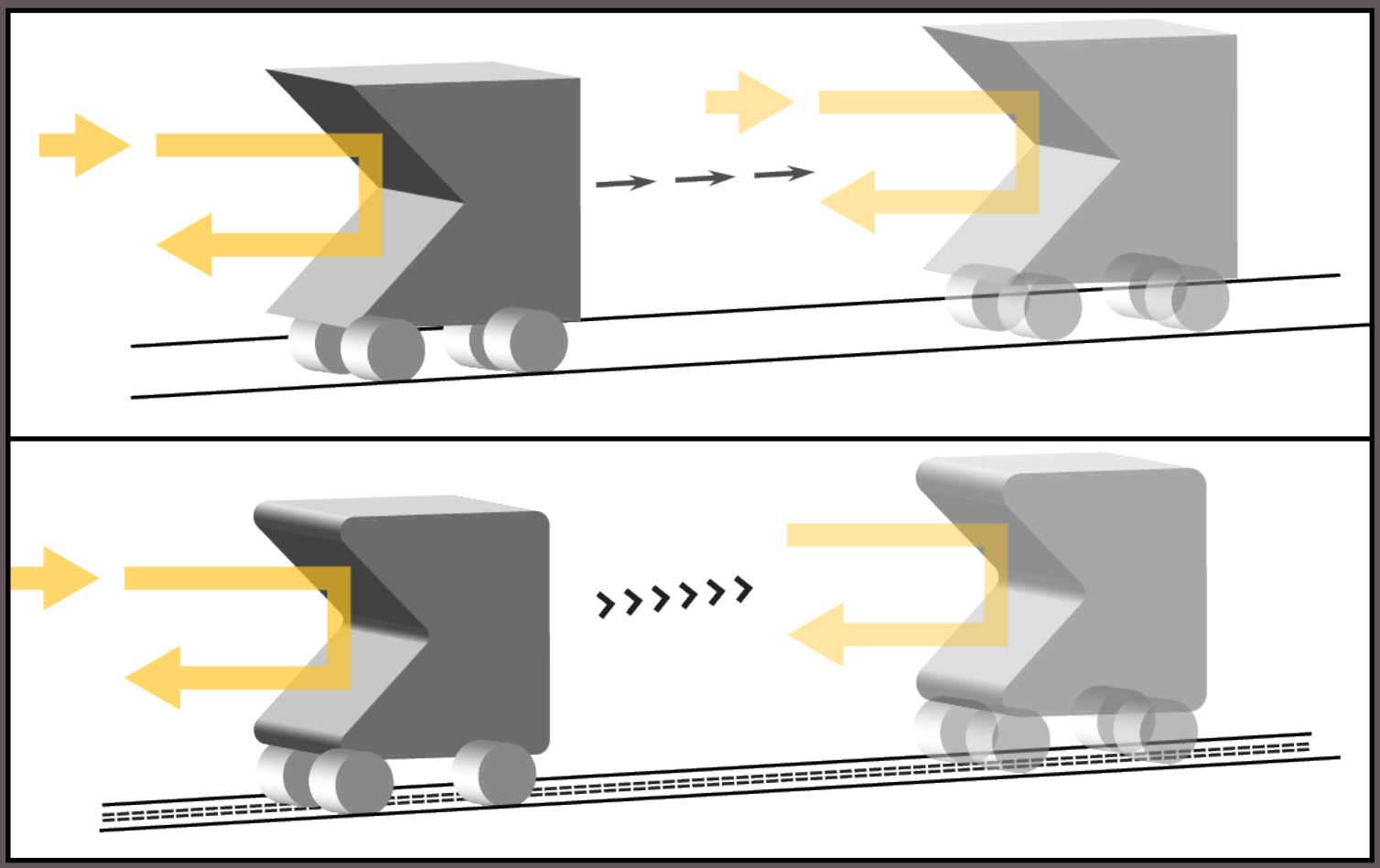
Due to the closure of New Mexico Tech because of COVID-19 virus concerns, there WILL NOT be a first Saturday of the month star party at the Etscorn Campus Observatory.

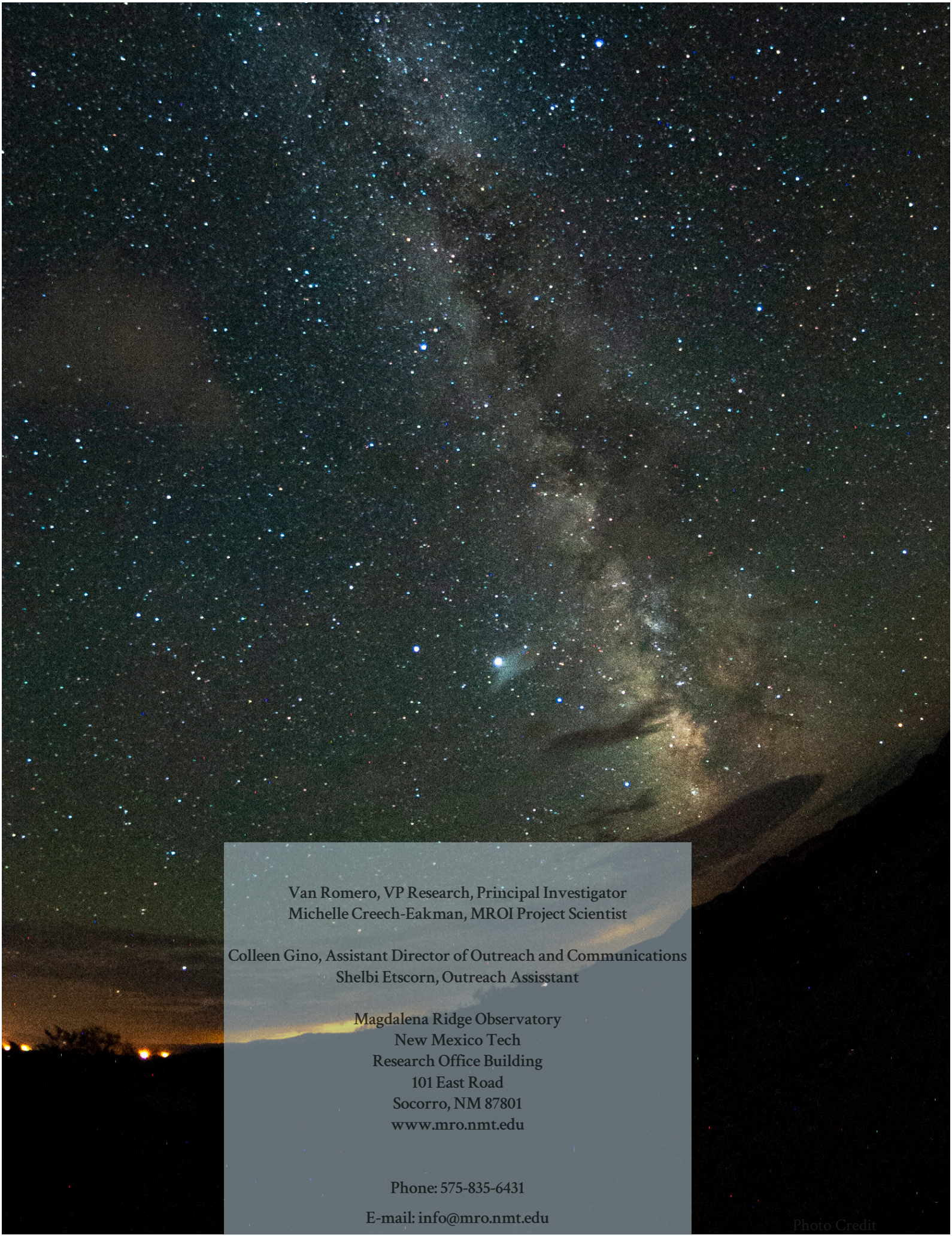
Stay safe and Clear Skies!

Jon Spargo
New Mexico Tech Astronomy Club
September 2020

Spot the Differences

If you would like a chance to win a MROI prize, figure out the five differences between the two images below, and send them along with your name and address to info@mroi.nmt.edu with the subject Spot the Differences. Good luck!





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