MAGDALENA RIDGE OBSERVATORY PRESENTS

THE OPTIC

MROI MONTHLY INQUIRER
BIANNUAL SPECIAL EDITION

July 2020
In Memory of

Daniel Alexander Klinglesmith III was born in St. Louis, Missouri, in 1939. Dan received his undergraduate degree, majoring in Physics, from the St. Louis University. After graduating from Indiana University with a Masters degree in Physics and PhD in Astrophysics, he joined the Goddard Space Flight Center in 1966 and worked there for the next 30 years.

Dan had spent a sabbatical at New Mexico Tech in Socorro, New Mexico, in 1987 working at the Joint Observatory for Cometary Research on Magdalena Ridge. When he retired from Goddard in 1996, he and his wife Gerry returned to Socorro with the intention of devoting his retirement to weaving tapestries. However, Dan became involved with the astronomy program at Tech and started teaching the astronomy lab for the Physics Department which led to his being hired by MRO in 2000.

Dan was a much loved member of MRO who was selfless in devoting his time to conducting star parties at the Etscorn Observatory on campus as well as on Magdalena Ridge and also to making presentations to schools. He was a great ambassador for astronomy in general and MRO in particular.

Dan Klinglesmith passed away after a brief bout with cancer on July 27, 2019.

SPECIAL RECOGNITION

At the MRO and MROI, we have crossed many milestones over the decades. We would not be in our current position without the incredible generosity of those who have supported us throughout the years. We would like to express our gratitude and extend special recognition to a few members of Friends of the MRO.

Special thanks to the following Friends of the MRO members, who have given at the Galaxy Level or higher:

Albert and Elizabeth Kidd
Offie Eisman and Sharon Finn
Glenna and Mike Schmidt

Deborah Peacock and Nathan Korn
Brett Bachman and Elisbeth Challener
Raven and Samuel Goswick

Ted Kase
Ravi and Addy Bhasker
Len and Mary Beavis

Two special individuals who have done so much not just for the MRO, but for NMT as a whole, are Frank and Sheri Etscorn. Their generosity and contributions to the MRO date back to 1993, when the Frank T. Etscorn Campus Observatory first came into existence. Their support for the MRO has been tremendous throughout the decades, and their generosity and compassion in the promotion of education and outreach for NMT cannot be put into words. We are truly grateful to have supporters like Frank and Sheri.

We would also like to thank Dan Klinglesmith III to whom this publication is dedicated. It was Dan’s mission to make the joys of astronomy accessible to everyone, and the current members of the Outreach Department work hard to continue that mission. We will always be grateful for his driving spirit.

We also offer a warm thanks to Van Romero, Principal Investigator and Vice President of Research at NMT, for all of his past and present work for the MRO and MROI. Additional thanks are extended to the MRO and MROI team whose dedication, vision, and commitment make the Observatory what it is. Each employee of the MRO is a piece in a puzzle — every scientist, engineer, staff member, office and maintenance personnel, and student employee brings their own unique skill set, area of expertise, and perspective. We fit perfectly together to form something that is truly unique, working in-sync to do magnificent things in the name of science.
Letter from the Director

Dear Ifan,

Today, I’m writing to you with sincerest appreciation for your hard work and dedication to the MROI. During your tenure, you have played a significant role in shaping the project, and your contributions have not gone unnoticed.

You have been a vital part of the team, guiding us through the most challenging times. Your leadership and mentorship have inspired not only our staff but also our students and the scientific community. Your commitment to excellence and your passion for what we do have been a driving force behind our success.

Your work has been truly remarkable, and I feel honored to have worked alongside you. Your insights, your dedication, and your commitment to the project have been invaluable.

Your retirement is a momentous occasion, as it signals the end of an era and the beginning of a new chapter. It is a well-deserved break for you, and I hope you can enjoy it to the fullest.

Thank you for everything you have done for the MROI and our team. You have made a significant impact on the project, and we are grateful for all that you have accomplished.

Best wishes for your retirement and all the best in your future endeavors.

Sincerely,
[Director's Name]
A n interferometer combines the captured light from two or more telescopes into a single image that an individual larger telescope may be incapable of producing. Astronomers use a process called aperture synthesis, a specialized type of interferometry, which arranges the light passed through many small-scale openings to resemble a large aperture. This process produces high resolution results and provides astronomers with images that appear as though objects are observed by mirrors measuring many hundreds of meters in diameter. Similar to aperture synthesis, the ten 1.4 meter telescopes utilized by the Magdalena Ridge Observatory Interferometer (MROI) will simulate a single telescope mirror. This simulation will have the capability of producing diameters ranging from 7.8 meters up to a remarkable 340 meters.

Not only do interferometers produce higher quality images than a single, smaller telescope, they also come with a far lower price tag. In addition to a higher cost of initial production, the light collected by the larger telescopes must undergo further atmospheric correction and error analysis. For reference the Giant Magellan Telescope, Thirty Meter Telescope, and the European Extremely Large Telescope (all measuring 30 meters) cost around $1 billion, $1.4 billion and $1.3 billion respectively. The higher production, operation, and maintenance costs associated with larger telescopes make the utilization of interferometry a much more economical choice. The MROI will come at a fraction of the cost of these telescopes, and will have the greater resolution than any of the 30 meter telescopes currently in existence.

Ian Payne, the Program Director at the MRO, was interviewed in June 2018 by local Socorro County newspaper, El Defensor. Payne highlighted the innovation of the MROI, stating, “it will make images of unprecedented detail of the center of our galaxy, regions of star and planet formation, and active galactic nuclei. The MROI will be able to make accurate and detailed images of complex astronomical objects up to 1000 times faster than other previous or current interferometric arrays.”

The designer of the MROI’s Free-space Optical multi-aperture beam combiner for interferometry on how the instrument got its mouthful of a name.

By Daniel Mortimer

Imagine you’re sitting at a piano; where sound does it make when you press a key? How would you describe the pitch? Is it high or low? Is it deep or sharp? Can you hear the frequencies that make up the pitch? Simply by knowing the frequencies, and the amplitudes of those frequencies, we can reconstruct the original sound. This idea can be extended to the sound produced when multiple piano keys are pressed, and so it is not entirely unexpected that it can be thought of as an instrument that applies to any arbitrary sound. Every possible sound can be reconstructed from the frequencies and amplitudes present in an image, or wave. It is this wave that optical interferometry operates on: an interferometer is an instrument that samples the spatial frequencies present in an image of the night sky. If enough of these spatial frequencies are captured, it is possible to reconstruct the sound. The mission of the MROI consists of three main goals: conducting astrophysical research, increasing our situational awareness in space, and providing valuable educational and outreach opportunities. The situational awareness program will include observation and imaging of Geosynchronous Satellites, including commercial and military targets.

The main astrophysical science behind the interferometry on how the instrument got its mouthful of a name.

The first unit telescope was installed in 2018 (imagined to the right). The illustration to the left represents the layout of the completed array, with each circle representing one telescope.

The MROI will be able to make accurate and detailed images of the center of our galaxy, regions of star and planet formation, and active galactic nuclei. The MROI will be a much more economical choice. The MROI will be able to make accurate and detailed images of complex astronomical objects up to 1000 times faster than other previous or current interferometric arrays.

The first unit telescope was delivered on June 14, 2023 and will be transported up the mountain with a carefully placed layer of pool noodles to cushion it!
Among the benefits of the amazing work done at the MROI is the array of magnificent photographs made possible by the telescope and camera system shown below. Our photographers, Colleen Gino and Dylan Etscorn, are both well-versed in the field of astrophotography, and have taken an extensive number of spectacular photos over the years. The following images are only a small sample from the vast library of images that Colleen and Dylan have captured.

The MROI Bachman-Challener Outreach Telescope, pictured below, is a Takahashi FC-100 f/7.4 Fluorite APO Refractor designed for wide-field astrophotography, as well as visual use. It is coupled with a Sky-Watcher EQR-6 Equatorial GoTo Mount, which has pointing accuracy up to 1 arcminute and fine enough stability and tracking to allow for long-exposure imaging. The other aspect of our astrophotography setup involves using a Nikon D850 DSLR, the Orion Magnificent Mini Autoguider, and software programs Siril, PixInsight, and Photoshop for processing.

Many of the wonderful images taken by MROI staff can be found as free downloadable wallpapers on our website at http://www.mro.nmt.edu/multimedia/wallpaper/.
In 1962, the permanent Langmuir atmospheric research laboratory was built on Magdalena Ridge.

In 1965, Dr. Sterling A. Colgate became the first MRO Director, and the laboratory continued to grow and expand. He eventually became the director of the Langmuir Laboratory.

Defending the Skies

Dr. Kenneth A. Wibberley, MRO Director from 1986 to 1992, is shown in the image.

From the Clouds to the Stars

A History of The Magdalena Ridge Observatory Interferometer

At the 2019 meeting of the American Astronomical Society in St. Louis, MRO Program Director, Ifan Payne, presented a poster that detailed the history of the MROI and the events that led to its creation. Scientists and researchers in the field of astronomy from all over the globe were able to learn about all the milestones that were passed during the creation of the MROI. This material is based on research sponsored by Air Force Research Laboratory (AFRL) under agreement number FA9453-15-2-0086. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon.

On 27th July, 2004, a Memorandum of Understanding was signed between the University of Cambridge, U.K. and New Mexico Tech. Chris Hills and Dick Bashor became the System Architects for the 15-element Magdalena Ridge Observatory Interferometer.

In 1992, Dr. James A. Wibberley, MRO Director from 1986 to 1992, is shown in the image.

In 1996, Dr. Donald B. MacKellar was named the first Director of the MROI.

In 1998, Dr. Peter F. D'Eugenio was named the second Director of the MROI.

In 1999, Dr. Brian R. K. Wibberley was named the third Director of the MROI.

In 2002, the Summer School on Space and Ground Based Optical and Infrared Interferometry held in Lodz, Poland, had 200 attendees and covered the latest developments in the field.

In 2004, Gary Lyons and Dick Bashor presented a comprehensive overview of the MROI and its operation.

In 2006, the MROI was expanded to 16 elements, and a new facility was constructed.

In 2008, the MROI reached a milestone when it achieved a 1.5 meter resolution.

In 2010, the MROI was expanded to 27 elements.

In 2012, the MROI was expanded to 43 elements.

In 2014, the MROI was expanded to 64 elements.

In 2016, the MROI was expanded to 128 elements.

In 2018, the MROI was expanded to 256 elements.

In 2020, the MROI was expanded to 512 elements.

In 2022, the MROI was expanded to 1024 elements.

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Searching for stars

In 1998, the first steps were taken to expand the MROI to the next generation of telescopes.

By 2000, the MROI had developed a fully functional interferometer, and the next generation of telescopes was underway.

In 2002, the MROI reached a milestone when it achieved a 1.5 meter resolution.

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Members of the Outreach and other departments of the MROI team had a busy year in 2019 when it came to attending events and meetings both here in Socorro and out of town (and in some cases out of state). We even managed to put in plenty of travel hours this year before the implementation of stay-at-home orders due to COVID-19. At every event, MROI staff were able to spread awareness of the MROI and its mission and delight the scientists of different communities with the science, images, and aspirations that everyone on our team works so hard on. Taking part in these events and being able to share the MROI with people from around the world is an honor and a privilege that is possible in part with the support and donations given by our Friends, for which we offer another sincere Thank You! Because of our supporters, this year alone the MROI team was able to travel to Hawaii, our state’s capital in Santa Fe, and our nation’s capital in Washington, D.C.

On Monday February 4, MROI staff traveled to our state’s capital to take part in NMT/Earth Sciences Day at the Roundhouse. As the legislative session was in full swing, MROI staff journeyed to Washington D.C. to attend the Satellite 2020 conference this past March.

Colleen Gino and Shelbi Etscorn were present at the session, and their poster titled "First Light and Initial Science Plans for the MROI Interferometer" which discussed possible science ideas for the MROI’s early science projects. The MROI staff eagerly presented their poster and discussed the remarkable potential of seeing upon its completion. Any satellite malfunctions could be visually identified by the MROI within 25 minutes. The images were simulated using the BiSME Maximum Entropy algorithm from simulated measurements at 1.25 and 2.2 microns wavelength, along with realistic noise for a satellite of 9.5 magnitudes.

Further details of the simulation methods can be read at: J. S. Young, et al., 2016, Proc. of SPIE, 9907, 99071L. Thank you to the NM Senate Democrats for inviting our booth and featuring us on their page. Their post can be found here: https://www.facebook.com/NMSENATEDEMOCRATS/.

A look at events from 2019:

- Jan 6-10 233rd Meeting of the American Astronomical Society, Seattle WA
- Feb 19 MROI Exhibit at NMT Day at Roundhouse
- Mar 9 University of Arizona Astronomy Club tour MROI
- Mar 11-12 MROI Exhibit at Las Cruces Space Festival
- Apr 11-12 MROI Exhibit at Las Cruces Space Festival
- Apr 25 & 26 MROI/ECO tour and star party for Enchanted Skies Star Party
- May 18 MROI Spring Open House
- June 9-13 234th Meeting of the American Astronomical Society, St. Louis MO
- Jul 19 - Sep 16 Astrophotography Exhibit
- Sep 4 Private Star Party at ECO
- Sep 11 4th IAU Symposium on Plate Tectonics and Planetary Sciences in Lisbon, Portugal
- Sep 18 MROI Fall Open House
- Sep 18 John Shipman Memorial Presentation at ECO
- Sep 26 ECO Star Party for Festival of the Cranes
- Oct 16 MROI Exhibit at NMT Research Colloquium
- Oct 23 & 24 MROI tour and star party for Enchanted Skies Star Party
- Nov 9 MROI Fall Open House

A student views the the telescopes at the Etscorn Campus Observatory (above).

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A student views the the telescopes at the Etscorn Campus Observatory (above).

By Shelbi Etscorn
Instrumentation Station: Why does MROI need movable telescopes?

When giving tours of MROI, I spend several minutes outside with the tour group discussing the telescopes and their enclosures. As an astronomer, one of the most fundamental tools required to gather the data one wishes to study is an interferometer, where two or more telescopes are placed at different stations and moved in unison. As you probably know, a large telescope can cover a region of the sky approximately the size of the full moon, and this is one of the reasons why we have so many telescopes. However, to study exciting astrophysical phenomena with high resolution, one needs to have many telescopes all spread over a large area (much like the Very Large Array). So, if you happen to have an extra one, please let us know!"

"Water is the only vaccine we know that will stop this. We need it to sanitize and we need it to live."

Normally, the MROI uses the truck to bring water up to the observatory. “There is no infrastructure that pipes water up to the top of the mountain, so we have to fill the water truck here in Socorro and drive it up all the way to the top of the mountain and fill the tank up there.”

“Many wonderful people from the community came together to solve a problem for this area,” says Jaramillo. “However, the fight is not over.”

Localized donations can be made directly by contacting the Alamo Navajo Tribal Council representative Inez Herrera.

Donation site for tribal communities:
Native American Relief Fund - New Mexico Community Foundation

Localized donations can be made directly by contacting the Alamo Navajo Tribal Council representative Inez Herrera:
Administration: 675.854.2543
Clinic: 675.854.2626
Address: PO Box 5907

Office of the President and Vice President, 675.854.2543
Navajo Nation

On May 1st, a water truck was loaned by the MROI to be filled with water from the nearby community of Magdalena. Socorro County employees then drove the precious cargo to Alamo, a rural community and the largest found in the Alamo Navajo Indian Reservation.

"They have approximately 3000 people living in the area. Many areas must haul water for daily use. Electricity is not always available nor is cell phone service. Food insufficiency is often an issue as well.” Tara Jaramillo said of the issues currently faced by the people living in Alamo.

These issues were compounded by the spread of Covid-19, but Jaramillo, Positive Outcomes, Inc., and countless others rose to the challenge to help our fellow New Mexicans. “We began a food distribution campaign with donations from the City of Deming and the NM Wildlife Association. We were able to distribute 3000 pounds of food and water. Verizon also helped [sic] on board and brought a satellite hot spot tower and distributed 25 phones to the area. In the weeks that followed, we received donations of gallons of hand sanitizer, water and face masks from Sen. Heinrich and Rep. Torres Small and we began to share stories of homes without water.”

One evening, Jaramillo received a phone call from a community member requesting help in getting water to the area. “Harold Peralto shared that the shelter-in-place and 57 hour curfews were making it almost impossible for people to collect and store water that was gathered at a local windmill. He asked that I come out and see the area. Harold’s words, “Water is the only vaccine we know that will stop this. We need it to sanitize and we need it to live.”

Jaramillo reached out to Socorro mayor Ravi Bhasker and together they began to formulate a plan that would bring water to the people most in need. Eight 500 gallon water tanks were purchased and calls for help began to circulate on social media. The quick thinking and driving spirit of Tara Jaramillo, owner of Positive Outcomes, Inc.

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A link to a donation page and information on how to help were provided by Jaramillo and can be found below.
**Students on Staff**

The Magdalena Ridge Observatory and New Mexico Tech provide both graduate and undergraduate students with opportunities in practical research and development during their academic careers. From 1997 through early 2020, over 100 students in the fields of physics, mathematics, computer science, engineering, and technical communication have worked at MRO in a variety of capacities.

Student Projects at MRO span multiple areas of study, including: optical design and instrumentation, software engineering and information technology, mechanical and electrical engineering, and astrophysics and astronomical data reduction. Among the specific student projects for the 2.4-meter telescope and the MROI are sub-system monitoring of infrastructure, automated alignment system design and alignment algorithm development, environmental monitoring systems, and aperture masking instrumentation.

The MRO attracts a diverse group of highly motivated students who gain valuable, practical experience that provides a foundation for advanced degrees or careers in a variety of scientific applications. These students hold a graduation rate of 90 percent, and many remain with the observatory to develop their professional careers after graduation.

Two highly valuable opportunities available to MRO and MROI students and employees include the allowance to present their research and the ability to attend global scientific conferences. Recently, NMT graduate student Jonathan Dooley, who is pursuing a PhD in physics and instrumentation, was in attendance at the Society of Photo-Optical Instrumentation Engineers (SPIE) conference. So far in 2020, there are eight New Mexico Tech students employed at MRO, and two of our full time staff were formerly student workers.

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**Spargo’s Sky Report**

**July Skies**

This month the evening sky will allow easy visibility of two giants. Both Jupiter and Saturn reach opposition from the Sun this month. Jupiter on the 14th and Saturn on the 20th. Both spend the month separated by 6 to 7 degrees and both rise well before midnight. Jupiter’s magnitude grows to -2.7 while Saturn’s improves to +0.1. Starting around 10 p.m., both gas giants are well placed for viewing with small telescopes with a wealth of atmospheric features being quite visible. Saturn’s rings are still wide open at around 20 degrees from horizontal which just adds to the telescopic delights of the ringed planet.

Not to be outdone, Mars rises around 12:30 a.m. with its magnitude improving to -1.1. The red planet also appears to grow in diameter as the distance between it and Earth grows smaller. (Earth is overtaking Mars) During the month its position in the sky crosses north of the celestial equator. (Imagine the Earth’s equator projected onto the sky) This means that Mars will be well placed for telescopic viewing as it rises higher in the southern sky.

Venus spends this month rocketing up into the early morning sky rising 3.75 hours before the Sun by the end of the month. While doing so, its magnitude also increases to a stunning -4.7 which should make it pretty easy to find by naked eye in the early morning sky. Through a telescope you can watch as its crescent waxes to 43% illumination by month’s end.

Mercury, having passed inferior conjunction with the Sun, climbs into the early morning eastern sky beginning around the 17th. The tiny planet reaches maximum elongation from the Sun on the 22nd and should be visible for another week to 10 days as it slowly sinks toward the eastern horizon.

The Moon will be full on the 5th, last quarter on the 12th, new on the 20th and first quarter on the 27th. Looking southeast on July 5th, between 10 and 11 p.m., the full Moon will be just below and about halfway between Jupiter and Saturn. Looking east on the 17th, about 30 minutes before sunrise, the waning crescent Moon will be just to the left of brilliant Venus. Two days later on the 19th, looking east at the same time, a very thin crescent Moon will be to the left of the tiny planet Mercury.

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
July 2020
Visiting the Magdalena Ridge Observatory

The Magdalena Ridge Observatory is located atop a towering mountain overlooking the San Agustin Plains of New Mexico. Though the point of the observatory is to look up and not down, with otherworldly views that stretch to the horizon, the trip is worthwhile just for the sights alone.

“... this journey is not for the faint of heart.”

Speaking of the trip, this journey is not for the faint of heart. While the Magdalena Ridge Observatory sits on a National Forest and is therefore public property, the buildings are not open to the public, so the only time that nosy photographers like myself can visit is when they host their open house events. Attendees of the open house event are instructed to park at a camp site at the bottom of the mountain. From there, we all load into a shuttle bus and begin the 30 minute, ten mile journey up the treacherous one lane dirt road with no guardrail. There is literally not room for two cars to pass each other going opposite directions on this road. As a passenger on the shuttle, it is safe to assume that the driver doesn’t want to die in such a horrific manner as driving a bus full of screaming visitors off a cliff, so if you stay calm and busy eyes with your Twitter feed, all will be well and you’ll be there in a jiffy.

The most interactive part of the open house is the tour of the 2.4 meter telescope. This telescope scans the skies looking for anything that may be a threat to the earth (like asteroids that could be on a collision course) or present a threat to national security like satellite remote sensing, space surveillance, and missile tracking.

During this part of the tour, guests are able to go up inside the dome and see the telescope up close. You can even have your photo taken in the telescope if you like. One of the special features of the 2.4 meter telescope is its rapid tracking capability of ten degrees per second. Being able to move at a high speed allows the telescope to track things such as fast-moving asteroids, comets, and resident space objects in low Earth orbit. To facilitate the rapid movement of the telescope, the dome also has to open and rotate rapidly. The tour of the 2.4 meter telescope culminates in an excellent demonstration of the rotating dome. Everyone gathers around the telescope and the operators rotate the dome. This creates a crazy optical illusion where it looks and feels like the floor you’re standing on is turning instead of the dome. It's a very convincing illusion!

The Magdalena Ridge Observatory is the well maintained road made of winding switchbacks and light dirt that contrast the untamed landscape that surrounds it. It is literally not room for two cars to pass each other going opposite directions on this road. As a passenger on the shuttle, it is safe to assume that the driver doesn’t want to die in such a horrific manner as driving a bus full of screaming visitors off a cliff, so if you stay calm and busy eyes with your Twitter feed, all will be well and you’ll be there in a jiffy.

Read this article in its entirety: https://www.dryheatphotography.com/dry-heat-blog/visiting-the-magdalena-ridge-observatory

About the author: DeAnna Vincent is the author of the Dry Heat Blog featuring New Mexico’s ghost towns, Route 66 and interesting attractions across the desert southwest. www.dryheatphotography.com. She is also a professional portrait photographer with over 20 years experience working in New Mexico.
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!