

A portion of WLM captured by JWST's Near-Infrared Camera. At a distance of only three million light years from us, WLM's proximity allows us to observe the individual stars and star-forming regions within it. Credit: (science) NASA/ESA/CSA/Kristen McQuinn; (image processing) Zolt Levay.



# THE LOWELL OBSERVER

Issue 128 | 2023 no. 1

## TINY BUT MIGHTY: Star Formation in Dwarf Galaxy WLM

By Haylee Archer, Research Assistant

Have you ever looked up at the night sky and wondered how stars are born? Scientists have been studying this question for centuries, and my research focuses on the process of star formation in the smallest galaxies in the universe: dwarf irregular galaxies.

Dwarf irregular galaxies are much smaller than typical galaxies like our own Milky Way. They have low amounts of the dust and heavy elements that are believed to be needed to form stars. Despite this, they are still somehow

actively forming stars. Astronomers believe the mechanisms that lead to this star formation may be different from those in larger galaxies and more like those in the first galaxies, which were also much smaller and lacking heavy elements.

My research looks at the dwarf irregular galaxy WLM. Short for Wolf-Lundmark-Melotte, WLM is located about three million light-years away from us in the

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## Finally Back to Chile

By Dr. Phil Massey, Astronomer

Twenty-four hours after leaving Flagstaff, I walked onto the tarmac at Aeropuerto La Florida in La Serena, Chile. I had done so dozens of times, but this was my first since the pandemic began.

I was once again on my way to the Las Campanas Observatory, for two nights on the mighty 6.5-meter Baade

Magellan Telescope. Low clouds hung over the airport, which I took to be a good sign: cloudy in La Serena usually meant crystal clear skies on the mountain top, still a 2.5-hour drive away. I spotted my driver, and off we went.

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## EXECUTIVE DIRECTOR'S UPDATE



By Dr. Jeff Hall

In the picture at the bottom of this page, you can see the Kemper and Ethel Marley Foundation Astronomy Discovery Center from an interesting vantage point – the second floor! A few weeks ago, I had the opportunity to walk out on the decking and take in the sight from that elevated perspective. It conveyed a good sense of the amazing scale of the facility. And we are thrilled and grateful for all the generous additional support we have received this year, including from our lead benefactors at the Marley Foundation and the Richard F. Caris Trust, as well as from so many of our friends in support of the now-completed \$1 million matching challenge. These gifts will help ensure the ADC opens with the full range of amazing experiences we designed into it from the start.

After several years of design, fundraising, and work, it is incredibly exciting to be saying “next year” in connection with the grand opening. The mountains of snow we received from January through March did push the schedule back a couple of months, but actually, the extra time to prepare the programming and staffing plan is not a bad thing. We are now on track for opening around the end of October 2024, and of course we’ll keep you up to date on all the developments as the next great thing at Lowell – equal in scale and ambition to the Lowell Discovery Telescope itself – comes to fruition! •

## TRUSTEE'S UPDATE



By W. Lowell Putnam

As you read this issue, you will get a sense of how much work goes on at the observatory, and not just in Flagstaff. Our scientists are observing in multiple locations, including with the James Webb Space Telescope, in Chile, and, of course, on the LDT. In addition, our education and outreach personnel are preparing for another summer of science camps. The archives are bringing online valuable records for researchers to work with, and construction on the ADC is gearing up again after the incredible winter Flagstaff just went through. And speaking of that, I want to make special note of the grounds crew and all those who volunteered to come in and keep clearing the campus again and again these past several months. Thank you to all of them from me. If you are visiting Mars Hill, you will find it a very busy place. I hope you will take a moment to thank the staff who make it all possible. •

## ADC Construction Update

By Dave Sawyer, Technical Project Manager

After nearly two months of delay due to relentless snow storms this winter, we are finally digging out and getting back to work on the ADC construction. This spring we expect to see the second and third floors poured, and steel erection completed. The masons will return to continue work on the remaining block walls, while piping, conduits, wiring, and ducts are being installed by plumbers, electricians, and mechanical techs. As soon as the remaining snow has melted away and the site has sufficiently dried out, the civil construction crews are slated to return to continue work on site grading, drainage, and underground utilities at the building and the main parking lot, as well as complete the secondary emergency access road.

*View from the 2nd floor north campus entrance looking into the elevator lobby and Origins Gallery balcony beyond.*



## Sykes Exhibit Coming Soon By Melissa Valenzuela, Archives Assistant

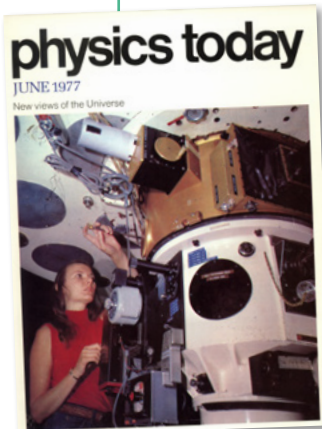
In November 2022, *Outlander* author Diana Gabaldon lent several boxes of photos, newspaper clippings, and other memorabilia belonging to her great-grandfather Stanley Sykes and great uncle Godfrey to the Lowell Observatory Archives. Percival Lowell commissioned the Sykes brothers, originally from England, to design the Clark Telescope dome. Stacey Christen and Melissa Valenzuela from the archives team have spent the last four months organizing these artifacts into an upcoming exhibit that tells how the Sykes brothers came to Arizona and the legacy they left at Lowell Observatory. This exhibit will open in June, 2023.

Archives Assistant Melissa Valenzuela (left) and Museum Specialist Stacey Christen sort through a box of personal items which they believe belonged to Stanley Sykes and his wife Beatrice.



## Exploration Fund to Benefit from Cal Tech Alumni

By Lisa Actor, Chief Philanthropy Officer



**When Donna Weistrop graduated from Wellesley College with an astronomy major, she had her sights set on a PhD from the California Institute of Technology.**

Cal Tech's graduate brochure said they accepted women "only under exceptional circumstances." Donna wasn't deterred. She became one of the first women to earn a doctorate in astronomy from Cal Tech. She later appeared on the cover of *Physics Today*.

David Shaffer's acceptance as a summer student at the National Radio

Astronomy Observatory (NRAO) after his sophomore year at the Carnegie Institute of Technology (now Carnegie Mellon) was also exceptional. Dave was invited back to NRAO for three more summers, including one summer while a grad student at Cal Tech.

Classmates at Cal Tech, Donna and Dave went their separate ways after earning their PhDs. Donna taught astronomy at Tel Aviv University before being selected as a postdoc at Ohio State University, a year that included trips to Lowell Observatory to observe on the Perkins Telescope. Dave spent two years at Yale University and a few more years at NRAO, after which he and Donna crossed paths again, got married, and ultimately landed at NASA Goddard in Maryland.



Donna later accepted a professorship in Astronomy at the University of Nevada Las Vegas (UNLV). Donna connected the UNLV astronomy program to Lowell Observatory and the 31-inch telescope operated by the National Undergraduate Research Observatory (NURO). "My students loved visiting Flagstaff and operating the NURO telescope," she said.

Dave's talent with instrumentation resulted in his finishing the auto guider for Lowell's 31-inch telescope. "They had the instrument case, the parts, and a conceptual design for the optics," says Dave. He worked with Lowell staff to build the auto guider over a couple of years.

After retiring to Flagstaff in 2005, Donna and Dave got to know Lowell Observatory astronomers and staff even better. Donna joined Lowell's Advisory Board in 2014 and later became a trustee on the Lowell Observatory Foundation Board. She has served as Foundation Board Chair since 2020.

As Donna and Dave considered their estate plans, they focused on gifts to a handful of Flagstaff nonprofits including Lowell Observatory.

"Neither of us came from families of means," said Dave. "We want to use the funds we've accumulated to make a difference for others."

The couple has arranged to leave part of their estate to the Exploration Fund of the Lowell Observatory Foundation. Payments from this fund support research and researchers at Lowell.

"We recognize that Lowell is at the forefront of astronomical research," said Donna. "That's the kind of thing we like to support." •

Drs. Donna Weistrop and David Shaffer.

# 4TH ANNUAL I HEART PLUTO FESTIVAL A SMASHING SUCCESS

By Kevin Schindler, Historian/Public Information Officer

The Fourth Annual I Heart Pluto Festival ran from February 18-20. With good weather and strong community participation, the event proved highly successful. The observatory is already starting to plan for next year's I Heart Pluto festival, which will run from February 16-19. Thanks to main sponsors UniSource Energy Services and North Country HealthCare for their support! •



(Left) Public Program Educator Peter Knowlton tells guests about Pluto's discovery.



(Right) Still Air Beer, by Mother Road Brewing Company.



(Left) Staff and guests dedicate the 9-inch Tombaugh Telescope. Left to right: Dr. Danielle Adams, Lisa Actor, Sherry Shaffer, Cherylee Tombaugh, Alden Tombaugh, Kevin Schindler, Becky Daggett (Flagstaff Mayor), Dr. Amanda Bosh.



(Right) Science experiments capture imagination of young onlookers.



(Left) A young guest enjoys getting his face painted.



(Right) Dr. Danielle Adams talks with guests during the Pluto Pub Crawl. Credit: Nate Nise



# NIGHT OF DISCOVERY AT THE ORPHEUM THEATER

(Left) Dr. Larry Wasserman presents Nicole Stott with a certificate recognizing Asteroid Stott. | Credit: Richard Bohner.



(Right) Visitor Experience Associate Tyler Flake tells a guest about Pluto-themed items for sale.



(Left) Christopher Fox Graham, who read poems during the Night of Discovery event, and his daughter talks with Nicole Stott.



(Right) Nicole Stott with Alden and Cherlyee Tombaugh.



Space artwork on display.



Images credit Abe Snider unless noted otherwise.

# NEWS FROM THE ARCHIVES

By Lauren Amundson, Librarian and Archivist

It's been a busy few months in the Lowell Observatory Archives! In August, 2022, we unveiled a new exhibit in the Putnam Collection Center (PCC) called, "Elizabeth Roemer: Comet Notes."

Dr. Roemer (1929-2016) was an astronomer who spent most of her career at the University of Arizona and donated her papers to Lowell upon her passing. In addition to the physical exhibit, we created an online exhibit at [bit.ly/3L2CUH4](https://bit.ly/3L2CUH4). Roemer's papers will be available for research by late summer, 2023.

Thanks to the generosity of our donors, we were able to purchase new content management software for cataloging our collections. We've been cleaning up the 40,000 migrated records and plan to go live with the new site on June 1, 2023. It will be a vast improvement over our current site in both appearance and function.

Finally, we reached a huge milestone in February. After eight years, we finished moving archival materials

Volunteer Jeff Pickens stands by the last boxes to be moved from the Slipher Building basement to the Putnam Collection Center.

(excluding glass plate negatives) from the Slipher Building basement to the PCC. A big thank you to volunteer Jeff Pickens, who was responsible for inspecting, cataloging, wrapping, freezing, and shelving approximately one thousand boxes of documents, photographs, books, serials, films, and logbooks. The items are now housed in our climate-controlled and secure collections repository. •



## Star Stuff, Season 2

After a successful, star-studded first season, *Star Stuff: A Space Podcast* is back for Season 2! Your favorite hosts Cody Half-Moon and Hailey Osborn are continuing to explore the cosmos with new special guest stars, plus a few fan favorites. Start your interstellar journey on your favorite listening platform today! All Season 2 episodes are now recorded on video as well, so you can watch them on YouTube.

## Dr. Joe Llama Attends Sun-as-a-Star Workshop

In March, Dr. Joe Llama attended the Sun-as-a-Star Workshop at the Flatiron Institute in New York. The workshop brought together astronomers working on understanding how stellar activity impacts our ability to find Earth-mass exoplanets in their data. Llama was invited to present the findings and data from the Lowell Observatory Solar Telescope, which uses the EXtreme PREcision Spectrometer (EXPRES) to observe the Sun in the same manner that scientists observe stars at night with the LDT.



# Weathering the Snowy Season at Lowell Observatory

By Madi Mooney, Content Marketing Specialist

Did you know that Flagstaff, Arizona, is one of the snowiest cities in the United States? Located at an elevation of 7,000 feet, our cozy mountain town receives an average of 100 inches of snowfall each year. This past winter was one of the snowiest since records started back in the late 1800s.

Stargazing is an infamously weather-dependent business, and Lowell is no exception. Winter storms caused several shutdowns to our Public Program over the past few months in the interest of keeping both staff and visitors safe, especially when the hairpin turn of Mars Hill Road becomes slick with ice. When possible, however, our dauntless snow removal team works to clear and cinder the road as well as the paths around campus to keep things up and running. Led by Facilities, Grounds, and Maintenance Manager Dave Shuck, this group of Maintenance Team members and interdepartmental volunteers arrives on Mars Hill long before opening hours begin.

"This has been the most snow I've seen in my 12+ years here at Lowell," says Shuck. "It took a lot out of the crew and the equipment." Visitors to the observatory may see the maintenance crew working to keep paths clear on campus during operating hours. Those who are especially lucky may get to see Dave operating a bulldozer (affectionately nicknamed Kathy) to move particularly large snowbanks. •

Marketing Manager Cody Half-Moon designed this commemorative sticker.



As winter wound down, Lowell staff members celebrated the Snow Team and thanked them for their efforts in keeping Mars Hill, Anderson Mesa, and LDT clear of snow. Crowns were decorated and given to our Snow Team Royalty. Left to right: Jeremiah McGeehee, Henry Monroe, Dave Shuck, Peter Knowlton, Jeff Hall, Christian Jones.

# Sponsor a Seat in the Universe Theater

by Rachel Edelstein, Annual Giving Officer

Have you considered a sponsorship opportunity in the new Kemper and Ethel Marley Foundation Astronomy Discovery Center? Would you like to sponsor a seat in the Universe Theater to honor a loved one and show your support for the new discovery center? To learn more, visit our website where a gift of \$1,500 will sponsor a seat: [lowell.edu/support/donate/programs-to-support/astronomy-discovery-center/universe-theater-seats/](https://lowell.edu/support/donate/programs-to-support/astronomy-discovery-center/universe-theater-seats/). If you would prefer to sponsor a seat over a period of two to three years, please set up a pledge with Rachel at [redelstein@lowell.edu](mailto:redelstein@lowell.edu) or (928) 255-0229.



# North Star Society

Lowell recently launched the North Star Society, a giving society that supports the Native American Astronomy Outreach Program (NAAOP). NAAOP began in 1996 and provides STEM (science, technology, engineering, and mathematics) educational enrichment to Arizona tribal nation schools. Check out the benefits of becoming a member at [lowell.edu/north-star-society](https://lowell.edu/north-star-society).

## Members-Only Facebook Page

Last May, the observatory started up the Lowell Observatory Member Community Facebook group. The idea was to host a space where members can meet and discuss topics of shared interest, as well as stay up to date on astronomical events. Every week members can expect to receive a Sky Report on the next week's astronomical events, courtesy of Stellar Vista Observatory. On top of that, members regularly share interesting articles, stories, beautiful pieces of astrophotography, astronomy memes, and more. Join now to become an engaged part of the Lowell Observatory Member Community!

[facebook.com/groups/lowellobservatorymembers](https://facebook.com/groups/lowellobservatorymembers)



## Members Event: Q&A with Executive Director Dr. Jeff Hall

by Emma Wood, Membership Assistant

Mark your calendars for June 17th! Lowell Observatory will be hosting a members-only Zoom Q&A at 11:00am MST. You will have a unique opportunity to meet our esteemed Executive Director, Dr. Jeffrey Hall, and ask him questions about his research and valuable contributions to the observatory. An RSVP email will be sent out two weeks before the event, but if you'd like to let us know now, please email [membership@lowell.edu](mailto:membership@lowell.edu). Don't miss out on this exceptional chance to engage with our Executive Director and learn more about Lowell Observatory. •

## Kevin White Public Programs Supervisor

by Madison Mooney, Content Marketing Specialist

### STAFF PROFILE

Public Program Supervisor Kevin White first began his tenure at Lowell as a Public Program educator in 2007. He left to serve in the Peace Corps in Ukraine from 2009 to 2012, then returned to Flagstaff and has continued working at Lowell ever since.

His day-to-day activities as a supervisor vary, doing whatever needs to be done to keep programs running smoothly. He often assists in training new staff members and volunteers. He oversees running nighttime activities a few evenings throughout the week. He makes the schedule for educators to follow, dealing with anything that needs to be dealt with, and generally does his best to make time spent at the observatory a life-enriching experience for both guests and staff.

When asked about his favorite part of the job, Kevin said, "There's a particular look of delight that people get when they understand something fascinating for the first time. I've loved



astronomy and the night sky since I was a small child, and I consider myself incredibly lucky to have a job where I can share that love with other people. Also, all our Public Program staff are such incredible and brilliant people. I don't think there's a single one that I haven't learned things from, and I am very fortunate to work with all of them as well."

Kevin would also like to give a shout-out to his cat who is, "the best cat of all possible cats, real or theoretical." He spends his free time playing video games while listening to science and philosophy podcasts. "I like to pretend that 3D-printing racks to hold the public program's lasers and radios counts as mad science," he says, "and I may occasionally laugh maniacally when I finish a design I especially like."



# ORBITS CURIOSITY: A NEW BEGINNING FOR AN OLD ADVENTURE

By Todd Gonzales, Education Manager

Eleven years ago, one morning in March, I remember sitting in a room with directors, astronomers, educators, and volunteers. The discussion was on whether to pilot a summer camp for children. Our group comprised parents, former camp counselors, and die-hard STEM education enthusiasts. The decision was unanimous that Lowell Observatory needed to start a space camp. I was anxious that this new summer program would launch in two months. Jill Allen, an outstanding longtime volunteer, and I would lead the first and second-grade space camp in what is now the Marketing building.

The summer was a flurry of late-night Walmart and Home Depot runs to prepare for our camp the next day. We built spaceships from cardboard boxes and moon suits from Tyvek and learned the Moon's phases with Oreos. It was so enjoyable coming up with activities on the fly around a central Moon theme and watching the kids find excitement in space science. We had so much fun and were so successful at exciting the kids that there was a demand to return to the camps the following year.

We put on another camp, changing the theme so returning campers could learn something new. In the third season, we realized, in hindsight, that we should have written the lessons down. Samantha Gorney and I spent hours writing the lessons and activities we could remember from the first year for all three camp groups, plus the new middle school

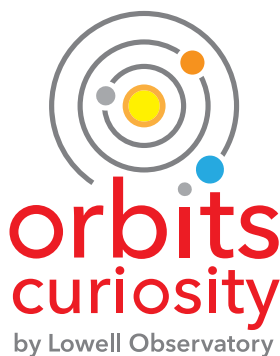
group. Those lessons are still used every summer.

Those fly-by-the-seat-of-your-pants camps evolved into something more significant and telling for us at the observatory. We began to see the power of sharing science and math with the younger visitors. We were barely scratching the surface of the demand for STEM education for children at Lowell Observatory. Quickly we grew from summer camps to preschool camps and sending lesson kits to preschools in the Phoenix area. We progressed from Uncle Percy's Kids Camps to Lowell Observatory Camp/Curriculum for Kids. (LOCKs).

Lowell Observatory is entering another new chapter with the planned arrival of the Astronomy Discovery Center (ADC). With it, the Orbits Curiosity Zone, an immersive children's exhibit that carries the goal of the first camps, is to have kids explore more rigorous concepts in science and math. Camps grew from a handful of campers per grade group to more than two hundred campers each summer.

School field trips returned with ferocity after the COVID lockdown, and the ADC is not just a signal of change; it is the solution to our capped growth in camps and field trips. Serendipitously, the Orbits Curiosity Zone signaled that we are more than just camps, and we needed new branding to describe the breadth of our STEM education. Under the new banner of Orbits Curiosity, we can focus on the main products of our STEM education for kids. The Orbits Curiosity Zone is an exhibit hall and a powerful tool for everyday exploration and self-discovery. The Orbits Curiosity Field Trips will integrate all the observatory has to offer to accommodate the thousands of students coming every year. The Orbits Curiosity Classrooms will eventually grow to meet the demand for programming brought into the classrooms of our local and surrounding communities.

Eleven years ago, I didn't think any of us at the table could have imagined what a small summer camp program would have grown into. Yet, here we are, excited for the future. •



## Recent Publications

Baines, E., **Blomquist, S.**, Clark, J., **Gorney, J.**, Maier, E., **Sanborn, J.**, Schmitt, H., Stone, J., **van Belle, G.**, Braun, K., 2023, AJ, 165, 41, Simultaneous Six-way Observations from the Navy Precision Optical Interferometer.

Zhao, L., **Kunovac, V.**, Brewer, J., **Llama, J.**, Millholland, S., Hedges, C., Szymkowiak, A., Roettenbacher, R., Cabot, S., Weiss, S., Fischer, D., 2023, NatAs, 7, 198, Measured spin-orbit alignment of ultra-short-period super-Earth 55 Cancri e.

Bowen, B., Reddy, V., De Florio, M., **Kareta, T.**, Pearson, N., Furfaro, R., Sharkey, B., McGraw, A., Cantillo, D., Sanchez, J., Battle, A., 2023, PSJ, 4, 52, Grain Size Effects on Visible and Near-infrared (0.35-2.5 m) Laboratory Spectra of Ordinary Chondrite and HED Meteorites.

Dr. Stephen Levine has created a listing of research utilizing the 4.3-meter Lowell Discovery Telescope. It is based on the Astrophysics Data System (ADS) and is updated regularly. See [http://www2.lowell.edu/users/tac/bio/dct\\_ref\\_pubs\\_et al.html](http://www2.lowell.edu/users/tac/bio/dct_ref_pubs_et al.html)

Dr. Levine has also put together a list of work by Lowell Observatory staff: [http://www2.lowell.edu/users/tac/bio/Lowell\\_Annuals.html](http://www2.lowell.edu/users/tac/bio/Lowell_Annuals.html)

# Eclipse Over Texas: Live From Waco to Celebrate April 8, 2024

## Total Solar Eclipse

By Kevin Schindler, Historian/PIO

On April 8, 2024, a total solar eclipse will be visible from a narrow path running from Mexico to Canada. Texas will be an ideal viewing spot, and Lowell Observatory is teaming with the City of Waco, Baylor University, and Warner Brothers Discovery on a public event, Eclipse Over Texas 2024: Live from Waco. This will include an onsite celebration at Baylor University's McLane Stadium in Waco, as well as virtual programming that people around the world may view.

Eclipse Over Texas 2024: Live from Waco will consist of a full day of presentations by astronomers and educators, interactive activities, and telescope viewing. Warner Brothers Discovery will broadcast the event on their linear and digital networks. All of this will center around the eclipse: the Sun will begin to be eclipsed at 12:20pm CDT. The Sun's surface will gradually be covered until totality sets in at 1:38pm CDT. This will last for four minutes and 11 seconds, at which point the Sun will begin its gradual move out of the Moon's shadow.

Waco sits in the middle of the path of totality. This, combined with typically excellent weather in April, as well as easy accessibility, makes Waco an ideal location for an eclipse event.

For information and to reserve your spot at this event, see [eclipseovertexas2024.com](http://eclipseovertexas2024.com).



### TINY BUT MIGHTY | CONTINUED FROM PAGE 1

constellation Cetus. This means it's close enough for us to observe the individual stars and star-forming regions.

In 2015, my advisor and Lowell Observatory astronomer Dr. Deidre Hunter and her team discovered small carbon monoxide (CO) gas cores in WLM. CO is a tracer of molecular clouds—the dense regions where stars are born—and previously believed to be too small to form CO. My work seeks to understand the conditions in WLM that led to the formation of these cores.

But why do CO cores lead to star formation in the first place? The answer lies in the fact that these cores are much colder and denser than the surrounding gas. When the gas in a CO core becomes dense enough, gravity takes over and begins to pull the gas inward, causing it to collapse into a protostar—the earliest stage of a star's life.

Recently, we looked at WLM in a variety of wavelengths, from radio to far ultraviolet, and found more massive amounts of CO where the gas density is higher, but still found CO cores in low density environments. We also found that the sizes of the CO cores are very small, regardless of age or location, suggesting that tiny cores are all that can be formed in galaxies like WLM.

This finding has important implications for our understanding of star formation in small galaxies. It suggests that the formation of stars in these galaxies may be driven by a combination of factors, including

the presence of dense gas clouds and the interactions between them. It also highlights the importance of studying small galaxies like WLM to fully understand the complex processes that drive star formation.

My future projects involve using the Hubble and JWST to get an even better look at WLM and various star formation tracers within it. While there is still much to learn, the goal of my research is to provide important insights into how stars form in small galaxies. By studying galaxies that are different from our own, we can gain a better understanding of the fundamental processes that shape our universe. •

*Nearby dwarf irregular galaxy WLM as observed by Lowell Astronomer Dr. Phil Massey. Over 1000 times less massive than the Milky Way, WLM is still actively forming stars despite its low dust and heavy element abundance. Credit: Phil Massey/Lowell Observatory/Knut Olsen/NOIRLab/NSF/AURA.*



I was in Chile to complete a decades-long project to answer the question of the distribution of stellar masses in the nearest starburst region to us, NGC 3603. This cluster can only be observed from the southern hemisphere, and it holds the key to answering a long-standing astrophysical question: when stars form, are the same proportional numbers born as a function of mass? For instance, for every star with a mass 100 times that of the Sun, how many stars are there with ten times the mass of the Sun? Everywhere we look we have found the same fraction, although theorists do not really understand why this law is universal. The one exception may be in regions like NGC 3603, where the star formation rate is intense.

When the pandemic hit, Chile locked down hard, and travel is only now opening up. When Las Campanas reopened, they did so cautiously, allowing only local staff access, and that only under strict protocols. Remote observing was implemented for their two largest telescopes, the Magellan twins. Kathryn Neugent and I have been privileged to use this capability several times during the pandemic. However, as our Carnegie colleague Nidia Morrell puts it, "Remote observing is better than not observing, but it's not as good as observing in person."

Why is that? After all, isn't it a lot more convenient to observe from your living room, and not have to put up with 30 hours of travel, dealing with weather-related delays? (Indeed, I had three extra travel days due to snowstorms in Flagstaff.) Some projects are well suited to remote observing. This one wasn't. We needed to use a particularly complex instrument (with an even more complex name): the Inamori-Magellan Areal Camera and Spectrograph (IMACS).

The instrument is huge and is permanently mounted at one of the Nasmyth platforms. It takes large metal masks, carefully designed by the astronomer, with laser-drilled holes at the locations of our objects. This instrument allows us to take spectra of dozens of stars at the same time. The detector is an array of eight large CCDs. An instrument like this you really want to be there to use, as things seldom go according to plan.

Indeed, the day after I arrived, I went to the dining hall and encountered Jorge Bravo, one of their facility's excellent instrument specialists, and he informed me that only four of the eight CCDs were working. I prevailed upon him to run some tests with my specific masks, and indeed we determined that the instrument would work just fine for my project in its current mode. Informal contacts like this don't happen over Zoom and are a vital part of the gestalt of what makes observing work.

That said, remote connections allowed Kathryn (whose

schedule precluded her traveling down in person) to join me remotely in the night-time festivities. She could "look over my shoulder" well enough to spot me making errors. When things didn't make sense in aligning the masks, she could jump in with the suggestions. We wound up with two perfect nights on the telescope, with excellent conditions, of the quality that is only seen in a few parts of the world.

And I got to see guanacos and burros, Alpha and Beta Centauri, the Southern Cross, and that silly Orion standing on his head. I suppose the day will inevitably come when I can no longer go down there, but despite our fears during the pandemic, that day is not here yet.

Although most of us make use of our excellent Lowell Discovery Telescope, many of us also compete successfully to use astronomical facilities elsewhere. The Keck 10-meter telescope on Mauna Kea, the Gemini 8-meters on Mauna Kea and Cerro Pachon, the 6.5-m MMT, and 3.9-m Anglo-Australian telescope, the 3-meter IRTF telescope on Mauna Kea, the 1-meter Swope on Las Campanas, are all telescopes that Lowell observers frequent, as well as Magellan. We might need the larger apertures, or different instrumentation, or access to the southern skies not visible from Flagstaff. (Plus, of course, many of us use the space-based Hubble and now JWST.) We go where our science takes us. I am very grateful that I got to go to this wonderful place again. •



*The local Chilean wildlife includes guanacos.*

*Front cover: Dr. Phil Massey holds one of the masks for the Inamori-Magellan Areal Camera and Spectrograph (IMACS).*

# Supporter Feedback

Compiled by Heather Craig, Marketing Operations Specialist

Lowell Observatory is a treasure of Flagstaff. Very educational, with lots of programs for children. More than worth the membership.

Google Review

Yelp Review

Fantastic grounds, fantastic staff. 10000000% worth a visit! I recommend checking the schedule for the day to see what kind of presentations they have going on for the day.

The stories and delivery were exceptional. They showed us the early telescopes and explained how they are different, why, and how they are used - all in understandable language.

Trip Advisor

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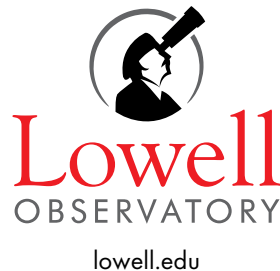
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The Lowell Observer is published quarterly by Lowell Observatory  
1400 W Mars Hill Road, Flagstaff, AZ 86001

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