

The High Desert Observer

The Bulletin of the
Astronomical Society of Las Cruces

Sharing the Universe with our
Community for over 60 years



Photo by John McCullough

July, 2013

The Astronomical Society of Las Cruces (ASLC) is dedicated to expanding public awareness and understanding of the wonders of the universe. ASLC holds frequent observing sessions and star parties and provides opportunities to work on Society and public educational projects. Members receive the *High Desert Observer*, our monthly newsletter, plus membership to the Astronomical League, which includes their quarterly publication, *Reflector*.

Individual Dues are \$30.00 per year

Family Dues are \$36.00 per year

Student (full-time) Dues are \$24.00

Dues include electronic delivery of the *HDO*. Prorated dues are available for new members. Dues are payable to ASLC with an application form or note to: Treasurer ASLC, PO Box 921, Las Cruces, NM 88004

ASLC members are entitled to a \$5.00 (per year) Sky and Telescope magazine discount.

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July Meeting

Our July meeting will be held on Friday, July 26, in Room 77 at Doña Ana Community College, with the following schedule:

7:00 pm - 7:30 pm Show & Tell

7:30 pm - 8:00 pm Business Meeting

8:00 pm - 9:00 pm Guest Speaker & Presentation

This month's speaker will be Society member Jerry Gaber, who will speak about Astrophotography 101.

Events

ASLC hosts deep-sky viewing and imaging at our dark sky location in Upham. We also have public in-town observing sessions at both the International Delights Cafe (1245 El Paseo) and at Tombaugh Observatory (on the NMSU Campus). All sessions begin at dusk.

Starting soon will be regular observing sessions at the new Observatory at Leasburg Dam State Park, which houses an ASLC-run Meade 16" LX-200 telescope.

Outreach

Outreach is a very important part of ASLC. We are always looking for more volunteers to help us educate the public. Even if you do not have a portable telescope to bring to the events, please consider attending our public outreach programs to help answer questions, share knowledge and point out constellations in the sky.

The President's column-inch...

Monsoon is traditionally defined as a seasonal reversing wind accompanied by corresponding changes in precipitation, but is now used to describe seasonal changes in atmospheric circulation and precipitation associated with the asymmetric heating of land and sea. Usually, the term monsoon is used to refer to the rainy phase of a seasonally-changing pattern, although technically there is also a dry phase.

That little excerpt is from Wikipedia, and is included to remind folks that the cloudy

skies really do NOT last forever. Actually, it is a reminder for myself; I have not had my imaging rig out since February, what with winds, clouds, and that cyclic light pollution, the full Moon. Notwithstanding TSP, the Texas Star Party, which I unfortunately missed this year.

School is out, mostly, in Las Cruces, so we have not had any school star parties for awhile, and with a few notable exceptions, amateur astronomy seems to have been fairly quiet over the last month. One of those exceptions is the great trip to McDonald Observatory which your immediate past president, Ron Kramer, organized, and on which he will report.

The clouds also contributed adversely to the monthly Moon Gaze and the Music and Stars in the Park events, neither of which enjoyed clear skies (though the music was not affected).

The June ASLC meeting presentation was "Spectroscopy 101" by ASLC member and past president Steve Barks. Steve gave us insight into the basic physics leading to the use of the electromagnetic spectrum in determining what is really going on out there in interstellar space, well beyond our physical reach. He brought his personal spectroscope (bought as a kit) and, although he could not demonstrate its use in our meeting room, explained what it takes to get a usable spectrograph from a star. Excellent! Later this year, he will expand on this presentation with Spectroscopy 201. Looking forward to it.

The July 26th ASLC meeting presentation will be by ASLC member and past president Jerry Gaber on Astrophotography 101. Jerry has a great observatory with a 14" Meade LX200 at his home, and has created many, many wonderful photographs of those night skies we enjoy (most of the time) here in Las Cruces. For anyone that wants to get into astrophotography, this is a meeting not to miss.

In July the Moon Gaze, and Music and Stars in the Park events will be on Saturday the 13th, hopefully under clear skies.

Have a Good Year; keep looking UP.

Chuck Sterling



Outreach Events for June, by Jerry McMahan

Saturday, June 15

We had three events scheduled for this day. Steve Shaffer would have been at the Tombaugh Observatory, Chuck Sterling and me at Moongaze and Ron Kramer had set up a Music Under the Stars event at the Leasburg park. The key word was scheduled. Clouds and the threat of rain prevented all three programs from being able to observe.

Ron said the music was great, but the Moon was visible for about 30 seconds. Chuck and I both set up at the International Delights and waited for things to clear. As lightning in the distance came closer, Chuck put the 10-inch back in his van. I had the EXT-125, which is an easier take-down, so I waited for a while longer. When the lightning started to get nearly overhead, I chickened out as well. When I got home, the Moon was visible through thinner clouds, but it was also raining. I have not heard from Steve, but since he was not far from us, I assume his luck was just as bad.

Tombaugh Observatory Report, Saturday June 15 (by Steve Shaffer)

I went to support the Sky Safari at NMSU under cloudy skies. Waited till the 9PM start time when it decided to rain and we all went home. Was told that sponsorship of the program was going to change to a different museum.

Sky Safari has been going on for some time at NMSU and we have not been supporting it, partially due to my not knowing about it. I will now. It does not seem to be scheduled on a regular basis, but is on our Moon Gaze Saturday night.

McDonald Observatory, Saturday, June 22 (by Ron Kramer)

The ASLC had arranged a private tour and observing session at McDonald Observatory, near Fort Davis, Texas. Departing Las Cruces by rented van and in two separate automobiles, a total of 11 people joined the caravan, starting at 9:00 am. Driving about 5 hours (including gas and lunch stops, with lunch provided by Lorenzo's Italian restaurant) we all arrived at the Observatory intact.

The tour included "behind the scenes" visits to the 2.1 meter (82"), Otto Struve, 2.7 meter (107") Smith and 9.2 meter (362") Hobby-Eberly telescopes, mainly conducted by William Wren at the Observatory. Dinner at the Astronomer's Lodge was served to all, and the highlight of the tour was a 3-hour observing session with the 36" telescope.

Even though the Moon was nearly Full, and the skies had been full of clouds and rain before dusk, we were lucky enough to enjoy fairly clear skies during the observing session. We viewed the Ring Nebula (M57) and most of us were able to see the central star. Also the Cat's Eye Nebula, Albireo (the double star) and other objects were observed.

The highlights were Saturn and six of her moons along with the Lunar Terminator, only 6 hours before the Full Moon. Blocking about 80% of the Moon's light by positioning the telescope behind the dome's edge, we were able to see many beautiful craters on the Lunar edge. Many of these craters are very difficult to see during any other time of the Lunar cycle, or with smaller instruments.

We left the Observatory around midnight, and arrived in Las Cruces around 4:00 am on Sunday.

Leasburg Park, Saturday, June 29

The intent is to have the new observatory open on Saturday nearest the third quarter Moon. This was the first attempt at this schedule, but was not advertised. It is just as well as, again, clouds were in the way the entire evening. We had only 4 people come to view through the 16-inch. A couple and their two young children were able to see Saturn. That was the only object we could see, as the planet was visible through thin clouds. It would come in and out of view, but when it was seen it was a pretty good view.

Jerry Gaber, Chuck Sterling, Sid Webb and Jerry McMahan were in attendance. Sid's friend, Lloyd Barr, who donated the 8-inch Schmidt Cassegrain that is mounted piggy-back on the 16-inch, was also in attendance. No personal scopes were brought since the event was not advertised and the clouds would have prevented their use in any case.

I really did not do anything stupid. By Jerry McMahan

Since we had a slow outreach month, I decided to use some space to defend myself from people who might think I did not act very intelligently at a previous event about three years ago.

We had a star party at the Desert Nature Park across the river from Mesilla. I got out of my last class at the community college at 5:30 so I had my telescope and school stuff, including the laptop, in the car. I took the wrong road and did not find the bridge across the river. I decided to go further south, knowing that I would find another way across the river. That was not dumb since I did find away across the river at the Mesilla Valley Dam. I knew that I was pretty far south of the park.

The problem was that was no road going south on the other side of the river. That was not my fault since I did not know that levy roads were almost non-existent these days. Instead of a road, there were a lot of high-rolling hills. I decided to try crossing the hills, but after going across a few, I could see that they seemed to go on forever. Rather than risk getting stuck, I decided to turn back. That was pretty smart wasn't it? I even avoided getting stuck while going back across the hills. It was really pretty good driving if I do say so myself.

When I got to the last hill, the way down seemed pretty steep, so I looked for another way down. There turned out to be only one other way and it looked steeper than the other way. I was on a part of the hill that seemed too narrow to back up, so I started down. I could not see, because of late afternoon shadows, that there was a small ditch at the bottom of the hill. My bumper dug right into the bank of this ditch and the two front wheels buried into the depression. I was stuck. That was not really my fault. It was the fault of the person that invented front wheel drive. As you can see, I really have not done anything that was really dumb.

I called Chuck Sterling on my cell phone since he was already at the park. He said he would come to pick me

up. Since I was stranded I decided, very sensibly, to charge my cell phone. I locked the car and went down the hill to wait for Chuck. My spare key had come off of my key chain a couple of weeks before, so had locked my keys in the car. That was the only stupid thing that I did, with the possible exception that the ignition was in the on position to charge my cell phone.

Chuck and a park ranger showed up. By this time it was getting dark enough that it was hard to see where my car was partly hidden in the hill. When we found the car, it became obvious that we were not going to get it out that night. My car, telescope and computer missed the star party, but I did not.

The next day (Saturday), Chuck and I went back to rescue my car. The wind was blowing sand in our faces as we dug the front bumper and tires out of the ditch. We still had the problem of the car being locked. Chuck brought a long wire and the front window was partly down, but it was a bad angle. One of the back windows was also down a little and provided a better angle so Chuck was able to get the car unlocked. We still had the problem of the ignition being in the on position to charge the cell phone. The battery was dead. I had jumper cables and Chuck had to drive his van up the hill, doing a great job of not getting stuck, so we were able to get the car started. The good news was that my cell phone was charged.

Chuck told me that I was not to go straight home. I was to stop and get a spare car key made. He seemed to be serious about that, so that is what I did.

It should be obvious that this series of events could have happened to anyone. At least something comparable must have happened to someone else somewhere. To quote from a character from the television series 30 Rock "Isn't a 75 IQ good enough?"

Calendar of Events: July 2013 - September 2013 (Mountain Time - 24 hr. clock)

| | | | |
|-----|----|-------|--|
| JUL | 22 | 12:15 | Full Moon |
| | 26 | 19:00 | ASLC MONTHLY MEETING |
| | 27 | 20:05 | Delta Aquarids meteor shower |
| | 29 | 11:43 | Last Quarter Moon |
| AUG | 03 | 16:22 | Moon - Jupiter Conjunction |
| | 06 | 15:51 | New Moon |
| | 09 | 20:19 | Moon - Venus Conjunction |
| | 10 | 18:00 | MUSIC UNDER THE STARS; Leasburg Dam State Park Observatory |
| | 12 | 11:59 | Perseid Meteor Shower |
| | 14 | 04:56 | First Quarter Moon |
| | 17 | 20:00 | OUTREACH EVENT; MOONGAZE, International Delights Cafe |
| | 20 | 19:45 | Full Moon |
| | 23 | 19:00 | ASLC MONTHLY MEETING |
| | 28 | 03:35 | Last Quarter Moon |
| | 31 | 10:38 | Moon - Jupiter Conjunction |
| SEP | 05 | | New Moon |
| | 12 | | First Quarter Moon |
| | 14 | 20:00 | OUTREACH EVENT; MOONGAZE, International Delights Cafe |
| | 19 | | Full Moon |
| | 20 | | Autumnal Equinox |
| | 26 | | Last Quarter Moon |
| | 27 | 19:00 | ASLC MONTHLY MEETING |

Be sure to visit our web site for the latest updates: www.aslc-nm.org

Minutes, June 2013 ASLC Meeting

Show & Tell:

A "Show & Tell" session, discussing tips, tricks and techniques useful for beginning and experienced astronomers, preceded the start of tonight's regular Business meeting. David Anderson started the session by talking about

planispheres that are available on the Internet, especially Amazon.com. He found "Uncle Al's Star Wheel" that he printed out and demonstrated tonight. Planispheres are useful for locating objects as the sky rotates from one night to the next. This is a technique that astronomy beginners should find useful.

Fred Pilcher asked how to stop receiving emails from Amazon and got tips on how to unsubscribe and/or limit his presence on the email lists.

Ron Kramer followed by presenting a 3-volume Millennium star catalog/atlas and how to use them with setting circles to locate viewing objects. The atlas includes overlays that provide additional information.

Fred noted he has also used star atlases to locate objects.

Call to Order:

Chuck Sterling, President, Astronomical Society of Las Cruces (ASLC) (the Society), called the June business meeting to order at 7:30 pm, 28 June 2013, Room 77, Dona Ana Community College, Las Cruces, New Mexico.

President's Comments:

Chuck Sterling, President, welcomed the group to tonight's meeting. He thanked the various members for the "Show and Tell" session and for addressing the topics of interest. There were no new members or visitors attending tonight's meeting. Chuck asked that all members be sure to check in on the roster.

Secretary's Report:

The Secretary, John McCullough, reported that the minutes for the May meeting were transcribed from Chuck Sterling's audio recording and submitted for publication in the June issue of the Society newsletter, the High Desert Observer (HDO). Corrections will be made in the July issue.

Tracy Stuart moved that the minutes be accepted as submitted, Ron Kramer seconded. The motion passed by acclamation. There was not an additional Secretary's report.

Treasurer's Report:

The Treasurer, Trish Conley, gave a status of the Society's accounts, including receipt of donations from the ASLC Observatory at Leasburg Dam State Park (LDSP) First Light event and donations made in memory of Cecil Post. There was not an additional Treasurer's report.

Committee Reports:

Apparel Committee:

Ron Kramer, temporary Committee Chairman, noted that jackets, "hoodies", shirts, caps, and other items are available for purchase after tonight's meeting. Ron reported that he has a number of items and sizes available, but he is assembling a "wish list", including new items, in preparation for submitting a "restock" order for the fall and winter. Contact him if you have a special request. Ron will continue to fill in as temporary committee chair, but a new, permanent chair is required.

Education:

Rich Richins, Committee Chairman, was not present at tonight's meeting.

There was no committee report.

Fund-Raising and Grants:

Sidney Webb, Committee Chairman, reported there has been limited new activity. Some furniture has been obtained for the ASLC Observatory at LDSP.

Sid is looking for one of the donated 8" SCTs similar to the one Jerry Gaber is using for the video system. He also mentioned that one aspect of the Space Consortium grant for the ASLC Observatory at LDSP is extending the Society's outreach and including young people in Society activities. Ron Kramer asked about renewing the Space Consortium grant for 2014. Sid is also looking for additional sponsors for the ASLC Observatory at LDSP, perhaps organizations associated with Spaceport America.

Society Library:

Brenner Fody, Society Librarian was not present. There was no Librarian report.



Loaner Telescope Program:

Ron Kramer, Committee Chairman, reported the program is doing well. There are currently four (4) telescopes active in the program: a 10" Dobsonian, two (2) ETX 90s, and a Unitron refractor. Ron continues to work on smaller telescopes and a 12" Dob to become active in the program. Some eyepieces are also available as part of the program.

Membership:

John McCullough, Committee Chairman, reported no new activity.

ASLC Observatory at Leasburg Dam State Park (LDSP) Committee:

Jerry Gaber, Committee Co-Chair, reported he will have the observatory open on 29 June for a training session and observing (weather permitting, 3rd quarter Moon) on the 16" Meade. Participants need to be at the Observatory by 7:00 pm and the session should last about two hours. The session will be open to the public but isn't an advertised event. The 16" is usable but still needs some work. Parts are being located for this repair effort. There is now a storage cabinet in the structure available for eyepieces and accessories. An article on the Observatory is due in the Pulse magazine.

Jerry and Chuck Sterling talked to a reporter and photographer earlier this week.

Ron Kramer, Committee Co-Chair, reported there was a "Music and the Stars" event on 15 June with Travis Manning and the Dye Packs performing.

85-90 people attended but viewing was "clouded" out. The next event will be 13 July (same as Moon Gaze) with Randy Gardner, Native American flutist, performing. Ron will be out of town in July and August and needs someone to oversee the event operations those two months. There are four (4) more "Music and the Stars" events planned through October. Ron will work out the schedule and distribute it to the membership.

Tombaugh Observatory:

Steve Shaffer, Committee Chairman, was not present. There was no Tombaugh Observatory report.

Outreach Committee:

Chuck Sterling, Outreach Coordinator, reported on recent and future events.

The monthly Moon Gaze at International Delights Cafe (IDC) was 15 June, the next one will be 13 July. A Vacation Bible School has requested a solar party on 10 July at 9:00 am. Rich Richins will support that but other Society members are welcome to join in. The August Moon Gaze will be 17 August. "Music and the Stars" at LDSP will be 10 August.

Publicity:

Daniel Giron, Committee Chairman, was not present. There was no Publicity report.

Society Website:

Steve Barkes, webmaster, requested calendar updates be submitted to him. No other updates have been submitted.

There were no additional committee or officer reports.

Old Business:

1. State-wide Star Party, 2013 - Ron Kramer has been working on this event with the TAAS (The Albuquerque Astronomy Society) president. The current planned date is 02-03 November at the Sevilleta National Wildlife Refuge north of Socorro. Participating clubs are expected to include Albuquerque, Silver City, Carlsbad, El Paso, Alamogordo, Socorro, and Las Cruces. It is expected that there will be no attendance cost to participants other than transportation. This has potential to be the largest star party in New Mexico. 8-10 Society members have expressed interest in attending.

2. McDonald Observatory Field Trip, 22 June - Ron Kramer reported on the recent trip to McDonald Observatory. There were eleven (11) participants (Jerry McMahan and John McCullough were last minute

cancellations), seven on the 15-passenger van. Departure from the Lowe's Home Center parking lot took place shortly after 9:00 am Saturday morning. A brief lunch stop occurred outside Van Horn where the Lorenzo's box lunches were distributed and consumed. Participants arrived at the Observatory shortly after 3:00 pm. They had a great tour of the 82", 107" and Hobby telescopes. There were thunderstorms and showers while the group was eating dinner at the Astronomers' Lodge but it cleared before dark. There was good viewing of Saturn (six moons!) and the Cat's Eye Nebula, and even though the Moon was just 6 hours short of being full, great views of craters at the terminator.

Everyone had a good time and left around midnight to return to Lowe's about 4:00 am Sunday morning. Ron hopes to arrange similar trips in the future.

There was no additional old business discussed.

New Business:

1. ALCon-2013 - Ron Kramer, as editor of the AL quarterly publication, the Reflector, will attend the Astronomical League Convention (ALCon) in Atlanta. He intends to observe the convention with an eye to the Society hosting an ALCon in Las Cruces and would like to propose that the Society members consider this. Fred Pilcher expressed his opinion that this is an idea worthy of further investigation. Chuck Sterling suggested that Ron check out the "behind-the-scenes" operations while in Atlanta.

There was no additional new business for discussion.

Announcements:

Items for Sale:

No items were announced for sale.

Announcements:

Ron Kramer needs articles for the High Desert Observer. Ron is also editor-in-chief of the Astronomical League's (AL) quarterly newsletter, the Reflector; he would like Society members to submit articles that can be published in the Reflector. Since Ron expects to be out-of-town for as much as six weeks, he may need to double-up or triple-up the July-September issues of the HDO.

Chuck Sterling noted that the meeting Presentation for July will be Jerry Gaber on Astro-Photography 102.

There were no additional announcements made.

Recognitions/Achievements:

There were no recognitions or achievements announced at tonight's meeting.

Chuck Sterling closed the business meeting at 8:00 pm.

Presentation:

This month's presentation was Spectroscopy 101, by Steve Barkes, Society member. Steve described some of the history and science associated with electromagnetic spectra, especially in the wavelengths visible to the human eye. He also described how spectra are applied to various theories in cosmology. He concluded his presentation by demonstrating a spectroscope he has assembled for his own research. He plans to make a follow-up presentation, Spectroscopy 102, by the end of the year.

The June meeting of the Astronomical Society of Las Cruces concluded at 9:05 pm.

-Respectfully submitted by John McCullough, ASLC Secretary

The Sirens of Interacting Galaxies, by John Kutney

Introduction

The inevitable question that an astronomer may ask is “Why am I doing this?” It is unreasonable to believe in our lifetimes that we will ever reach the stars; yet, there are many professionals and amateurs that pursue a career, studies, or hobby in this or related fields. It has been to the benefit of mankind that there has been this interest. The technological and cosmological breakthroughs that have resulted from the pursuit of astronomy and space exploration have been phenomenal. Man will continue to try to fill the missing pieces to the puzzle of the universe and to be excited by the mystery of space. Remember the line from *Blade Runner*¹ when Rutger Hauer², a replicant, was describing what he had seen in his past journeys. “I’ve seen things you people wouldn’t believe. Attack ships on fire off the shoulder of Orion... All those moments will be lost in time... like tears in rain...” We can look at a simple evolution and growth of observing even in our timeframes: galaxies were once thought as comets or nebulas (indefinable), double stars were thought to be rare, it was impossible to determine the makeup of a star, the expansion of astro-spectroscopy, the measuring of light from quasars as guideposts to the expanding universe, the discovery of dark matter, the speculation that Earth may actually have been part of a formation called the Sagittarius Dwarf galaxy (an entity so small that it got swallowed up by the Milky Way), the moon not made of green cheese, Well you get the idea.

When starting to observe there is all the technical stuff that one has to get behind them in choosing equipment and being able to find objects in the celestial sphere. One generally migrates to observe bright objects (Messier/ Caldwell lists) or obtain astrophotos of famous entities. Few move past this point and may be missing some of the real “sirens” of amateur astronomy.

The Path to Interacting Galaxies

There are three areas that have focused my latest observing ventures to the potential wealth of information available from galaxies that are interacting, accreting smaller galaxies, and bending light from a distant galaxy group. These areas are: Northern and Southern Arp Peculiar Galaxies and the Local Galaxy Group. I will briefly discuss each area and try to develop an understanding why these types of galaxy structures provide a special horizon for astronomical research and a very interesting set of observing objects for the amateur.

It started with the Southern Arp Galaxies. I selected this set of objects mainly because this was a neglected group of galaxies to observers in the USA. My knowledge and awareness of these types of galaxies was expanded by studying and observing the Local Group with its dwarf galaxies and impossibly faint objects, and was confirmed by the abundance of Northern Arp Peculiar Galaxies. These three distinct but similar areas of observing started out simply to observe different special types of objects but culminated in the knowledge that these interacting galaxies, these accreted dwarfs galaxies of the Milky Way, and these other peculiar galaxies with their irregular shapes and small companions were all relating to the theory of how galaxies are formed. These observing areas overturned the theory of evolving types of galaxies with special characteristics originally presented by the Hubble Morphology Sequence and provided a new methodology of galaxy creation and formation with the additional missing aspect of “dark matter”.

Along the way I became a proponent of “dark matter,” where not seeing is believing (just can’t see it); and how dark matter played a prominent role in galaxy formation. This path was certainly a departure from my comfortable bright objects such as the Messier and Caldwell lists.

Arp Peculiar Galaxies

I wrote the article about the Southern Arp Peculiar Galaxies and their Visual Observation for the August 2012 *HDO* where the article described how Halton Arp compiled the *Atlas of Peculiar Galaxies*³ for the Northern Region above -23 degree declination in the sixties to better understand spiral and unusual galaxies. That Atlas contains 338 of the most interesting objects. Halton Arp continued his studies of peculiar galaxies and teamed with Barry Madore in 1973 to generate the *Southern Arp Peculiar Galaxy Atlas*⁴. This collaboration lasted for over 10 years analyzing plates from a large telescope in Australia for declinations of -90 to -22 degrees. The Southern Atlas was completed in the eighties and published in 1987. The Astronomical Leagues’ list for the Southern Arp Collection is comprised of 498 peculiar galaxies while the Northern Arp Collection is made up of the original 338 members. A great website to view the particulars of the Northern Group is: <http://arpgalaxy.com/>

The Northern Arp Galaxies

I had no organized plan of action to address observing the Northern Arp list of galaxies. My original plans were to

focus on the Southern Arp Peculiar Galaxies and see how many could be observed from southern New Mexico. As one may realize from last August's HDO article about the Southern Arps, the majority of the constellations are not accessible for a good part of the year. Therefore, I started on another set of observations, "The Local Galaxy Group and Galactic Neighborhood." While pursuing this observing list it became quite clear that one needed very good seeing and transparency to observe many of the small and faint objects from the Local Group. The method for my observing was to always have multiple lists to ensure that the nights and early mornings spent in the desert are fully utilized. The Northern Arps became my backup list since there are objects in the sky for all seasons. To date I have observed 228 out of the 338 objects and project that only a very few (< 10) will not be viewable due to the size and magnitude of the objects. The Northern Arps have been very generous and observable when the Local Group was not cooperating. There are many very exciting galaxies to observe and the observation of interacting, companion, and irregular galaxies was very robust.

My observing logs were submitted in the Fall of 2012 to the Astronomical League⁵ for completing the requirements for observing 100 Northern Arp Galaxies. The observing list has the total 338 Northern Arp Galaxies all within reach of the Las Cruces area. More than 250 of the Northern Arp Galaxies on the Astroleague's list are brighter than 15th magnitude, with most within the range of medium size amateur telescopes.

Northern Arp Highlights

In Figure 1 (*Sloan Digital Sky Survey* (SDSS)), one can observe the interaction between NGC 2872 and NGC 2874. The Arp Galaxies provide many spectacular observations as the photo indicates. Obviously not as colorful through one's telescope but just as dramatic.



Figure 1: ARP 307 [NGC 2872/2874/2873] in LEO

Figure 2 is NGC 2623 (aka: Arp 243). It is based on Hubble Legacy Archive⁶ image data that also reveals even more distant background galaxies scattered through the field of view. This jewel is very observable from Las Cruces. NGC 2623 is really two galaxies that are becoming one. In the final stages of a titanic galaxy merger, the pair lies some 300 million light-years distant toward the constellation Cancer.

The Northern Arp Galaxies also include the following interesting special groups where one can determine how many objects of these groups can be observed with their telescope:

| | | |
|-------------------|---------|---------|
| Leo Triplet | Arp 317 | Leo |
| Stephans Quintet | Arp 315 | Pegasus |
| Pisces Cloud | Arp 331 | Pisces |
| Wild's Triplet | Arp 248 | Virgo |
| Copeland's Septet | Arp 320 | Leo |



Figure 2: ARP 243 or NGC 2623 in Cancer, magnitude 13.8

The Hubble web site⁷ has released a set of 59 galaxies in collision to commemorate the end of the Hubble Telescope Space Mission. Many of these are within the Arp collection but many more have been identified by the Hubble. Halton Arp would be amazed at the advancements in this area of research since his initial findings in 1966. Figure 3 is a poster available from the Hubble web site. You can also Google “galaxy collisions” to find this data.

The Local Galaxy Group & Galactic Neighborhood

Observing the Local Group (LG) & Neighboring Galaxies started out very slowly as I was trying to observe Leo I near Regulus (see Figure 4). I thought it would be easy but it became an obsession since it was easy to locate but hard to observe. It required a very dark site with good seeing conditions. I also imaged this object challenging my limited astrophoto abilities to capture the object in the glow of Regulus.

Many of the objects that I observed and sketched from the LG were challenging but they returned a rich sense of accomplishment. There was a well-balanced selection of objects that takes even the experienced observer to new levels of concentration. Even though there were many cloudy and overcast nights during my observing timeframes, there were enough clear nights to address some of the very faint objects. We are usually blessed with excellent seeing and transparency in southern New Mexico and I have been able to make the most of the current limited observation sessions of 2012 thru 2013.

The presentation, “Local Galaxy Group and its Amazing Dwarfs” was provided in the March meeting of the ASLC⁸. The presentation addressed the following topics:

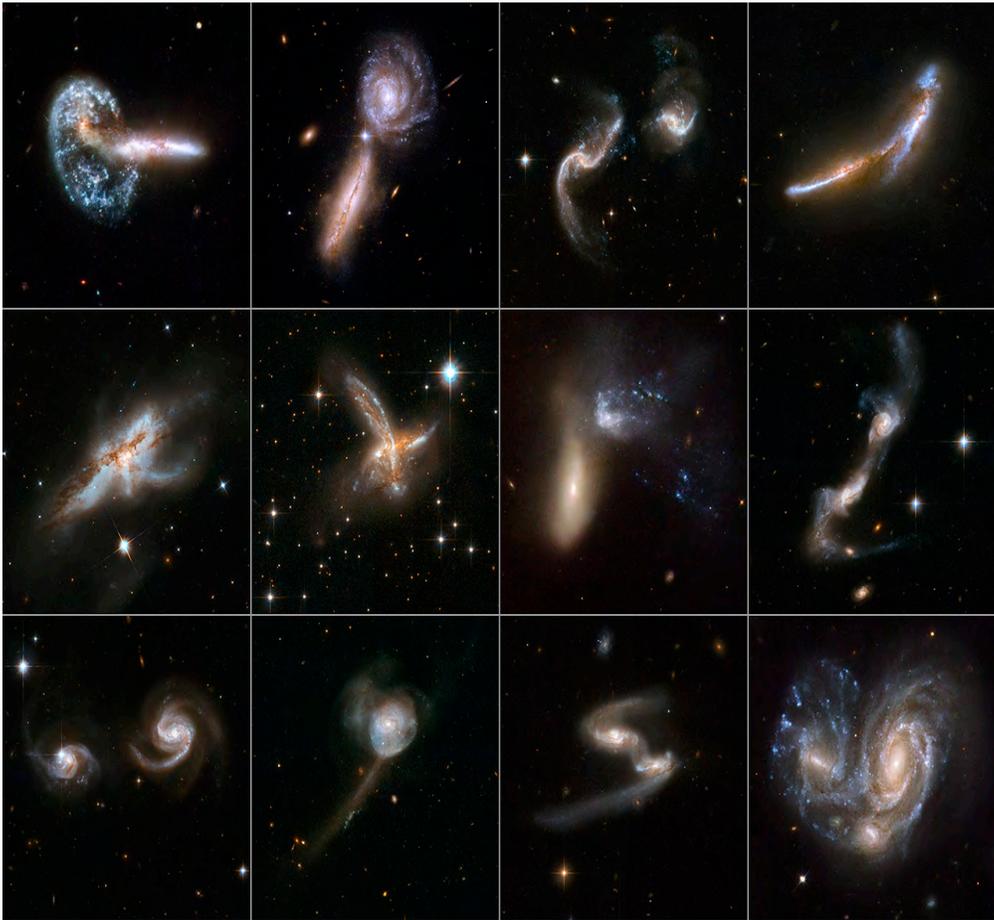


Figure 3: Hubble Poster of Colliding Galaxies

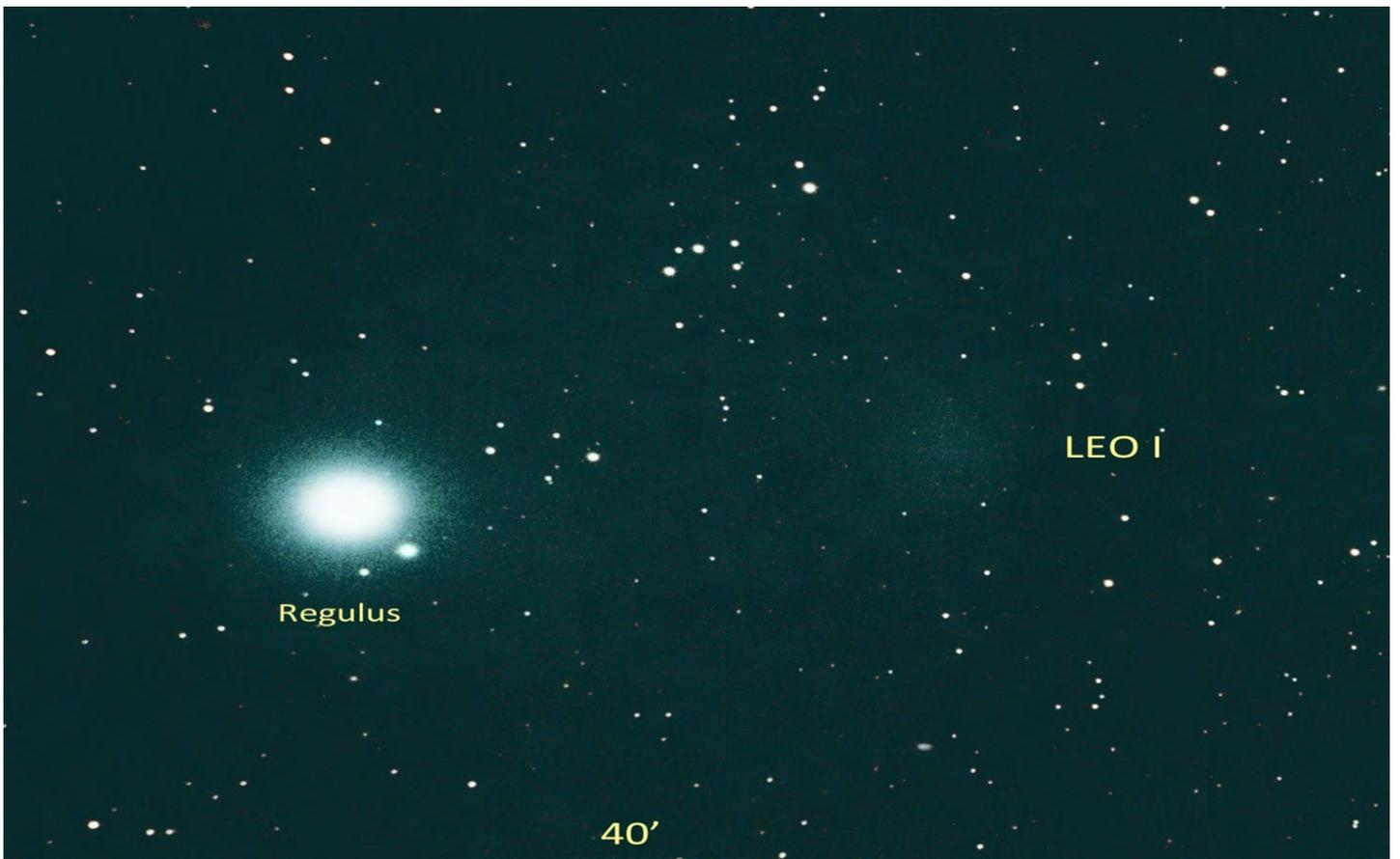


Figure 4: Leo I Dwarf Elliptical Galaxy

- What is the Local Group?
- Why is the local group interesting?
- Observing the Local Group
- Analysis of Local Group Dwarfs
- Galaxy Formation and the Local Group

Overview of Local Group

The Local Group is a physical (i.e. gravitationally bound) association of at least 50 galaxies (continues to increase as new satellites of the Milky Way and M31 are discovered) with a radius of 1.3 Mpc⁹. Nearly all galaxy types are found in the Local Group. The “dwarf galaxy” becomes a very special galaxy class and important to the study of galaxy formation.

Components of the Local Group:

1. Two large spiral (disk) galaxies the Milky Way, and Andromeda (M31)
M31 is somewhat larger and more luminous than the Milky Way: $M31 \sim -21.1 M_V^{10}$
MWG $\sim -20.6 M_V$ ($M_V = -20.6$ corresponds to $1.4 \times 10^{10} L_{\text{sun}}$).
M31 and the Milky Way dominate the mass of the LG
2. One smaller and less luminous spiral (disk) galaxy M33 $\sim -18.9 M_V$
3. The prototype of the Magellanic Irregular class, The Large Magellanic Cloud (LMC) $\sim -18.1 M_V$
This galaxy lacks the spiral-arm structure evident in the MWG, M31 and M33, although still primarily a disk galaxy. All these galaxies contain significant amounts of gas and are currently forming stars.
4. The remaining galaxies in the Local Group are classified as Dwarfs.

The action plan was to observe as many objects from the Local Group as possible. Only two objects that are within my observing spectrum were missed. And II and the Draco Dwarf were just not visible within the local conditions. I needed the perfect night to catch these two objects and possibly a limiting magnitude of 7.0.

I was able to observe all the extragalactic globulars associated with the Local Group. NGC 2419 (The Intergalactic Wanderer) in Lynx is always exciting since it is one of the most distant globulars in the Milky Way and an interesting visual object. Finding the faint and hidden globulars of the Sagittarius Dwarf (SagDeg) such as Terzan 7 & 8 and Arp 2 were difficult but very stimulating as a visual observer. The globulars and nebulas in both M31 and M33 are a challenge from our location in southern New Mexico but I was lucky to get excellent position and observing conditions for these objects.

Dwarf Galaxies in the Local Group

Dwarf galaxies are important because they provide evolutionary histories from simple systems and are the building blocks of larger galaxies. They also have high dark matter content and are the least luminous galaxies known¹¹. There are three types of dwarf galaxies: Elliptical (dEs), Spheroidals (dSphs) and Irregular (dIrr). The dEs and dSphs are usually found near larger galaxies while the dIrrs are more isolated.

Dwarf Ellipticals (dEs) and Dwarf Spheroidals (dSphs)

These dwarf galaxies contain no or very little gas. They are not forming stars now, nor have they done so recently in any significant way. They are generally elliptical in shape (see Figure 4). They are normally found near the large galaxies of the Local Group. The Milky Way has at least 20 dE/dSph companions while M31 most likely has a similar number (still being discovered).

The study of these dwarf galaxies was fundamental in the advancement of the study of dark matter and its association with the formation of galaxies. For example, different theories about how galaxies form predict different numbers of dwarf galaxies versus large galaxies. Just comparing/counting numbers of dwarf galaxies is significant to the research.

It's only recently that astronomers have discovered just how prevalent these dwarf satellite galaxies are, thanks to projects like the Sloan Digital Sky Survey, which imaged large areas of the nighttime sky in greater detail than ever before. In the past several years alone, the number of known dwarf galaxies orbiting the Milky Way has doubled from the dozen or so brightest that were discovered during the first half of the twentieth century.

Evidence for Mergers & Accretion

If the primary mechanism for growth of large galaxies is accretion of low mass dwarfs, we should find evidence of present day merger events in the Local Group. The Sagittarius Dwarf (SagDEG) was discovered in 1995 in a spectroscopic survey of the radial velocities of red giant stars towards the Galactic Center¹². This was a case of a PhD student finding something more interesting in his data than he originally anticipated.

SagDEG orbits our galaxy in less than one billion years and must therefore have passed through the dense central region of the Milky Way at least 10 times during our galaxy's lifetime. The fact that it has remained intact suggests that SagDEG may contain a significant amount of dark matter that helps to bind it together. It is, however, apparently now in the process of being disrupted by ram forces of its massive neighbor. This may lead to its globular clusters and many of its other stars finding a new home in the Milky Way's halo, while its remaining stars escape to become solitary intergalactic travelers¹³. It has been speculated that M54 (globular in Sagittarius) was once the center of SagDEG.

It is important to continue finding additional satellites and Local Group members. With more objects there is a greater opportunity of determining what drives the complex star formation histories of these supposedly simple systems. For example, there is the well-known morphology-density relation in which the majority of the isolated dwarf galaxies in the Local Group are star-forming, gas-rich dIrrs, but not dEs. This hints at the role of the 'parent' galaxy in governing the evolution of the satellite dwarfs (e.g. gas removal mechanisms such as ram-pressure stripping in a hot halo preventing gas retention).

Dark Matter¹⁴

dSphs galaxies are believed to be the most dark-matter dominated objects in the Universe and are the smallest objects on which dark matter is found. Dark matter has heavily influenced dSphs formation and evolution and understanding dark matter on these scales can be extended to larger objects. This makes them incredibly valuable in the study of Dark Galaxies. We are fortunate to have multiple dwarfs to investigate that are close by space standards.

dSphs also contain some of the most metal-poor stars found in the LG. The Galactic halo of the MW also contains such stars but with far greater frequency, which is puzzling. That the dSphs should contain metal-poor stars is not surprising as they are very old systems that contain very old stars¹⁵; these stars will have formed before any significant chemical enrichment of the interstellar medium (ISM) could have taken place and so they will be of very low metallicity.

Given that the halo of the Galaxy has been formed from the continual accretion of dSph systems, we would expect to see a similar fraction of metal poor stars in the halo as we do in the dSphs, brought in by accreted satellite galaxies. Since this is not the case, it could indicate some fundamental difference between the early-accreted satellites that have built up the halo and those that are only now accreted into the MW. This concept may provide a fundamental understanding to the morphology of galaxy structure.

The SDSS dwarfs are very metal-poor, like a lot of stars found in the halo, however the classical, pre-SDSS¹⁶ dwarfs lack any really metal-poor stars. This would imply that the new discoveries are a part of the old dwarf population from which the MW halo was first formed. The new dwarfs are less regular in shape than those previously known, indicating that tidal forces are at work and are an important consideration in any further study.

Morphology of Galaxies¹⁷

Changing Models of Galaxy Formation

- Classical (1963-1985) Hubble Morphology:
 - galaxies evolve in isolation, present day properties governed by star formation history
 - ellipticals: prompt conversion of gas, then stars
 - spirals: gradual consumption of gas, continuous star formation
- Dark matter based (1985-):
 - gravitation governs merging of DM halos
 - low mass halos collapse first (bottom up formation)
 - mergers transform morphologies (ellipticals form late)
 - dense environments evolve faster (clusters older than field)
 - hierarchical assembly on a DM basis

The following is my rendition of the sequential description of the Dark Matter Based Morphology:



| <u>Sequence</u> | <u>Action</u> | <u>Results</u> |
|-----------------|--|---|
| 1 | Invisible dark matter halos condense into loosely structured mass | Dark matter globs |
| 2 | Gas condenses within the dark matter halos. Some stars form and collect into globular clusters. Most of the gas collects forming into a disk | Dark matter halos with disk shaped object. First inkling of a spiral |
| 3 | Stars form in the disk building the spiral galaxy, possible accretion of smaller galaxies into disks | Spiral disk with globular clusters, dwarf clusters, dwarf galaxies accreted (e.g. MWG) |
| 4 | Spiral galaxies collide | Multiple spiral galaxies with disks and globular clusters interact such as in Figure 3. |
| 5 | The collision of spiral galaxies produces an elliptical galaxy while preserving the original globular clusters | Elliptical galaxy with preserved globular clusters (e.g. predicted merger of M31 and MWG in 10^9 years. |

Observation Process

The 18" Ultra Compact (UC) Obsession Reflector was used for all the observations. This enabled me to observe objects along with some details either with the 6mm Ethos or 22mm Panoptic eyepieces. The 6mm seemed to work best for the very low or faint objects. The 6mm was also used to observe additional detail.

It was necessary to explore for an additional viewing site to get the necessary southern view with no local light pollution or reduced sky glow from Las Cruces and El Paso. I found a suitable spot about half-way between Las Cruces and Deming on the outskirts of the Burris Ranch. This is designated as location 116NW at Latitude 32 17' 40" and Longitude -107 16' 47". It falls within the darkest areas within a 50 mile radius of Las Cruces and rivals our dark site at Upham that does not have a very dark view to the South.

Summary

LG dwarfs are difficult but interesting to observe. I am more comfortable with Dark Matter theory since one can now understand how the theory blends with the new galaxy morphology. Observing and studying this area has increased my knowledge about galactic structure and formation along with determining the difference between Dwarfs Galaxies and Globular Clusters. We can only rely on simulation models and astrophysics research to forecast the outcome of galaxies colliding. However, observers may immerse themselves into the phenomenon that is taking place before their eyes. Bottom line: still a lot of interesting Astronomy and Astrophysics to do in our own backyard!

Dwarfs become elevated in stature; no longer the faint objects that few want to observe and photograph. Colliding galaxies are becoming the basis of a major phase of galaxy formation. And the visual beauty of the three legs of the "Special Horizon" is simply thrilling to observe and photo.

Structured formation in the universe is hierarchical, this makes dSphs the dark matter building blocks of the Universe and, thus, they are some of the first objects to form. This also makes them some of the oldest systems in the Universe and host to some of the oldest stars. These primordial stars are essential for investigating the first stars that formed and reionized the Universe. Take a look at one of these dwarfs some night and you can see some of the first stars created in our Universe.

Therefore studying and observing galaxy collisions, dwarf galaxies and dark matter theory, which are all associated with "Interacting Galaxies," provides unique knowledge that comes with the territory of this "Special Horizon." Are the "Sirens" calling you?

In *Blade Runner* the replicants escaped to the earth in search of how to extend their existence. We humans look the other way to the heavens for the explanation of "Life and Existence".

Metadata

I can provide my electronic logs which provide all the objects and fairly detailed descriptions of the objects that I have observed for anyone interested in observing the Northern Arp Peculiar Galaxies, the Southern Arp Peculiar Galaxies, or the Local Group. The logs are available in Right Ascension or Constellation sequence for ease

of recording and planning. I can also lend my sketch book and log for the Local Group that also has detailed descriptions if anyone wants to pursue obtaining a certificate from the Astronomy League or has a special interest in this area.

Footnotes:

¹ *Blade Runner* (1982) is an American science-fiction film, directed by Ridley Scott

² Human like robot with a built in life span.

³ *Atlas of Peculiar Galaxies*; 1966

⁴ *A Catalogue of Southern Peculiar Galaxies and Associations*, Arp, H. C. and Madore, B.F., Vol. 1, Positions & Descriptions, Cambridge University Press, 1987.

⁵ www.astroleague.org

⁶ www.hubblesite.org

⁷ www.hubblesite.org

⁸ Astronomical Society of Las Cruces

⁹ Parsec equals 3.2 light years

¹⁰ Total Luminosity

¹¹ Segue 1- Approx. 1000 visible stars has the mass for 600K stars

¹² Ibata et al 1995 MNRAS 277 781

¹³ Astronomy Picture Of the Day (APOD)

¹⁴ Lectures: Univ. of Hawaii Lecture Course on Galaxies; Australian National Univ. Lecture on Galaxies.

¹⁵ Dr. Marla Geha: Article about Segue 1 from Daily Mail Online, 8/3/2011.

¹⁶ For example: NGC 6822, Fornax Dwf., Pegasus Dwf., etc.

¹⁷ Ibid; Lectures.

Astro-Tidbit of the Month

Metamorphosis of Moon's Water Ice Explained, June 19, 2013

Institute for the Study of Earth, Oceans, and Space

DURHAM, N.H. — Using data gathered by NASA's Lunar Reconnaissance Orbiter (LRO) mission, scientists believe they have solved a mystery from one of the solar system's coldest regions—a permanently shadowed crater on the moon. They have explained how energetic particles penetrating lunar soil can create molecular hydrogen from water ice. The finding provides insight into how radiation can change the chemistry of water ice throughout the solar system.

Space scientists from the University of New Hampshire and NASA's Goddard Space Flight Center have published their results online in the *Journal of Geophysical Research (JGR): Planets*. Lead author of the paper is research scientist Andrew Jordan of the University of New Hampshire's Institute for the Study of Earth, Oceans, and Space (EOS).

Discovering molecular hydrogen on the moon was a surprise result from NASA's Lunar Crater Observation Sensing Satellite (LCROSS) mission, which crash-landed the LCROSS satellite's spent Centaur rocket at 5,600 miles per hour into the Cabeus crater in the permanently shadowed region of the moon. These regions have never been exposed to sunlight and have remained at temperatures near absolute zero for billions of years, thus preserving the pristine nature of the lunar soil, or regolith.

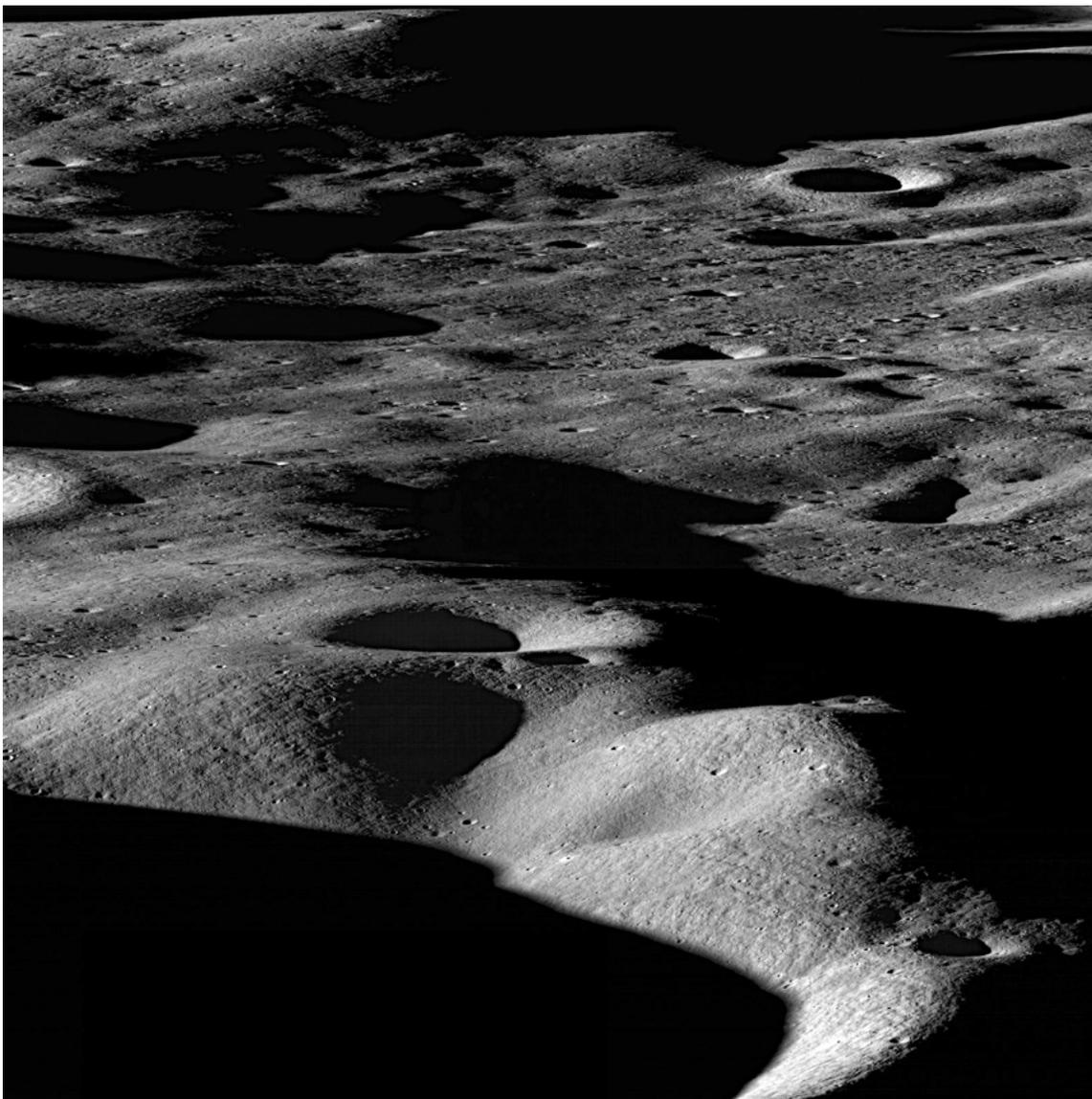
Instruments on board LCROSS trained on the resulting immense debris plume detected water vapor and water ice, the mission's hoped-for quarry, while LRO, already in orbit around the moon, saw molecular hydrogen—a surprise.

"LRO's Lyman Alpha Mapping Project, or LAMP, detected the signature of molecular hydrogen, which was unexpected and unexplained," says Jordan.

Jordan's JGR paper, "The formation of molecular hydrogen from water ice in the lunar regolith by energetic charged particles," quantifies an explanation of how molecular hydrogen, which is comprised of two hydrogen atoms and denoted chemically as H₂, may be created below the moon's surface.

“After the finding, there were a couple of ideas for how molecular hydrogen could be formed but none of them seemed to work for the conditions in the crater or with the rocket impact.” Jordan says. “Our analysis shows that the galactic cosmic rays, which are charged particles energetic enough to penetrate below the lunar surface, can dissociate the water, H₂O, into H₂ through various potential pathways.”

That analysis was based on data gathered by the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument aboard the LRO spacecraft. Jordan is a member of the CRaTER scientific team, which is headed up by principal investigator Nathan Schwadron of EOS. Schwadron, a co-author on the JGR paper, was the first to suggest energetic particles as the possible mechanism for creating molecular hydrogen.



Panoramic lunar view taken by the Lunar Reconnaissance Orbiter Camera of the north rim of Cabeus crater. The distance from left to right is about 75 kilometers (46 miles). Image courtesy of NASA/GSFC/Arizona State Univ.

CRaTER characterizes the global lunar radiation environment by measuring radiation dose rates from galactic cosmic rays and solar energetic particles. Says Jordan, “We used the CRaTER measurements to get a handle on how much molecular hydrogen has been formed from the water ice via charged particles.” Jordan’s computer model incorporated the CRaTER data and showed that these energetic particles can form between 10 and 100 percent of the H₂ measured by LAMP.

The study notes that narrowing down that percent range requires particle accelerator experiments on water ice to more accurately gauge the number of chemical reactions that result per unit of energy deposited by cosmic

rays and solar energetic particles.

Co-authors on the JGR paper include CRaTER scientists Harlan Spence, Colin Joyce and Jody Wilson of EOS and Timothy Stubbs of the NASA Goddard Space Flight Center. To view the paper, visit <http://onlinelibrary.wiley.com/doi/10.1002/jgre.20095/abstract>

The University of New Hampshire, founded in 1866, is a world-class public research university with the feel of a New England liberal arts college. A land, sea, and space-grant university, UNH is the state's flagship public institution, enrolling 12,200 undergraduate and 2,300 graduate students.