



NOVAC

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ASTRONOMY CLUB

MARCH 2015

Clear, Dark, Dry Imaging from Northern Virginia

by Craig Anderson

My longtime friend and astronomy partner, Dave Roemer, and I built a remote observatory at his home in Sierra Vista, Arizona, realizing a goal we established two years ago. With a roll-off roof, a 6 in. refractor, a quality mount, and computer control, I can log in from home, check the weather, open the observatory, initiate data collection, and still get some sleep knowing that the imaging run will complete, and that the scope will be parked safely by morning. Soon we will be completing automation, enabling the roof to automatically close when imaging is complete, or if threatening weather approaches.

This article chronicles our journey from imagining what might be possible to capturing first light at our observatory, which we call RISS-Remote.

Losing Dark Skies

I grew up in Bloomington, Minnesota, not far from where the Mall of America is located today. Of course back then

it was Metropolitan Stadium, home of the Twins baseball team. Skies were noticeably light polluted when I was growing up, with the Milky Way seldom visible unless we drove out to the country, which we often did. Armed with a home made 6 in. reflector on a pipe mount built when I was 13, my friends and I tried some dark sky imaging from rural locations with an SLR and 400 speed film by bumping the pipe mount along with the camera strapped on the telescope tube. It wasn't pretty, but it was enough to spark my interest in astrophotography.

I moved to California in 1988, and found that it was insanely bright where I lived in the heart of Silicon Valley. Fortunately, I soon discovered Fremont

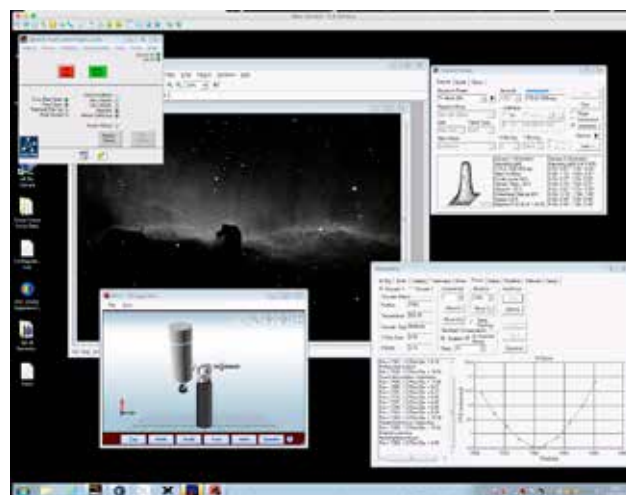


Figure 1: RISS-Remote Viewed from Home

Peak, an oasis of dark sky 3,000 feet above sea level near Monterey Bay. It was at Fremont Peak State Park that I met David Roemer and his wife Nancy Hannaford, where amateur astronomers set up their scopes around every new moon.

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Site Coordinator Request from NOVAC President, Terry Cabell

NOVAC is looking for several volunteers to be Site Coordinators for two of our locations: C. M. Crockett Park and Sky Meadows State Park. Coordinators are the people who ensure good communication with park personnel regarding member observing privileges after normal park hours, and monthly public events held by NOVAC to support our outreach efforts with the community.

While the details differ slightly as to how we support Crockett and Sky Meadows, someone who might want to become a Site Coordinator should:

1. Be diplomatic and courteous: Site Coordinators need to ensure we have excellent channels of communication between our members, the park staff and—while they are on site—the general public at our public night events. Consequently, good people skills are important.
2. Be available to attend scheduled public nights at the park. Typically, while it is possible to hand off a specific public night to another volunteer, the Site Coordinator, or his/her designee, needs to be on site for public nights.
3. Put out calls via the listserv for volunteer NOVAC astronomers for public nights, and coordinate with the park staff on any special conditions at public night events (e.g.: field conditions).
4. Take occasional questions from the general public about public nights, NOVAC members about access times or field conditions and park personnel on scheduling or park conditions.
5. Negotiate the annual Member Observing Agreement (MOA) with the park for 2016. Usually, either the park or NOVAC has a few minor adjustments they wish to make to an agreement, and dates for public events need to be coordinated to ensure they do not conflict with other park events, or NOVAC special events. Both MOAs are done for 2015.
6. Site Coordinators have the support of NOVAC's Board of Trustees for advice and guidance, but the Site Coordinator is the primary point of contact between the NOVAC membership and the park. Consequently, if you're a Site Coordinator, it's your show.

Site Coordinators need not have any previous public night experience, nor need he/she be an experienced amateur astronomer. While such experience would be a help, Site Coordinators are really just what their title says they are, folks who coordinate activities that help NOVAC advance its mission: To Observe and Help Others Observe.

One huge benefit for someone who assumes the duties of Site Coordinator at either Crockett or Sky Meadows is that the previous Site Coordinators will still be available to provide advice. Although Jim Mosquera and I wish to step down from our roles, we both plan to remain active at our locations, and can provide all the training and ongoing guidance anyone will need to be successful.

*If you think you might be interested in becoming a Site Coordinator, please respond to Terry Cabell directly at president@novac.com. He will be happy to answer your questions, and discuss further details regarding each location. **

Upcoming NOVAC Meetings

March 8
Exploring the H II
Regions of Galaxies
Speaker: Loren Anderson

April 12
The Physics of Space
Speaker: Sten Odenwald

May 3
Radio Astronomy
with ALMA
Speaker: Alberto Bolatto

June 14
Meeting topic TBA
Speaker: TBA

Monthly meetings are normally held at 7 p.m. on the second Sunday of each month (except for the month of May, when the meeting is held on the first Sunday) in Room 163 of the Research Building on the campus of George Mason University. More info at www.NOVAC.com.

NOVAC

The *NOVAC Newsletter* is the official publication of the Northern Virginia Astronomy Club and is published quarterly. The *NOVAC Newsletter* is available to members of NOVAC as a regular membership benefit.

Membership

Membership in the Northern Virginia Astronomy Club is \$35.00 per year and is open to anyone interested in astronomy or the sciences. Additional memberships at the same address are \$10.00 per person. Membership in the Astronomical League is free with NOVAC membership and includes the *Reflector* magazine plus access to their Observing Awards.

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Submissions to the newsletter

NOVAC members are invited to submit articles for publication in the *NOVAC Newsletter*. The editor reserves the right to edit all materials submitted. Send article submissions to the Editor, Chris Lee, at newsletters@novac.com.

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Clear, Dark, Dry Imaging from Northern Virginia

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I built my first Dob in Dave and Nancy's Santa Clara garage, and enjoyed observing at Fremont Peak with that scope for many years. Light pollution kept increasing, even at Fremont Peak, but on nights when the marine layer (dense fog) darkened the lights from Hollister and Salinas, true dark skies could still be enjoyed from that location.

In 1995 I moved from California to Colorado, purchasing a home on the edge of suburbia southeast of Denver where it was still relatively dark. Within a few years CCD imaging was gaining in popularity and becoming more affordable, so I bought in with an SBIG ST2000 camera, an AP155 F7 refractor, and an AP900 mount. (I started with a G11 mount but moved up to an AP900 after convincing my wife, Amy, that there would be less cursing at star parties if I had a more solid mount.) I had a great time imaging in and around Colorado, traveling to star parties like the Weekend Under the Stars in Wyoming and the Rocky Mountain Star Stare Southwest of Pueblo, Colorado.

It was in Colorado that I built the pre-cursor to RISS-Remote. I started with a cement column under my deck as a base, bolted on a Le Sueur Astro Pier, and topped it with a Losmandy G11 Mount with the Gemini system. I soon added cables to supply



Figure 2: First Light Image



Figure 3: The Precursor to RISS-Remote in Colorado

12vdc power to the pier, and to carry mount and camera connections into the house. This allowed for "remote" imaging from inside when it was cold, or when I had something else I wanted

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to do—like watch some TV during long exposures.

Living in Colorado with that pier out back I had it pretty good. I could image more days than not, and it was dark enough to do some interesting work. It was also very dry in Colorado so I could leave my polar aligned mount out year round with a grill cover on top, and just slide my scope into the dovetail when I wanted to set up for observing or imaging.

Fast forward to 2006 when my company suggested a move to Northern Virginia. As much as I loved Colorado, my employer had always been good to us so we decided it was time to return the favor by migrating East. With my wife Amy six months pregnant with our first child, we quickly found a house in Herndon, Virginia, and settled in to our new home.

Our house in Herndon backs to the woods of Sugarland Run, and there are no exterior lights directly visible from our back yard. This seemed promising for another pier. We're technically not in the big city, but I soon found that skies here are pretty bright, the air is moist, and there are a lot of trees to obstruct the view. There's also a lot more cloud cover here than I had in Colorado. After a few months it was pretty obvious that our new location wasn't going to work out for deep sky imaging due to all these factors. Resigned to drop out of astrophotography for a while, I sold my CCD camera, and comforted myself with a big dob and regular outreach as part of NOVAC at Sky Meadows, Crockett, and Great Meadows.

Undeterred and hopelessly optimistic I built a new pier anyway, running power and control wiring into my home office.

I enjoyed using the Herndon pier for solar and planetary work, and did



Figure 4: Backyard Pier in Herndon Set Up for Solar

some imaging with an Imaging Source DMK41 web camera. This got me interested in some deep sky astrophotography again, but, since that wasn't much of an option from our location, I figured I'd have to go portable. Setting up, configuring, and tearing down in the field turned out to be too much of a time investment, and, although I bought a new CCD camera, I never managed any significant imaging. If I was going to realize my dreams of dark sky imaging from Herndon, I was going to have to find another way.

Getting Dark Skies Back

Two years ago Dave and Nancy sent me a note to let me know that they had bought a home in Sierra Vista, Arizona, and were moving there in a few weeks. Sierra Vista! I'd been to Tucson and the surrounding area and knew this meant good conditions for astronomy. And, as

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Mismatched Twin Stars Spotted in the Delivery Room

From Harvard CfA News

The majority of stars in our galaxy come in pairs. In particular, the most massive stars usually have a companion. These fraternal twins tend to be somewhat equal partners when it comes to mass, but not always. In a quest to find mismatched star pairs known as extreme mass-ratio binaries, astronomers have discovered a new class of binary stars. One star is fully formed while the other is still in its infancy.

"We caught them at just the right time. In effect, we're seeing these stars in the delivery room," says lead author Maxwell Moe of the Harvard-Smithsonian Center for Astrophysics (CfA).

The more massive a star is, the brighter it shines. This makes it difficult to identify extreme mass-ratio binaries because the heavier star outshines, and thereby hides, the lighter star.

To combat this effect Moe and his CfA colleague Rosanne DiStefano looked for eclipsing systems, in which the two stars line up in such a way that they periodically pass in front of each other as seen from Earth. When the fainter star eclipses the brighter star, their combined light drops detectably. These systems are rare because they require a precise alignment as seen from Earth.

After sifting through thousands of eclipsing systems, they identified 18 extreme mass-ratio binaries in a neighboring galaxy called the Large Magellanic Cloud. The stars circle each other tightly in orbits with periods of 3 to 9 days. The more massive stars weigh 6 to 16 times as much as the Sun, while the less massive stars weigh about 1 to 2 times the Sun.



A clue to the young nature of these systems came from an unusual feature in the data. The fainter star shows illumination phases, just like phases of the moon, as the two stars orbit each other. This indicates that the companion is reflecting the light of the brighter, more massive star.

We only see phases because the fainter and less massive companion is not yet a full-fledged star. Astronomers describe it as being "pre-main sequence."

A star forms when a giant clump of gas pulls together under its own gravity, growing denser and hotter until nuclear fusion ignites. This process happens faster for more massive stars.

"Imagine if a human baby shrank as it got older instead of growing. That's what happens for young stars," says DiStefano.

In the young systems this research identified, the more massive star is already on the main sequence, while the less massive companion is not. As a result, that companion is puffier than it would be, since it is still contracting. This effectively lets the pre-main sequence star act as a giant mirror, reflecting the brilliance of its partner.

The discovery of these stellar twins could provide invaluable insight into the formation and evolution of massive stars, close binaries, and star nurseries.

These 18 systems were culled from millions of stars in the Large Magellanic Cloud observed by the Optical Gravitational Lensing Experiment. Due to their rarity, finding examples in our galaxy likely will require an extensive survey using facilities like the upcoming Large Synoptic Survey Telescope.

This research has been accepted for publication in *The Astrophysical Journal*.

Headquartered in Cambridge, Mass., the Harvard-Smithsonian Center for Astrophysics (CfA) is a joint collaboration between the Smithsonian Astrophysical Observatory and the Harvard College Observatory. CfA scientists, organized into six research divisions, study the origin, evolution and ultimate fate of the universe. ★

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The Heavyweight Champion of the Cosmos

By Dr. Ethan Siegel

As crazy as it once seemed, we once assumed that the Earth was the largest thing in all the universe. 2,500 years ago, the Greek philosopher Anaxagoras was ridiculed for suggesting that the Sun might be even larger than the Peloponnesus peninsula, about 16% of modern-day Greece. Today, we know that planets are dwarfed by stars, which themselves are bound together by the billions or even trillions into galaxies.

But gravitationally bound structures extend far beyond galaxies, which themselves can bind together into massive clusters across the cosmos. While dark energy may be driving most galaxy clusters apart from one another, preventing our local group from falling into the Virgo Cluster, for example, on occasion, huge galaxy clusters can merge, forming the largest gravitationally bound structures in the universe.

Take the “El Gordo” galaxy cluster, catalogued as ACT-CL J0102-4915. It’s the largest known galaxy cluster in the distant universe. A galaxy like the Milky Way might contain a few hundred billion stars and up to just over a trillion (10¹²) solar masses worth of matter, the El Gordo cluster has an estimated mass of 3×10^{15} solar masses, or 3,000 times as much as our own galaxy! The way we’ve figured this out is fascinating. By seeing how the shapes of background galaxies are distorted into more



X-rays are shown in pink from Chandra; the overall matter density is shown in blue, from lensing derived from the Hubble space telescope. Ten billion light-years distant, El Gordo is the most massive galaxy cluster ever found.

IMAGE CREDIT: NASA, ESA, J. JEE (UC DAVIS), J. HUGHES (RUTGERS U.), F. MENANTEAU (RUTGERS U. AND UIUC), C. SIFON (LEIDEN OBSERVATORY), R. MANDELBUM (CARNEGIE MELLON U.), L. BARRIENTOS (UNIVERSIDAD CATOLICA DE CHILE), AND K. NG (UC DAVIS).

elliptical-than-average shapes along a particular set of axes, we can reconstruct how much mass is present in the cluster: a phenomenon known as weak gravitational lensing.

That reconstruction is shown in blue, but doesn’t match up with where the X-rays are, which are shown in pink! This is because, when galaxy clusters collide, the neutral gas inside heats up to emit X-rays, but the individual galaxies (mostly) and dark matter (completely) pass through one another, resulting in a displacement of the cluster’s mass from its center. This has

been observed before in objects like the Bullet Cluster, but El Gordo is much younger and farther away. At 10 billion light-years distant, the light reaching us now was emitted more than 7 billion years ago, when the universe was less than half its present age.

It’s a good thing, too, because about 6 billion years ago, the universe began accelerating, meaning that El Gordo just might be the largest cosmic heavyweight of all. There’s still more universe left to explore, but for right now, this is the heavyweight champion of the distant universe! ★

Learn more about “El Gordo” here: <http://www.nasa.gov/press/2014/april/nasa-hubble-team-finds-monster-el-gordo-galaxy-cluster-bigger-than-thought/>

El Gordo is certainly huge, but what about really tiny galaxies? Kids can learn about satellite galaxies at NASA’s Space Place <http://spaceplace.nasa.gov/satellite-galaxies/>.



This article was provided by NASA’s Space Place. Kids, parents and educators can find fun facts, activities and more at <http://spaceplace.nasa.gov>

My Excellent NOVAC Astronomy Day Adventure

by Cal Powell

For once, the observing gods were on our side for NOVAC Astronomy Day 2014 on the last day of May. When I arrived at our Sky Meadows State Park event site in the early afternoon, the tents were pitched, many of our club members were already there, and the sky was clear and sunny. I set up my SolarScope, a nifty and relatively simple system that uses a plano-convex lens and a small convex mirror to project a safe, white-light image of the Sun onto a small screen within the device. The Sun also cooperated by displaying some nice sunspots.

In the late afternoon, I gave a talk entitled "Nebulas and Clusters and Galaxies, Oh My!" which provided the audience with an introduction to the three major categories of deep sky objects. After the "test your comprehension" segment, my presentation concluded with a lively session of "Moon or Frying Pan?"

The sky was now getting dark, so I quickly set up my (night-time) telescope and headed over to the area of the observing field where I conducted a tour of the late spring night sky. I especially enjoy pointing out stars and constellations to an audience because it reminds me of the talks I used to present as a part-time planetarium lecturer in Connecticut.

Public observing started at dusk, with the Moon, Jupiter, Mars, and Saturn.

Although my alignment was off slightly, the views in my Celestron CPC1100 were pretty good and the sky was rea-



sonably clear, so I decided to attempt an elusive target—an object that I had wanted to capture for years. Earlier in the day, I used Stellarium to determine that my target would culminate at 10PM ET on May 31st.

At 10PM, I began my search by keying in a preliminary target, another object that I had never seen before, NGC 5128. Better known as Centaurus A, NGC 5128 is a galaxy that was discovered in 1826 by James Dunlop, observing from Australia. The galaxy is a strong radio and X-ray source due to emissions from a supermassive black hole at its center.

Although NGC 5128 is listed as the fifth brightest galaxy in the night sky, its southerly declination (-43°) makes it quite challenging to observe from mid-Northern latitudes. Not quite centered in the field of view, there it was, a definite circular smudge at 175x. Viewing it, I knew there was a chance to glimpse my ultimate quarry, four-and-a-half degrees farther South. I grabbed the NexStar hand control, and keyed in... NGC 5139!

NGC 5139, better known as Omega Centauri, was cataloged as a star by Ptolemy and drawn as such in the Uranometria star atlas by Bayer. It was rediscovered as a non-stellar object by Edmond Halley in 1677 and recognized as a globular cluster in 1826 by James Dunlop. At 36 ft. in diameter and glowing at magnitude 3.9, it is by far the biggest and brightest globular cluster in the Milky Way Galaxy. (Astronomers suspect that it is the remnant core of a dwarf galaxy that was consumed by the Milky Way!)



SolarScope—a nifty and relatively simple system that uses a plano-convex lens and a small convex mirror to project a safe, white-light image of the Sun onto a small screen within the device

At -47.5° declination, Omega Centauri is never more than a few degrees above the Southern horizon during Winter and Spring from mid-Northern latitudes. The CPC1100 slewed nearly horizontal to a murky field of view. A few minor positional adjustments with the hand controller allowed me to detect a large slightly oval brightening that just about filled the field. That had to be it. I had finally observed Omega Centauri!

The remainder of the night observing session was spent sharing wonders of the late spring and early summer deep sky with our visitors, objects such as the magnificent globular cluster M3 and the needle-thin edge-on galaxy NGC 4565. However, I will always remember NOVAC Astronomy Day 2014 as it was my first encounter with Omega Centauri, the emperor of Milky Way globular clusters. *

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Dave is a fellow observer, I knew they would have picked the perfect spot.

Coincidentally, the first Arizona Science and Astronomy Expo (ASAE) was coming up in Tucson, so I made plans to visit Dave and Nancy at their new home, and to attend the first ASAE all in one trip—my version of an astronomy hole in one.

We had a great time at the conference, and I found that my friends had indeed picked a great location for astronomy for their new home. While visiting, I helped Dave to reassemble his dome, and set up his classic orange tube C14 with a Byers drive. I had helped him to set up this same dome at their home in California years ago, and we jokingly called it RISS for “The Roemer Institute for Selfish Science”. (When we set up multiple telescopes we used to call it “the very strange array”.)

After we got the dome and the scope set up I found myself wandering around Dave and Nancy’s new backyard; noticing the great horizons, absence of nearby lighting, and available real estate. Jokingly, I stood in a good spot, put out my arms, and declared, “How about if I put my observatory right here!” Much to my surprise, and delight, Dave and Nancy agreed to consider a remote observatory on their property, which we later decided to build and to christen “RISS-Remote”.

I’d never before entertained the possibility of a remotely operated observatory for many reasons. I assumed the cost would be too high. Places like New Mexico Skies and Arizona Sky Village seemed out too far away and too expensive. Hosted piers were mysterious, and seemed out of reach. Also, I worried that if anything went wrong with a remote observatory I’d be in big trouble because I’d be hundreds, if not thousands, of

miles away from my gear. I briefly considered a location in West Virginia, closer to home, but that, too, seemed out of reach between finding land, acquiring it, getting the necessary infrastructure in place, etc.

All of this is what made building a remotely controlled observatory at Dave and Nancy’s so attractive. It might not be as dark as other potential locations, but it was a lot darker than home, the land was there, power and intranet connections were nearby, and it was right in my friend’s backyard. So, if anything went terribly wrong Dave could just walk out there and take care of it (a feature we’ve used since more than a few times).

Defining Requirements

Our first order of business was to decide what, exactly, we wanted RISS-Remote to be able to do. One core requirement was that I would be able to image remotely from my home in Herndon, Virginia. This meant that I had to be able to remotely control the CCD camera and the mount—driving the need for a remotely accessible Internet connection and control computer. I needed to be able to focus remotely, too. And to monitor the position of the telescope to make sure it was slewing correctly, parking safely, and never heading for a crash with the pier.

I needed to be able to open and close the roof, either by opening and positioning a dome, or by rolling the whole roof to one side. Remote control over



Figure 5: Dave and Nancy’s New Place in Sierra Vista

AC power was needed, and for almost every device—even the main control computer (what if it froze and needed a reboot)? Finally, I needed a way to check the weather, and monitor the sky conditions including clouds, wind, and rain.

Planning and Prototyping

We decided to divide and conquer to create RISS-Remote. It was agreed that I would provide the telescope, mount, imaging camera, guiding camera, control computers and other “inside” parts while Dave and Nancy would provide the land, building, and other infrastructure (outside parts). Dave and I would share the use of the observatory so we would both benefit from the investment. We also agreed that the user of the observatory would be responsible, within reason, for anything that went wrong while he was operating it.

Serious planning began right away, and we decided we’d better start with a prototype to test our ideas. The idea behind the prototype was to assemble all the optical, mechanical, electrical, and control systems and to try operating them as if they were remote. This would allow us to safely test our ideas

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prior to actually fielding the equipment.

The prototyping was my responsibility, and I began by building up a control computer and loading it with all the necessary software for what we had planned. This software included Windows 7, TheSky6 Professional, RAdmin Server (for remote access), MaxIm DL, PEMPro, ASCOM, the AP V2 ASCOM driver, the RoboFocus ASCOM driver, QSI and ST-i camera drivers, and Alnitak "Flip Flat" control software and drivers. I also established a subnet on my home computer network that included a remotely accessible static IP address so that I could emulate connecting remotely as realistically as possible.

Once the computer was set up and remote access worked, I integrated the control computer with the rest of the equipment on a table in our basement. This included the telescope itself, a QSI 683wsg imaging camera with 8 position filter wheel, an SBIG ST-i guide camera, a RoboFocus unit, a Flip Flat (combination dust cover and flat field device), a FOSCAM IP camera, a network switch, and a Digital Loggers power strip that allowed each outlet to be turned on, or off, over the internet. I also put my Astro Physics AP900 mount on the table (with plenty of clearance for slews) and cabled it up to the computer. Now I had a fully integrated set of components set up just like we planned to put them together at RISS-Remote in Arizona.

Once the prototype was assembled I began to test by "remotely" logging on to the "observatory" from a separate computer upstairs. I would establish a connection using RAdmin through a static IP as if I was more distant than one flight of stairs away. I practiced all the observatory operations we anticipated, including slewing, opening and closing the dust cover, connecting and disconnecting the cameras, control-

ling cooling, focusing, imaging, and processing. I used RAdmin because I didn't have Windows 7 Professional at the time and TeamWare didn't seem to work well for me in low bandwidth testing.

Testing the prototype allowed for a lot of kinks to be worked out while the equipment was still within reach. This turned out to be critical because I had to make quite a few adjustments to both the configuration and the approach we had planned. For example, I found that high frame rates in TheSky6 would overwhelm the remote connection when bandwidth was low, leaving me unable to connect back to the computer until it was rebooted. This particular problem was easily resolved by changing the update rate in TheSky6, but could have been a real hassle to figure out and change remotely.

Within weeks our prototype remote observatory was working fine in my basement. This meant that it was time to take the next step: moving it all outside, and imaging remotely for real, even if remotely meant just a few steps away. Using my friend, Industrial Velcro, I stuck literally everything I could on to the control computer so I could just haul it outside as a unit for testing. Then I installed my mount on the pier in our back yard, and built a bundle of cables to allow for quickly connecting and disconnecting everything. I even stuck the IP camera on top of the control computer (more Velcro) to monitor slews and observatory conditions, as we would have to do at the real observatory once deployed.

On every clear night I could I'd haul the prototype outside, plug it all together, and try to operate it remotely from my office inside the house. I would use the IP camera to monitor all of the slews.

I'd measure network utilization and other factors to verify that this would really work when it was over 2000 miles away. During some tests I'd execute actual imaging runs, and when there were problems I'd try to fix them without going outside and touching the equipment. Ever try to resynchronize the telescope position with the sky after completely losing calibration? I have, and made sure we could do it without traveling out to the scope. This testing was really valuable for flushing out the system, and for developing the necessary procedures to operate RISS-Remote safely, and confidently, once deployed.

Site Preparation

When I was about half way through integrating and testing RISS-Remote in my basement and backyard it was time for another ASAE conference. I made another trip out to Arizona—this time with another good friend and astronomy buddy, Ralph Jung. Ralph and I stayed with Dave and Nancy at their place in Sierra Vista. In between gawking at the ASAE vendor displays, attending the talks, enjoying the solar observing, and encouraging my friends to buy new gear, we spent a lot of time on more detailed planning for RISS-Remote. And with the prototype well under way, it was time to focus on the site and the observatory building itself.

We considered many options for the observatory. Initially, I was in favor of a clamshell, reasoning that it could be easily opened and closed remotely, and that not having to rotate a slit would be easier to manage. The cost for a commercially available clamshell in the necessary size, with automation, was fairly high, but that was offset by the fact that it could be easily installed, would be pretty secure, and would be

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Figure 6: Dave and Ralph Marking Surveying the Spot for RISS-Remote

easy to operate. The clamshell option was eventually vetoed on aesthetic grounds, which probably saved us a lot of money.

Next we considered a more traditional dome—including another like the one already up on Dave and Nancy's deck for what we now called "RISS Actual" (the C14).

Unfortunately we discovered that we'd need a fairly large dome to accommodate the planned 6 in. refractor on a German Equatorial Mount while leaving room for a future upgrade in aperture, which would be expensive. But there were a lot of advantages, including security, wind protection, and light shielding. When a used dome came up for sale in Dave and Nancy's neighborhood for a very reasonable price, we looked very seriously to see if everything would fit.

Fortunately, I set up a test in my basement to check actual clearances before we committed to buy the used dome. I say fortunately because we found out that our equipment wasn't going to fit, and future upgrades to the telescope and mount (a 14 in. RCOS?) would be impossible.

All this time Dave had been researching roll-off roof options for RISS-Remote. There are quite a few private observatories in Sierra Vista, and Dave has a lot of contacts through his local astronomy club that he consulted with on ideas. After looking at various designs and implementations he came up with something new that I haven't seen before, or since. He took a steel shed from a big-box store, shored it up with extra steel supports, and used garage door track, rollers, and an externally mounted opener to morph it into a roll-off observatory design. Advantages included simplicity, material that would hold up well in the desert environment, and cost. This he could build quickly on a concrete pad for a very reasonable price, and this was the design he selected.

Did I mention that Dave and Nancy are really good friends? Not only did they bring in a crew to prepare the site and pour the cement pad, they also had a security enclosure built with high block walls and locking gates. This provides physical security, and also added wind protection for the observatory. Winds can get really high out there, and 50 MPH gusts are not unusual.

You may notice that the perimeter fence encompasses a much larger area than needed for the observatory. There are two reasons for this. First, this spring Dave and Nancy plan to plant an orchard inside the security perimeter to complement the observatory, and create a new feature in the yard. Secondly, Dave is thinking of pouring a couple of guest pads, with power, for visiting astronomy friends.

Building the Roll-Off

With the observatory pad complete and the security perimeter in place, it was time for the shed to go up. Dave selected a 10 ft. by 12 ft. Aero Shed from Lowes—reasonably priced and locally available. He had experience with a similar shed having built a manual roll-off observatory at his prior home in Santa Clara, California, and it had worked well. This project would present some new challenges because it was going to be larger, had to be



Figure 7: Testing for Fit within a Six Foot Diameter Dome

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 10*



Figure 8: Forms for the Roll-Off Pad



Figure 9: Cutout for the Pier Base. Note the Conduit



Figure 10: Pouring the Pad



Figure 11: Pad Complete, Ready for the Shed!

sturdier and had to provide for remote operation. He shored up the structure with extra steel 2x4s, and isolated the roof from the main building. Then he installed garage door track and rollers, using fence posts for support, to allow the roof to roll on and off. Sliding doors in front, secured with a padlock, provide easy access for equipment. Grading of the cement provides for drainage, combined with grading of the soil around the pad.

One Thing Missing

With the roll-off complete, it was time to figure out how to put it all together. We planned to integrate the new observatory, and to “go live” in conjunction with ASAE 2014, so I could attend the conference and we could stand up RISS-Remote all in one trip. I began packing all of my equipment and preparing it for shipment, eventually sending it all via FedEx Ground with the

exception of the telescope which I sent UPS in a custom made double box.

Packing and shipping were probably the riskiest part of our adventure, so I spared no expense in carefully packing everything. I considered driving it down to Arizona, but the time involved was more than I could spare from work. In the end shipping worked out fine, and there were no problems at all—zero

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 11*



Figure 12: Security Perimeter for the New Area Under Construction

damage (whew!). We did receive something of a compliment from the FedEx delivery driver, who noted that almost every box was as close as it could get to overweight without actually exceeding the limit.

About this time I learned that the pier I had ordered, a key component, was not going to be fabricated, let alone shipped, in time for my trip to install the equipment. Since we really needed



Figure 13: Roll-Off Ready



Figure 14: RISS-Remote Components Ready to Ship

that pier, I delayed my trip, and hoped for the best. But it soon became clear that the pier would not be completed for weeks, or even months. With some regret I canceled the pier, shipped out my ATS portable pier as a stopgap, and made new airline reservations. I'd already missed ASAE, but at least the trip to assemble the observatory was back on track.

When I arrived Dave came up to Tucson to pick me up at the airport, and of course we decided to stop at a local astronomy shop, Starizona, on the way to his house. Dave needed a part for his Hyperstar, and I always enjoy stopping at a local astronomy shop. While we were there I noticed there were some piers in the Starizona showroom. Piers? I couldn't believe it. I didn't even know they sold piers at Starizona. What were the odds that they would have one to match our requirements?

Dean Koenig, the owner of Starizona, saw me checking the piers out, and came over to see if he could help. I told him what I needed, and to my surprise he went in search of a tape measure. "This one is spoken for...this one is too short...this one is too long...hey, what size did you say you needed?" Believe it or not, after ordering a custom pier, and waiting weeks before finding out it wouldn't be delivered on time, there was a pier of exactly the right size right there at Starizona. And Dave had

brought his pickup truck.

But now I needed a pier adapter, and I figured there was no hope. Dean asked the kind of mount we planned to use. I gave him the specs, and pointed to an older AP900 he had in the showroom and said "Like that one, over there?" With a smile, he then rummaged around, and emerged with a pier adapter built as a prototype that fit the one pier he just happened to have that wasn't spoken for. It was just exactly what I needed. A very reasonable few hundred dollars later we loaded that pier and the adapter into the back of Dave's pickup truck, and drove off to his house, hardly believing our good fortune. We now had the last part we needed to assemble RISS-Remote. Thank you, Starizona!

Installing the Pier

Thanks to detailed planning, lots of prototyping, plenty of testing, advanced prep work on site, and a healthy dose of good luck we had everything we needed to turn RISS-Remote into a fully functioning, remotely operated, astronomical observatory. There was only one problem: we hadn't planned on having a pier! So, remember that hole where the cement would go to mount the pier? It was still a hole. And I was only going to be on site for a few short days.

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 12*



Figure 15: Nancy Mixing Cement for the Pier Base



Figure 16: Conduit for Wiring in the Pier Base Hole



Figure 17: Dave and Nancy Working the Cement



Figure 18: We Built this Jig for the Pier Anchors



Figure 19: Dave Smoothing the Cement



Figure 20: Pier Base Completed on Day One

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 13*



Figure 21: Leveling the Pier with Nuts Above and Below



Figure 22: Recycled Tire Mulch to Dampen Vibration



Figure 23: AP900 Mount Installed

Dave, Nancy, and I talked it over and decided to go for it. We'd pour the pier support on the first day to allow for the rest of the project to get done before I left. We headed off to Home Depot, picked up 27 bags of cement mix, and settled in for a fun first day. By that day's end the pier base was poured, and we'd made and installed an anchor system to bolt the pier in place. Things were coming together nicely.

We let the cement for the base of the pier sit overnight, watering it frequently and keeping it covered with plastic to help it cure. Then we carefully placed the pier over the anchor bolts the next afternoon, leveling the pier using nuts and washers both below and above the base plate.

One thing I noticed right away was that the pier rang like a bell. This seemed like it could be a big problem since vibration is the enemy of imaging. So we headed back to Home Depot to see what we could find.



Figure 24: IP Camera for Observing Slews and Roof Status Inside the Observatory

Walking the aisles at Home Depot we thought of all sorts of crazy options to dampen the vibration in the

pier. The most obvious was sand (in sandbags), but that was vetoed on the basis of weight. We'd just poured the cement for the base of the pier, and we were afraid it hadn't cured enough to carry all that weight. If the anchor bolts came loose, we'd really be in big trouble, and it would probably take a second trip from Herndon to Arizona at a later date to finish this project. Other candidate damping materials we discussed included shingles, tar paper, and insulation—but none of these seemed quite right. Then, in the garden section, we found it. A lightweight, flexible material that could be tightly packed, perfect for damping vibration in a pier: recycled tire mulch. Three bags later, and we were in business.

Connecting It Together

Once the pier was in place things began to come together even more quickly. We installed the control computer inside an old Craftsman tool chest to protect it against the elements

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 14*

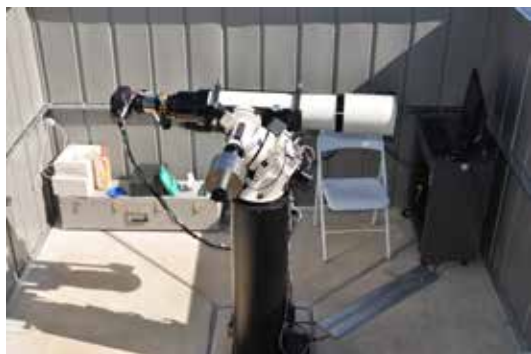


Figure 25: Scope Mounted and Wiring in Place



Figure 26: Flip Flat as a Dust Cover on a Homemade Rail

(water and critters). We mounted the IP camera on the wall to the North of the pier, enabling remote views of the telescope position, and verification of whether the roof was open or closed. We placed the AP900 mount on the pier, installed the network switch, and put the network wiring in place. The telescope was test fitted, and cabling installed for the cameras and other equipment.

Dave and Nancy already had a router capable of supporting a static IP address, and they had made prior arrangements with their local ISP, Clark Info Systems, to set up that static address when needed. I called during my trip, and we set that all up. Interestingly, Clark Info Systems uses an innovative line-of-site communications system for providing internet connections.

Armed with the static IP, I configured Dave and Nancy's router to use port forwarding so that traffic directed to one port would go to the Digital Loggers power strip, and a second to the Foscam IP camera, and a third to the control computer. Using this technique we leveraged a single IP address to support remote access for all three required devices.

Interestingly, routing all the cables to the equipment mounted on the telescope turned out to be one of the biggest challenges on this project. Dave and I spent a lot of time with zip ties and Velcro trying to find the right balance of location and length for all the cables—winding up with quite a bundle hanging from the scope. Although we moved the telescope around, and observed the cables carefully while doing so, our configuration ended up causing some serious problems in actual use. Dave had to go out more than once to free a caught cable and sometimes they would even apply enough force to rotate the imaging camera. This is an area that requires careful attention, and has since been redone

after a near catastrophe. Thanks especially go to a very helpful member of the local Ft. Huachuca astronomy club, Rick Burke, who fixed this for me, and saved the day (and night) when Dave and Nancy were out of town.

Motorizing the Roof

With the equipment installed and daylight remaining, our attention turned to working on the roll-off roof system again. Since this area of the country is very dry, and because we wanted the roof to open all the way, Dave elected to mount a garage door opener outside to operate the roof. This is a bit unconventional, but has worked very well. To control the roll-off, we selected a Foster Systems roll-off observatory card, and complementary magnetic sensors to detect whether the roof was open or closed.

We laid out the garage door opener, and installed additional fence posts to properly support it outside the observatory. We also trenched a line for power and control so that even the garage door opener could be turned on and off using the remote power switch inside the roll-off shed. This has turned out to be another critical feature, since the roof would really clobber the tele-



I definitely recommend remote power control separate from the computer for a remote observatory. This makes it possible to take a peek inside the observatory using the internal camera without powering up the control computer, for example. More importantly, we can remotely cycle the computer by cycling power to it in case things lock up. Even the computer monitor has separate power control, as does the mount, the camera and other major components.

Figure 27: Digital Loggers Power Switch

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 15*



Figure 28: Modified Aero Shed Roll-Off Observatory with Partially Complete Roof Tracks and Opener



Figure 29: Supports and Conduit for the Garage Door Opener

difference slewing and tracking. I used PEMPro v2 for polar alignment at RISS-Remote, and highly recommend it. PEMPro guides you through a simple calibration process, and then instructs you on exactly how to move the mount—first in azimuth and then in elevation—until the polar alignment is complete. The results are far better than I’ve ever achieved in the past, with drift rates that appear negligible even over multiple 20-minute exposures.

scope if it closed at the wrong time. In fact, we’ve adopted a procedure of powering off the roof’s garage door opener any time it’s not in motion as an added safety measure.

Speaking of the garage door opener, there are now some metal guides on the chain track, which were not installed when the photo was taken, that prevent

the chain from sagging. There’s also a cover over the opener itself to protect it from rain. The door opens and closes very smoothly, and it was quite a thrill to see it operate for the first time.

We had a lot of trouble getting the Foster Systems card to work correctly, and got pretty frustrated with it. In fact, when I left for home we still couldn’t operate the door remotely because of this problem. It turns out that I had incorrectly wired the power to the card, flipping the positive and negative connections. Fortunately, it was not damaged, and worked perfectly once we connected the power correctly. I guess reading the directions does make a difference.

Testing and Calibrating

We spent the next night testing everything out, sitting inside the house and “remotely” operating the equipment. We focused a lot of attention on polar alignment since that’s something that can only be done in person, and because it would make a big

I also used PEMPro to program analyze the AP900 periodic error, and to program a periodic error correction (PEC) curve into the mount, achieving tracking of .87 arc sec peak-to-peak fairly easily. This has proven easy to guide out so I haven’t worried about refining it further. Once again, I’ll pitch PEMPro as a great tool.

First Light and Finishing Up

Amazingly, first light at RISS Remote occurred on November 8, 2014—just two days after I arrived on site to help to integrate the equipment. I selected M27 (the Dumbbell Nebula) as the first image because it’s been a tradition of mine ever since finding it as my first deep sky object with a 6 in. home-built reflector when I was 13 years old. I’ll mention for trivia’s sake that the only reason I found that object at all back then was because a satellite passed through the field of view while I was



Figure 30: Calibrating with PEMPro on the Big Screen

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Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 16*

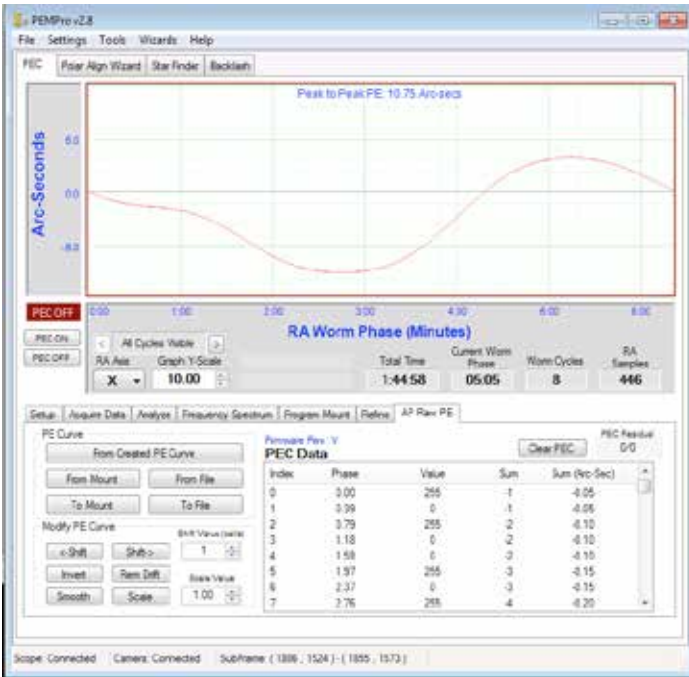


Figure 31: Periodic Error Curve (Uncorrected)

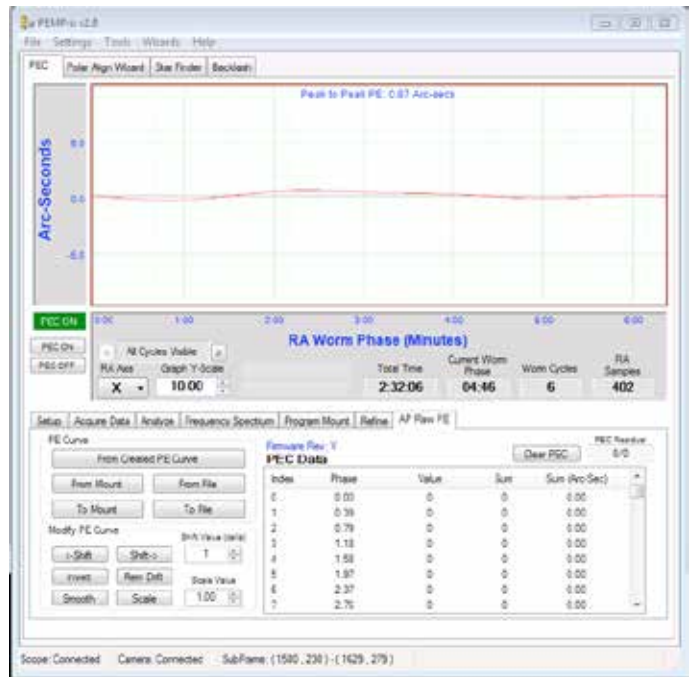


Figure 32: Periodic Error Curve with PEC



Figure 33: Fully Operational

searching around and, when I followed that satellite with the telescope, it passed right through M27!

Since first light we've completed automation of the roof, added a second control computer, integrated an all-sky camera, and imaged dozens of objects. We've also added the new Astro Physics Control Center (APCC) software, which adds another layer of functionality and security that made imaging Comet C/2014 Q2 (Lovejoy) easy by tracking it directly with custom rates.

Other improvements include weather stripping the gap between the roof and the walls, sealing the walls to the pad, and rerouting the cables to eliminate the catch points. This spring Dave and

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Blast from the past—This article originally appeared in the Feb–March 1989 issue of the NOVAC Newsletter.

REFLECTIONS ON NOVAC

By John Huggins

I have enjoyed my many years in this club. I have seen many changes since its inception by Nils Thomas in 1980. It started out with six people you know. The club grew as people recognized it for its simple goal of simply observing.

When Richard Lawson first created the Burke Lake Telescope Meet (BLTM), NOVAC was thrust into the limelight.

Once Nils said to me “NOVAC exists to observe and help others do the same...” I continued, “... to observe and to help others observe.” Nils liked it and suddenly it became the motto of NOVAC. Yes, it is humorously poetic, but it says it all. The sun’s corona became a symbol of the club for its simplicity and easy recognition.

Richard Lawson published the original three NOVAC newsletters. They were a struggle to make. You can only do so much with a mechanical Smith-Corona and a magic marker. The NOVAC Corona began to flourish when Blaine Korcel took hold of it and shaped it into a masterpiece.

Past events like BLTM’s, Halley’s Comet, and NVTM88 have steadily increased our presence in the astronomical community. Many people have joined since then. I hold much respect for many of the members whom I have met. Our merry band of amateur astronomers is a happy community; this is something not easily found these days.

For years I have been an officer in NOVAC. Nils, Blaine, and I have raised the club from an infant to an adult. Nils told me once that someday we would have to let the club move onward on its own. I am pleased to say that MANY of the members are qualified for the above offices. It is time for me to get out of office (albeit nervously) and let some others get underway. Al Boldt said I needed a rest; he’s right.

I look forward to doing more astronomical things like finishing my scope, doing more astro slide presentations for the public, getting more involved with the planetarium programs, etc., etc., ... *

Clear, Dark, Dry Imaging from Northern Virginia *Continued from p. 17*



Figure 34: Dave and Nancy at RISS-Remote

Nancy plan to install landscaping inside the perimeter fence, which will include an irrigated orchard with a variety of fruit trees.

Many thanks to everyone who contributed to this project, and made it a reality. Dave and Nancy for allowing this to be built on their property, constructing the gated perimeter, pouring the pad, building the shed, mixing tons of concrete for the pier and roll-off mechanism, and generally putting up with me. Thanks to Ralph Jung for inspiration, ideas, and mocking commentary, comparing us to SkyNet as the level of automation increased, while regaling us with photos of the Sun using his Tri-Band imaging setup. And thanks to Rick

Burke and Ted Forte, members of the Ft. Huachuca astronomy club, for offering to be emergency responders for RISS-Remote if things go terribly wrong.

I now enjoy clear, dark, and dry imaging from home on a regular basis. I’ve learned to operate the equipment safely, and I’ve been delighted with the results. If I had to do it all over again, I’m not sure that I’d change a thing. With advances in technology and integration, I think an observatory like RISS-Remote is within reach of anyone with a place to put it. Clear Skies, and thanks for looking. *

Astronomy Day 2015

Hosted by the Northern Virginia Astronomy Club
Saturday May 16st @ Sky Meadows State Park 3-11pm

www.novac.com

No RSVP Required

Free Family Friendly Event

Activities will include:

- * Safe views of the Sun!
- * Activities for the kids!
- * Guided tour of the night sky!
- * Views of the universe through telescopes!

Sky Meadows State Park

Location: The park is less than 2 miles south of Paris, VA via US Rte. 50 to Rte. 17 South; or 7 miles north of I-66, Exit 23 on Rte. 17 North. The park entrance is at State Rte. 710. The park charges \$5 per vehicle entrance fee

Special Presentations – Rain or Shine!

Speakers to be Announced!

If you are interested in speaking or working the event contact
the event contact

Zack Panitzke

astroday@novac.com

NOVAC
NORTHERN VIRGINIA ASTRONOMY CLUB

“To observe, and to help others observe”

NOVAC is a non-profit, all-volunteer organization chartered to advance amateur astronomy in Northern Virginia. Member benefits:

Access to dark sky observing sites

NOVAC maintains agreements that provide club members with year-round access to observing sites away from city lights. www.novac.com/wp/observing/

Monthly meetings

Monthly meetings are normally held at 7 p.m. on the second Sunday of each month [except in May when the meeting is held the first Sunday] in Room 163 of the Research Building on the campus of George Mason University. Each meeting features a lecture on an interesting topic by a local expert. See the meeting web page or future newsletters for a schedule of speakers. www.novac.com/wp/outreach/meetings/

Quarterly newsletter

The NOVAC newsletter provides information specifically for NOVAC members, as well as general interest articles on such topics as observing reports, equipment reviews, upcoming events, amateur telescope making (ATM) projects, and more.

www.novac.com/wp/members/newsletter/

High-quality telescopes to borrow

NOVAC members may borrow one of the club's several loaner telescopes at no charge. Members may choose from among three 6 in. reflectors, two 10 in. f/6 reflectors, an 8 in. SCT, and a hydrogen-alpha solar scope. Binoculars are also available for loan.

www.novac.com/wp/members/loaner-scope/

Club website

Up to date information about club events and activities is maintained on the club website at www.novac.com.

Large club library

NOVAC maintains a well stocked library from which members may borrow by contacting John Deriso (librarian@novac.com). A full list of titles is available on the club website.

www.novac.com/wp/members/library

Private email listserv

Members keep up with current club information by subscribing to the NOVAC email list, without fear of flame wars or spam emails.

Public outreach opportunities

Several times each year volunteers from NOVAC present astronomy programs to schools, churches, Scout troops and other public groups. Contact outreach@novac.com or fill out the outreach form on the NOVAC website to request a program or help in supporting an event. www.novac.com/wp/outreach/outreach-form/

Membership in the Astronomical League

Through NOVAC's membership in the Astronomical League (AL), NOVAC members gain access to the AL's newsletter, services and observing programs.

www.astroleague.org

Discounts on astronomy magazines

Subscriptions to *Sky & Telescope* and *Astronomy* magazines are offered to club members at a considerable discount.

Contact Rebecca Stone: treasurer@novac.com

Mentor Program

Young or old, new or experienced, this program is for everybody. If you would like to meet with a mentor, think you would like to be a mentor, or have any questions about the program, contact: mentor@novac.com.

See your Membership Guide for more details about member benefits.

<http://www.novac.com/wp/members/>