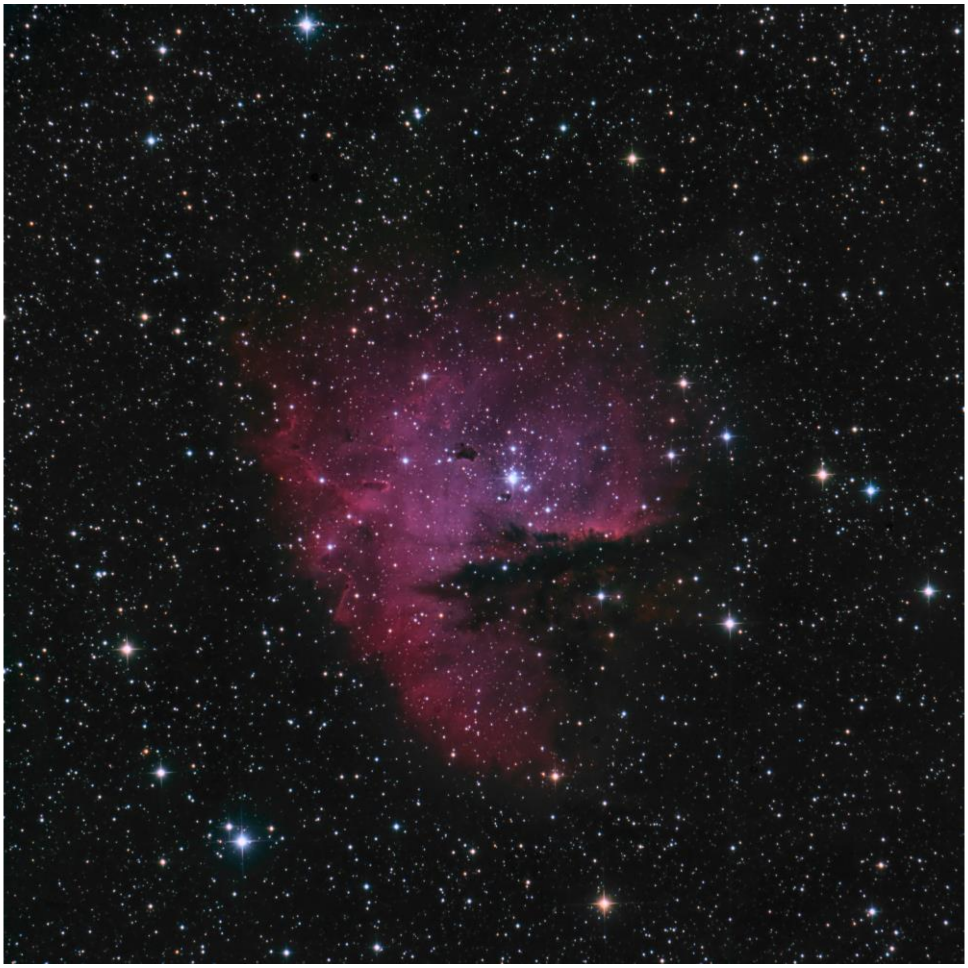
SkyWAAtch



A Bit of Nostalgia

Olivier Prache provided this image of NGC 281, the Pacman nebula, in Cassiopeia. NGC 281 is a nebulosity associated with the open Cluster 1590. Its name, of course, derives from the vintage video arcade game that blessed many a tavern in the early 1980s.

The nebula lies at a distance of 9400 light years and is close to 100 light years in diameter. Olivier employed his 12.5" Hyperion astrograph with an ML16803 camera (a 14 hour LRGB image).

In This Issue . . .

Events for December

WAA December Lecture

"Exploring the Extreme Universe with Gamma-Ray Telescope"
Friday December 2nd, 7:30pm
Leinhard Lecture Hall,
Pace University, Pleasantville, NY

Very-high-energy gamma-ray astrophysics has emerged as an exciting and vital area of research, with major discoveries made through satellite experiments in space and observatories on Earth. Gamma rays are the most energetic forms of light and are generated in some of the most violent processes in the Universe. One example is a supernova explosion, which generates a blinding flash of radiation, as well as shock waves. Outside our own galaxy, another exciting astrophysical object is a type of high-energy quasar, thought to harbor a supermassive black hole.

Our speaker, Professor Reshmi Mukherjee, will explore some of the experiments scientists have developed to take a glimpse at these mysterious and energetic aspects of our Universe.

Dr. Mukherjee is Professor of Physics and Astronomy at Barnard College, Columbia University. She teaches Intro Physics and Quantum Mechanics. Prior to Barnard, she was a postdoctoral researcher at NASA Goddard Space Flight Center on satellite experiments. Her research interests include experimental and observational astronomy, development of gamma-ray detectors and telescopes, the study of extragalactic gamma-ray sources such as blazars, and the particle acceleration and emission mechanisms in astrophysical objects. Directions and Map.

Upcoming Lectures

Pace University, Pleasantville, NY

On January 6th, our presenter will be Matt Ganis who will speak on asteroid occultations.

Starway to Heaven

Saturday November 19th, Dusk.
Ward Pound Ridge Reservation,
Cross River, NY

There will be no Starway to Heaven observing dates for December, January or February. Monthly observing sessions will recommence in March 2017.

New Members. . .

William Meurer – Greenwich
Richard Steeves - Hastings on Hudson

Renewing Members. . .

Michael Lomsky - Wilton
Edgar S Edelmann - Tarrytown
Mauri Rosenthal - Scarsdale
Olivier Prache - Pleasantville
Kristina Newland - White Plains
Emmanouil Makrakis - Scarsdale
Claudia & Kevin Parrington Family - Harrison
Elaine Miller - Pound Ridge
Hans Minnich - Bronx
Bob Kelly - Ardsley
Kevin Mathisson - Millwood

This image of the November Super Moon is courtesy of John Paladini

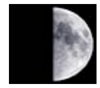
Wanted Assistant Editor

The WAA newsletter (the *SkyWaatch*) is seeking an Assistant Editor. If you can help, please let us know. Your participation in editing, compositing and proofreading tasks or submitting articles or images, will be much appreciated. Email Tom at waa-newsletter@westchestersastronomers.org

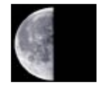
Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

ALMANAC

For December 2016 by Bob Kelly


Dec 7


Dec 13


Dec 20


Dec 29

The largest Super-Moon until 2034 occurs in December. Didn't we say that last month? It's not going to be as close to Earth as October and November's Full Moons, but not much farther. This month's lunar perigee is 358,461km, about eighteen hours before Full Moon, as opposed to 356,509km three hours before November's superest Full Moon. So, if you missed the largest Super-Moon since 1930, try again at Moon set on the 13th or Moonrise on the 13th or 14th. Be alert for larger than normal tides through the 16th, with nuisance flooding in the usual places or worse if sustained northeast winds tip the Atlantic Ocean further into coastal backyards. There are no similar Super-Moons in 2017, so here's to the 'Super-Moon' chatter dying down in 2017. There's a great chart of the lunar distance the past few month at Guy Ottewell's Universal Workshop website.

Mercury's greatest elongation is 21 degrees east of the Sun on the 11th, bright and very low in the southwestern sky through mid-month. Venus is part of the southwest sky kickline of planets; the brightest of the bunch at magnitude minus 4.2, outstanding to all who find her. Mars anchors the left side of the line, more sublime (or is it sub-red?) at magnitude plus 0.7. Mars, Venus, the Moon and Mercury make nice parings from the 1st through the 4th.

The Moon tries hard to get all the attention this month. The one-day-short-of-a-Super-Moon photobombs the Hyades star cluster and Aldebaran on the evening of the 12th. (Aldebaran is not a member of the cluster, but they need it to complete the "V" in the horns of the Bull). A 3rd magnitude cluster member is occulted by the Moon about 10pm, followed by Aldebaran disappearing on the thin dark limb of the very bright Moon about 11:10pm, reappearing on the bright limb at 12:20am.

The winter solstice is at 5:44am on the 21st. The earliest sunset for the year is December 7th, and latest sunrise is in early January.

Jupiter is looking good, well up over the southeastern horizon before dawn. Saturn is hiding out in the solar glare with a conjunction with the Sun on the 10th. Watch for Saturn and Mercury crossing the SOHO C3 camera's view this month. Uranus floats among the faint stars of Pisces; highest in the south right after twilight.

Geminid meteor shower peaks in the evening of the 13th. It's one of the best showers of our year, but with a nearly full Moon, only the brightest will be seen. But if you're out anyway – watch for them. Is the Ursid meteor shower underrated? Peaking on the morning of the 22nd, a busy, cold and dark time of year, maybe it will do better than the projected 10 per hour. The radiating point of the Ursids is above the horizon all night. There's some competition with the 38 percent full Moon rising before sunrise, so the evening-time may be just as good as the traditional pre-dawn hours.

You can view Venus and Mercury in the daytime after noon as they follow the Sun – they're difficult to see because they are so low in the sky, even when they transit across the southern sky. If you catch them in daytime or strong twilight, watch as they get larger and their phases decrease over the month.

The International Space Station is in the evening sky until the 22nd, and in the morning sky starting the 27th.

Here Comes 2017!

Bob Kelly

Equinoxes: Mar. 20 6:29am EDT Sept. 22 4:02pm EDT
Solstices: June 21 12:24am EDT Dec. 21 11:28am EST

Latest sunrise: 7:20am December 29 – January 9
Earliest sunset: 4:27pm December 1 – 14
Earliest sunrise: 5:22am EDT June 10 - 18
Latest sunset: 8:31pm EDT June 20 – July 3

Eclipses

- Penumbral eclipse of the Moon Feb. 10: 5:32pm to 9:55pm, darkest at 7:44pm. Moon rises just before the eclipse starts for our area. The moon will be low in southeastern sky, so this not-even-partial eclipse may be hard to detect.
- Annular eclipse of the Sun Feb. 26: Not visible in our area. Visible in the S.E. Pacific Ocean, S. half of S. America, most of Antarctica, Africa (except northern parts).
- Partial eclipse of the Moon Aug. 7: Not visible in our area. Visible in the Western Pacific Ocean, Oceania, Australasia, Asia, Africa, Europe, easternmost tip of South America.
- **Total eclipse of the Sun Aug. 21:** Over land areas, it's a total eclipse only in the continental United States, starting in the northern Pacific Ocean and ending over the Atlantic Ocean off Africa. In our area, it's a partial eclipse, with a maximum 71 percent of the Sun obscured.

Super-Moons? The closest lunar perigee in 2017 is May 25 at 357,208km distance, when the Moon is at new Moon phase and unobservable.

Occultations of Planets and Bright Stars by the Moon that may be visible in our area:
Apr.24 12noon EDT (Daylight) Pallas: Most of N. America, Greenland, Iceland, Ireland
June 22 11am EDT (Daylight) Aldebaran: Most of N. America, S. Greenland, Azores, most of Europe, N.W. part of Africa
Sept.12 9am (Daylight) Aldebaran: Hawaii, Central most of North America, Azores
Nov. 5 10pm Aldebaran: North America except westernmost part, N. Europe, N.W. Asia
Dec.30 8pm EST Aldebaran: Most of North America, Greenland, Europe except S., W. Russia

Meteor Showers in 2017:
Quadrantids: morning of January 4th after the first quarter Moon sets
Perseids: peak around August 13th.
Orionids: peak around October 21-22.
Leonids: peak around November 17-18.
Geminids: peak around December 14. Waning crescent Moon in the morning hours.
Ursids: peak around December 21-22. Waxing crescent Moon sets during the evening.

Viewing the bright planets:
Mercury is a morning object:_January 4 to February 24; April 29 to June 14; September 4 to September 28 (better appearance for our latitude); December 19 to December 31 (better appearance for our latitude)

Mercury is an evening object: March 16 to April 12 (best appearance for our latitude); June 29 to August 20; October 23 to December 7.

Venus blazes in the evening sky into mid-March. By April it's a morning sky object through late November. Venus is in conjunction with Mars on October 5 and with Jupiter on November 13.

Mars hangs on in the evening sky into early June, low to the left of the setting Sun. It poses with a variety of constellations, with the prettiest picture in early May as it passes Aldebaran and the Hyades cluster. Then Mars spends a lot of time in the solar glare (look for added complications communicating with Mars probes during this time). It's back, in the morning sky, in mid-September. Mars is in conjunction with Mercury on September 16 and with Venus on October 5. The reddish tint of Mars should assist in its identification.

Jupiter rises in the morning sky until opposition on April 7th. Jupiter inhabits the evening sky until mid-October. In mid-November, it's back in the morning sky (passing 4° N of Spica on January 20 and again 4° N of Spica on February 23); (passing 3° N of Spica on September 5). Jupiter is in conjunction with Venus on November 13.

Saturn starts the year rising just before sunrise. Saturn is at opposition on June 15. It hangs in the evening sky into early December. Saturn is in conjunction with Mercury on November 28.

Uranus is in the evening sky into March. It gets back into the morning sky in May. Opposition happens in October and best evening visibility is late in the year.

Neptune is low in the evening sky until early February. It can be found in the morning sky in March. Opposition occurs in September, at its best location for evening viewing very late in the year.

Sources:
USNO Astronomical Phenomena for the year 2017

Less is More: Ultraportable Video-Assisted Astronomy for Urban Skies

Mauri Rosenthal

"Hey Mauri, when are y'all bringing your telescope out to Texas? It's really dark here!" This is exactly the sort of invitation I had envisioned back when I bought my little Questar 3.5" telescope in 2012. But to my surprise I've been running in the opposite direction, at least from a Bortle Scale perspective: I've been carrying my astro equipment to one of the most *un*dark locations I can access: the Meatpacking District of Manhattan.

The current vogue for measuring light pollution is to quantify the sky's brightness with a sky quality meter, but I like the qualitative descriptions that distinguish my backyard "red zone" ("Suburban/Urban Transition Zone 7 -- Milky way invisible, through a telescope the brightest Messier objects are pale ghosts of their true selves") from the "Inner-city white zone" ("the only objects to observe are the Moon, the planets, and a few of the brightest star clusters"). One phrase I've seen in descriptions of the white zone is, "most people don't look up." This is true. So how did I end up becoming a specialist in the eccentric world of downtown astrophotography?

Figure 1 Grab 'n Go TV85

As an adult, my first backyard telescope was a Televue-85. This compact refractor is great for views of the Moon, Jupiter, Saturn, and Mars. I remember being fascinated by M42, the Orion Nebula. I still love this telescope, but I was eager to try my hand at astrophotography, which required a motorized tracking mount rather than the nice alt-az mount Televue sells for their smaller scopes. I assumed that I'd want to bring the scope out to parks like Ward Pound Ridge and other dark sites, and every German equatorial mount (GEM) I looked at seemed too big and bulky to make this an appealing prospect. I had also gotten used to the benefits of a "grab-and-go" telescope setup. The TV-85 on its mahogany legs looked pretty nice in our dining room, which meant I could be out the back door and viewing Jupiter in about one minute from the time I decided that conditions were good. The GEMs I could find, on more serious tripods, were not going to cut it aesthetically and space was too tight for me to pull the trigger.

So by the time I found myself driving past the Questar facility in New Hope, PA one day, it occurred to me to learn whether their telescope might be suitable for astrophotography. The Questar is a Maksutov-Cassegrain reflector with impeccable optical qualities, mounted on a very solid motorized fork mount. The Internet reputation for the scope was similar to that of an expensive Swiss watch – it is a beautiful and functional display of craftsmanship, but there are a gazillion ways to meet or exceed the optical performance at a much lower price. And for a small backyard telescope, the absence of Go-To capability is an anachronism. But in the commentary and reviews, I also saw a confirmation of my premise – that the precision motorized drive made for an unmatched combination of quality and durability in a very compact package. Indeed, the Questar comes with a set of screw-in legs which allow this "backyard observatory in a box" to be set up on a tabletop and polar aligned in a few minutes, allowing the observer to keep Saturn or other targets in view for hours if desired.

Regarding the question of whether or not I could use this scope for astrophotography, the Internet and telescope dealers offered two conflicting answers. The conventional wisdom is that the scope "punches above its weight" for solar system imaging – with some practice an image of Jupiter with the 3.5" Questar might resemble an image from an 8 inch consumer scope – but it was not suitable in any way for "deep sky" imaging. The less conventional answer could be found in the Internet image galleries of Robert Vanderbei, a Professor of Operations Research and Financial Engineering at Princeton, who started imaging with the Questar in 2002 and did a lot of very cool looking stuff with it for three or four years before acquiring a larger 10 inch Ritchey–Chrétien scope and GEM. I was able to find a nice white paper he wrote on backyard imaging with the Questar, presentations he delivered to local astronomy clubs in New Jersey, and ultimately even found him as a regular participant in one of the online forums for Questar users.

Figure 2: Questar loaded for imaging

Bob and a couple of other people who had achieved some decent results were neither encouraging nor discouraging about imaging with the scope, but they did point out some of the limitations and the steps I'd need to go through to make it work. So I bought the scope with plenty of questions in mind: would I be able to achieve similar results? What would be the best cameras and other accessories for this scope 10 years after Bob and others had configured their Questar imaging systems? And most important, would I be able to "see" anything from my red-zone yard in the City of Yonkers, or was I going to need to jump in the car with the scope and tripod on any night that I wanted to image?

The short answer to these questions is that I could get very nice images right from my own backyard with this little scope. I needed to learn several skills from scratch, and I've spent more on cameras and accessories than on the telescope itself, but I have been both pleased and surprised by the images. On a more philosophical level, imaging has enabled me to successfully expand the range of celestial targets I can enjoy with my little telescope from home. The sense that *I'm* capturing photons which have been crossing space for 30 million years or more registers in a way that feels very different from viewing the far superior images of the same targets from the Hubble or from experienced dark site astro-photographers. This image of M63, the Sunflower Galaxy, is a case in point:

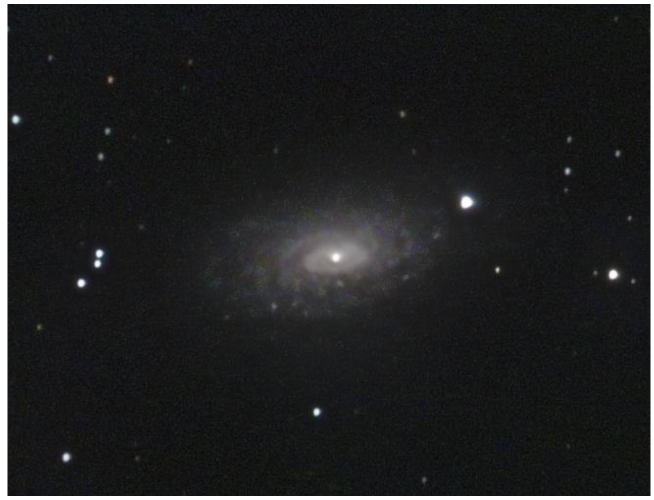


Figure 3: M63 The Sunflower Galaxy, Questar Image

It will never win any awards, and even though it has nearly a thousand views in Flickr, it has not received a single "Favorite" designation. But three years ago I had never so much as seen a single spiral galaxy through a telescope and now here is a fully recognizable view delivered by my own Questar of this enormous yet delicate looking structure posed 37,000,000 light years away. Perhaps a large aperture scope would afford me this view on a good night from Pound Ridge, or a great night from my yard – but here it is, and *I* know it was hovering, invisibly, *right over my own house.*

Astrophotography has a steep learning curve regardless of your location and equipment. Over a span of months, I took several important steps. I made some adjustments to my equipment, adding a high quality focal reducer from Questar. Lowering the focal length – and focal ratio – added more tolerance for small tracking errors while improving the amount of light delivered by any length of exposure. And with the ability to consistently generate useable 10 minute exposures, I was able to add broadband and narrowband filters that improve imaging from light polluted locations. I completed a five day *PixInsight* workshop, which not only helped me gain control of this powerful processing tool, it also gave me coaching from a professional astrophotographer regarding the qualitative aspects of better imagining. My images started to improve. For example, this image of the Bubble Nebula resembles many of the versions I can find online submitted by amateurs around the world.

Figure 4: The Bubble Nebula NGC 7635 Questar image

One of the lessons I learned slowly is that celestial targets come in a wide range of sizes and there is no single telescope that is truly optimal for everything. While this may seem obvious, the long focal length of the Questar – which provides great utility for views of Jupiter -- comes at the expense of a small field of view (FOV). I learned how to build mosaic images in the *PixInsight* workshop, which seemed like a provisional approach that could allow me to image some of the interesting deep sky targets that exceed the diameter of the moon, a useful benchmark for the practical FOV of the Questar. Indeed, my summer project to image the Eastern Veil Nebula resulted in a pretty good, detailed finished image, as shown in the adjacent column.

But it was literally a summer project! The image was collected in three sections (top, middle and bottom as shown), and for each section I used at least one night's data for each of three filters – broadband RGB; HA, and OIII. I may have spent over 40 hours processing the data – which now occupies 30 Gigabytes on my desktop computer – assembling the mosaic in different ways to see how I would get the best result. My first night of imaging was in early July and I posted the finished image in mid-August. I was very open to finding a different solution to the FOV problem.

In January 2015, I imaged Comet Lovejoy but was frustrated to only be able to frame the core of the comet; with the narrow FOV I had no way to image the tail. I really wanted to be ready for the next significant comet, Catalina, which was going to pass over

Figure 5: Eastern Veil Nebula Questar Mosaic Image, broadband and narrowband filters

my house roughly one year later. I started experimenting with "piggyback" imaging, using the guided Questar as my mount, but now with a telephoto camera lens on my astro-camera rather than on the telescope. My wife's old Praktica SLR film camera used screw-mount lenses that happened to fit my Starlight Xpress camera perfectly, and my experiments with this configuration were an immediate success. The lower focal length lens (135mm vs the Questar's 900 mm using a focal reducer) is very tolerant of tracking error at the same time that it's delivering more light on the chip per unit time – so my imaging time became much more productive. I was able to get some decent views of Catalina when the time came, capturing both the dust tail and the ion tail

Figure 6: Comet Catalina over my house, 135mm lens, January 2016

I then splurged on a used 200 mm lens on eBay for $39 – there is not much demand for screw mount lenses – and this also worked well as shown in this image of the Rosette nebula, which took a small fraction of the total project time of my typical Questar project of similar quality:

Figure 7: The Rosette Nebula, 200mm lens

New Direction: Ultraportable Urban Imaging

This brings me to my current focus. Having demonstrated to myself that I could indeed image deep space objects from Yonkers, any motivation to bring my equipment to dark sites melted away and instead I became intrigued with this question: How well could I use the same techniques that work at home to "see through" the worst light pollution, within the city limits? I have seen excellent images posted online from advanced astrophotographers around the world who used serious equipment with narrowband filters to achieve excellent results from "white zone" light polluted skies. Typically they mounted the telescope on a high quality GEM, which allowed them to generate long exposures (10 to 20 minutes) in order to accumulate enough astronomically interesting photons to make a decent image, since the purpose of the filters are to block unwanted wavelengths from reaching the camera chip. This approach could work for a city resident with a safe and convenient yard or rooftop, but is not practical for schlepping into the city to attempt imaging from a public space, or even a friend's private space if one were available. And for city residents who have some access to the skies via rooftop or terrace, it is clear that a "grab 'n go" setup would also provide the sort of benefit I enjoy at home – the ability to carry the entire rig in or out of the house with one hand.

Figure 8: My entire imaging rig packed up

Over the past few months I solved the two key aims of this challenge: (1) Could I get an entire imaging system into one backpack which I would feel comfortable wearing on Metro North and the subway; and (2) Could I find a venue in Manhattan for safely spending the two or more hours needed to image a deep sky target?

My 22 pound backpack holds literally everything I need – except for a chair, which really helps but is not absolutely required. I acquired the backpack at the same time that I bought the attached Vanguard Carbon Fiber tripod, which folds down to 16”, a big improvement in portability over the Manfrotto tripod I had been using at home. Several high end travel tripods could also meet my desired specs but this relatively new product was an excellent value.

Over the winter I will take a stab at configuring a similarly compact system using my Questar. The Questar imaging setup also weighs in between 20 and 25 pounds, obviously fully portable compared with GEM-based imaging rigs where the counterweights alone might weigh this much. But as I realized that I was only going to be using the Questar in piggyback mode, I found that there were a few good options for mounts that could deliver adequate tracking in an even more compact configuration.

Here is what’s currently inside the pack, which takes me less than 10 minutes to assemble:

- A Sky-Watcher Pro Star Adventurer mount, with a declination bracket and adjustable equatorial wedge
- A small tripod head for the guide camera
- An SBIG ST-I guider
- A mounting ring for the imaging camera
- A Starlight Xpress SX-694C astro camera
- A couple of screw mount telephoto SLR lenses (I can only use one at a time) and a few adapter rings
- Broadband light pollution and narrowband filters
- A Tracer 12 Volt LiPO Battery
- A Microsoft Surface Pro3 Laptop
- Cables
- A jet blower and lens pen for cleaning lenses
- A flashlight and a few small wrenches
- A Kindle Paperwhite for flat frame illumination (and supplemental reading on the train to Manhattan!)

Figure 9: Ultraportable setup using 500mm Samyang mirror lens with Baader coma corrector

The Star Adventurer Mount runs on four AA batteries, can handle 11 pounds of equipment, and has an integrated auto guiding port. While it has a good integrated polar scope, I usually do not have a view of Polaris so I use my guide camera with the Drift Alignment utility in *PHD*. Since there is no motor for the Declination axis, the quality of the polar alignment makes a significant difference on the length of an exposure, which I want to be as long as possible without perceptible drift. In my yard I have achieved nice 5 minute exposures with it.

The SBIG ST-I Guider comprises a high quality monochrome planetary/guiding camera, a 100 mm C-mount lens, and mounting rings. This provided me with the lightest and most compact option for a guide scope for my Questar, for which total weight of accessories is a critical constraint. The imaging camera was also selected for the Questar because of its light weight (400 g) and compact footprint (see Figure 2 for how these devices look mounted on the Questar).

This setup relies heavily on the processing power of a contemporary laptop. I selected the i7 Surface Pro 3 to get the maximum power in the lightest and thinnest configuration available at the time. The "bonus" feature of having a touchscreen that can be controlled like a tablet has turned out to be a huge plus for my purposes, especially at outreach events.

Once I assemble the hardware, I load the following computer applications:

- *Cartes du Ciel* as an overall planetarium / star chart program
- *Nebulosity 4.0* to control the imaging camera
- *PHD 2.8* to control the guiding camera
- *AstroToaster*, a front end to *Deep Sky Stacker*, which enables live stacking of images and good control over the display
- *All Sky Plate Solver* to determine where the camera is pointed in the sky
- *PixInsight* – sometimes helpful for reviewing frames
- *Team Viewer* – at home this allows me to control the laptop from a computer inside the house

Before I describe a bit more of the process, let me return to my second big challenge – the venue. I joined the Amateur Astronomers Association (AAA) of NY so that I could bring this rig to their viewing parties on the High Line on Tuesday nights during the summer. These stargazing sessions satisfied the most important attributes for a city-based imaging location:

1. Safety first: The park has plenty of security guards who are well aware of what the group of men and women with telescopes is up to. While there are sections of Central Park that would be sheltered from ambient light (and probably comparable to my yard for overall LP) there is just no way that it would make sense to stand out there alone with thousands of dollars of equipment, focusing on a computer screen, so I ruled that venue out.
2. Fairly wide open stretches of sky, depending on where you park yourself. Note, however, that I still don't get a view of Polaris when I set up with good views to the East, South, and West
3. Benches – lots of them -- that have allowed me to sit without having to carry a chair
4. Easy logistics (for me, anyway). Even though I've got to take two subway lines from Grand Central, it's a pretty quick and tolerable process, followed by a few blocks' walk. It has also been easy to get a taxi back to Grand Central on the return trip. Many suburbanites will have the opposite preference from mine, but I much prefer to be riding a train home than driving in the dark after a long viewing session.

I've made one additional key adjustment to my goal of imaging from the city. Since these are outreach events, I have placed a premium on achieving "real time" views to share with the public rather than gathering the optimal data for subsequent processing into finished images. This in turn brings me into the realm of Electronically Enhanced Astronomy (EAA), which has heretofore revolved around devices like the Mallincam, a video camera meant to be connected to a telescope for live views. I recall seeing an impressive view of M101 at Pound Ridge from one of these devices on an 8" telescope. In my case, however, working with a relatively tiny aperture under a brighter sky, I focused on generating a sharable live view from my astrocam using my laptop, and I was delighted to learn from Cloudy Nights that an amateur in the NYC metropolitan area, Howard Levine, has written a fine Windows program to enable this. Howard's free *AstroToaster* uses the also free *Deep Sky Stacker*'s processing engine to debayer, register, and stack subframes as they come off the imaging cam, and it provides nice controls for "stretching" and otherwise adjusting the image for immediate display. Under good conditions in my backyard, I have gotten great results out of this software:

Figure 10: Screengrab of "live" image of M33 using AstroToaster and 500 mm mirror lens, from Yonkers

This detailed image of M33 integrates about 90 minutes' worth of short exposures, so it is not quite the same thing as a Mallincam image off a big scope that resembles this within 2 minutes. But I don't need a perfect, noiseless image of a galaxy to share the view at a star party. All I am seeking is a view that is comparable to, or better than the ghostly monochrome view of a spiral galaxy that might be seen visually through a 10 inch Dob at a typical suburban star party – and the electronics allow me to do this with my ultraportable setup within 10 minutes or so.

Having now completed seven sessions at the High Line starting in mid-September, ending the last week of October, I can report that I have had a moderate amount of success and a terrific amount of fun trying. I have successfully shared views of the complete Veil Nebula and the Andromeda Galaxy on four of those occasions. Here is how my last few viewing sessions played out:

6:45-7:00 pm: Arrive at the High Line at 14th Street and check in with the group showing off Saturn or Mars in the Southwest. Set up my rig adjacent to a bench just south of the Standard Hotel at 12th Street where I have clear views to the East and West. The Standard blocks any view of Polaris. While the visual observation group can offer nice views of the bright planets or the moon while the sun is setting, there's not much I can do until it is dark enough for me to pick up stars easily with my guide camera.

7:00-7:15pm: Polar alignment using the drift utility in *PHD*. While it is easy to approximate "North" from the High Line, I have to iterate between the azimuth adjustment (up and down from the horizon) and the altitude (north/south) settings several times to get a respectable alignment. I haven't come close yet to perfection, but 10 to 15 minutes of tweaking can get me 2-5 minute exposures with round rather than oblong or streaked stars.

7:15-7:30 pm: Focus the imaging camera with the focusing utility in *Nebulosity*, which gives a quantitative readout of the "tightness" of a star's light distribution on the imaging chip. This is easy with the 200 mm lens but laborious with the 500 mm mirror lens. Once I have sharp focus, I can start working on target acquisition. The deep sky targets I'm looking for are completely invisible to the naked eye from my yard, let alone Manhattan. But the plate solving application I added to my laptop, *All Sky Plate Solver*, makes good use of my "electronic assist" to find targets. I take a 10 second exposure wherever I have pointed the camera, and this is sufficient to be compared with a database the application has downloaded of the entire sky imaged at this focal length. Matching my image to the database is processor intensive, and it crunches away for 10-25 seconds on my laptop. As long as there are several stars in focus it will spit out the celestial coordinates – Right Ascension (RA) and Declination (Dec) – to which I can compare with my target's position according to *Cartes du Ciel*. I rotate the mount's RA wheel and use the slo-mo control on the Dec bracket to move the camera closer to the target. In 4-6 moves I usually have the deep sky target on my chip and I can finish the positioning without additional plate solving.

7:30-9:45 pm: Take a series of 2 to 5 minute exposures of the target and monitor the stacked images with *AstroToaster*. When I tried the Veil using narrowband filters, I switched from the HA filter (which shows the red Hydrogen and Sulfur intensive regions) to the OIII filter (which shows the blue oxygen intensive regions) after about an hour. This allowed me to show off, for the last 45 minutes or so of the session, a red and blue image, which looked like this:

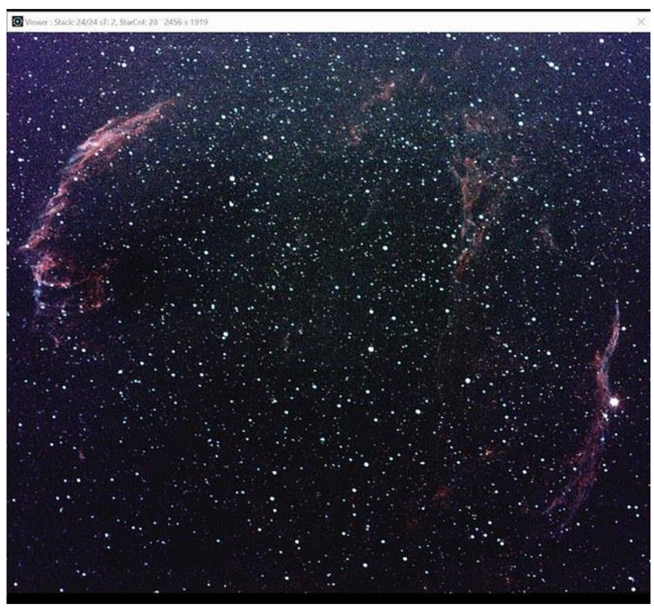


Figure 11: Screen capture of narrowband image of the Veil Nebula, from Manhattan

9:45-10:00 pm: Shoot a set of flat frames using my Kindle as an even illumination source, and then dismantle and pack up the equipment.

The Veil image above was my first real success, on week 3. For the final 3 weeks, I imaged the Andromeda Galaxy, which is less colorful, but more consistent with my desire to provide something truly distant to stimulate discussion. Here is how the stack looked on my laptop at the end of the last session:

Figure 12: LIve view of Andromeda from High Line

And for comparison, here is how the same stack of two minute exposures of Andromeda looked after more complete processing in *PixInsight* back home:

Figure 13: Andromeda image from High Line, stack of 33 2 minute exposures 200 mm lens

The live view is a bit messy and shows less detail than a fully calibrated and processed image. But it is easy to understand the broader enthusiasm for EAA, and it is a particularly great fit for a city outreach event – we're not trying to maximize anyone's night vision, so the view off the laptop screen, which I use in tablet mode, is very easy to share with individuals or groups. And I can adjust the contrast settings to show more galaxy (along with a lot of noise you wouldn't show in a finished astrophoto) or zoom in as desired.

Not every session was successful; one night a light haze was sufficient to block any signal from my faint target; and I once tried the Triangulum galaxy (M33) without success – it may simply be too faint for the city.

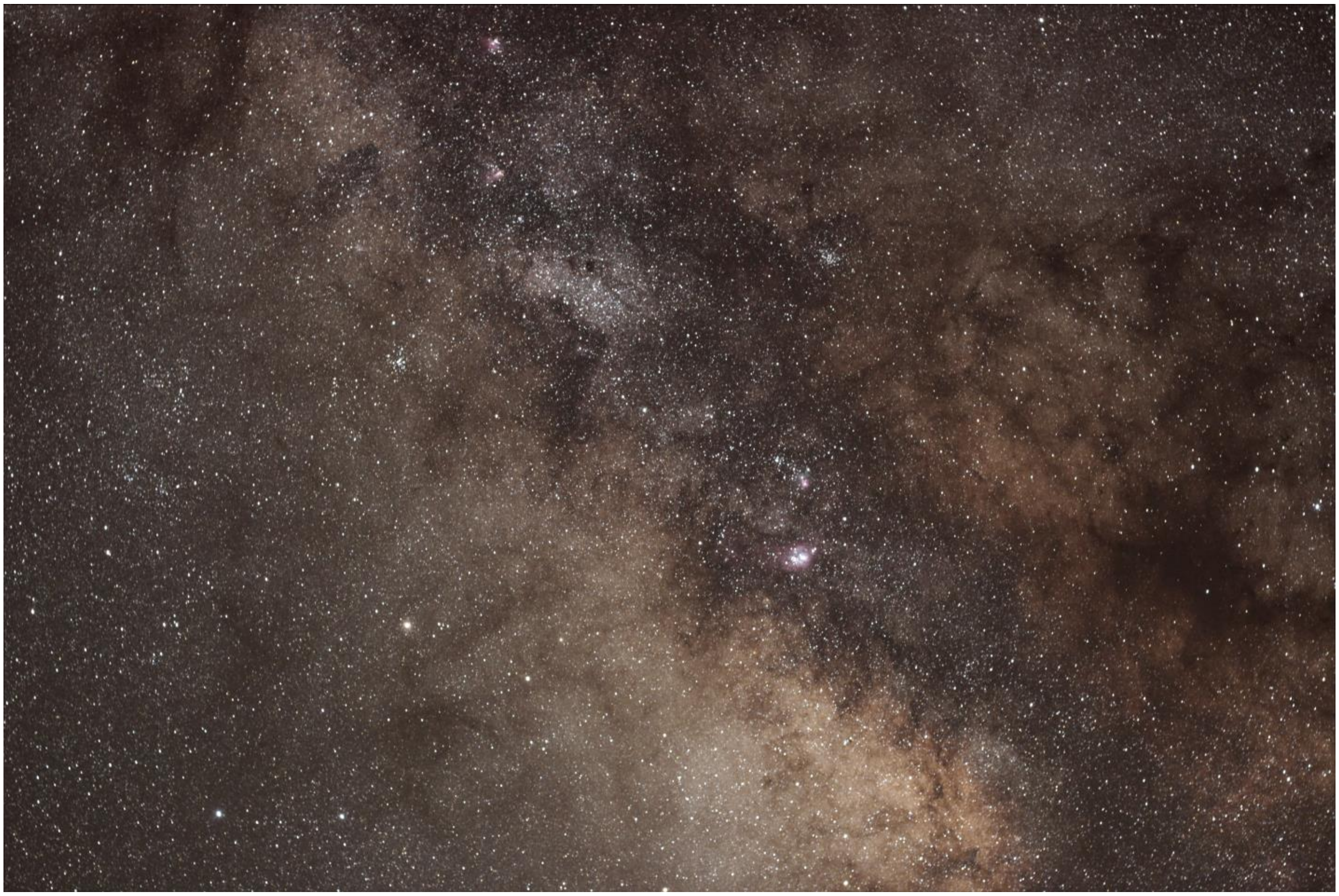
With these images, this year's experimentation with Ultraportable Urban Deep Sky Imaging comes to a close. I have a fairly long list of things to try when the season starts again in the spring, including using narrowband imaging with the camera in "binned" mode, in which every four pixel array is treated as one large pixel, adding sensitivity. I have some additional lenses and targets to try out as well.

Figure 14: The author on the High Line, October 25th (photo courtesy of Stan Honda)

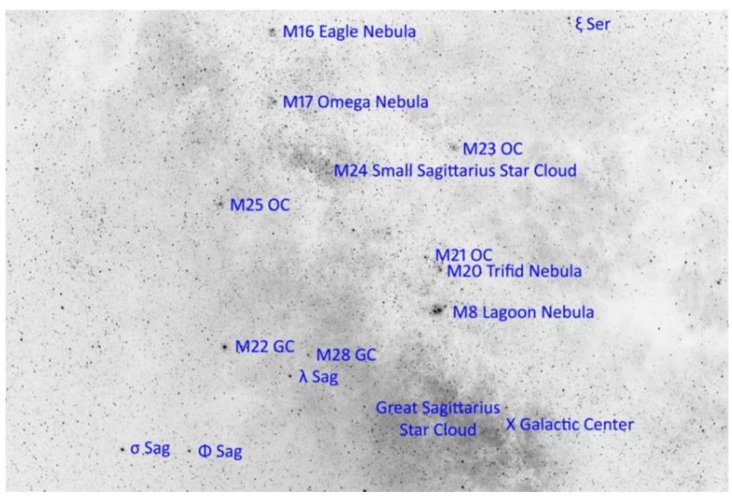
On the whole, I've gotten much further punching through the city's light pollution than I ever expected before I started imaging successfully from home. On the High Line, with everything running properly, it has been a blast to show off a galaxy and explain my equipment to people. Many are visitors to New York who have simply worked an evening visit to this unique park into their city tour; many others are New Yorkers who saw publicity about the AAA stargazing parties and came to check one out. My personal favorite reaction to date came from a woman in a group who listened to my description of the galaxy 2.5 million light years away, holding a trillion suns, as I pointed out a few details on my screen. She looked a bit bemused and said, "Wait, so there's something out there even bigger than New York?" She got it, and she didn't even need to look up. ■

The Milky Way in Western Sagittarius

Larry Faltz



The western part of Sagittarius, in the direction of the center of the Milky Way, is the telescopically richest area of our galaxy. It contains emission nebulas, dust clouds, globular and open clusters and a vast number of stars.



The image was taken July 7, 2016 at Camp Hale, Colorado, elevation 9,235 feet. It's a stack of two 4-minute exposures taken with Canon T3i, 50 mm lens @ f/4, ISO 1600, on a iOptron SkyTracker mount. Stacked with Deep Sky Stacker, finished in Photoshop Elements. An inverted black-and white version of the image is annotated for orientation.

From WAA's regular observing site in Ward Pound this part of the Milky Way is essentially invisible to the naked eye. It's low in the southern sky and competes with light from Greenwich, New York City and Nassau County. Camp Hale is where the 10th Mountain Division trained in World War II. It's an alpine valley isolated from urban centers. The tiny hamlet of Red Cliff (pop. 278) is nine miles north. The closest community to the south is Leadville, pop. 2,602, 15 miles beyond a ridge of 12,500 foot mountains of the Continental Divide. South of Leadville, there's another mountain range and then a further 135 miles to the next sizeable town, Alamosa, Colorado, population 8,780. Another 120 miles gets you to Santa Fe, New Mexico. In other words, it's *dark* there! The SQM reading was 21.71

Dimming Stars, Erupting Plasma, and Beautiful Nebulae
Marcus Woo

Boasting intricate patterns and translucent colors, planetary nebulae are among the most beautiful sights in the universe. How they got their shapes is complicated, but astronomers think they've solved part of the mystery—with giant blobs of plasma shooting through space at half a million miles per hour.

Planetary nebulae are shells of gas and dust blown off from a dying, giant star. Most nebulae aren't spherical, but can have multiple lobes extending from opposite sides—possibly generated by powerful jets erupting from the star.

Using the Hubble Space Telescope, astronomers discovered blobs of plasma that could form some of these lobes. "We're quite excited about this," says Raghvendra Sahai, an astronomer at NASA's Jet Propulsion Laboratory. "Nobody has really been able to come up with a good argument for why we have multipolar nebulae."

Sahai and his team discovered blobs launching from a red giant star 1,200 light years away, called V Hydrae. The plasma is 17,000 degrees Fahrenheit and spans 40 astronomical units—roughly the distance between the sun and Pluto. The blobs don't erupt continuously, but once every 8.5 years.

The launching pad of these blobs, the researchers propose, is a smaller, unseen star orbiting V Hydrae. The highly elliptical orbit brings the companion star through the outer layers of the red giant at closest approach. The companion's gravity pulls plasma from the red giant. The material settles into a disk as it spirals into the companion star, whose magnetic field channels the plasma out from its poles, hurling it into space. This happens once per orbit—every 8.5 years—at closest approach.

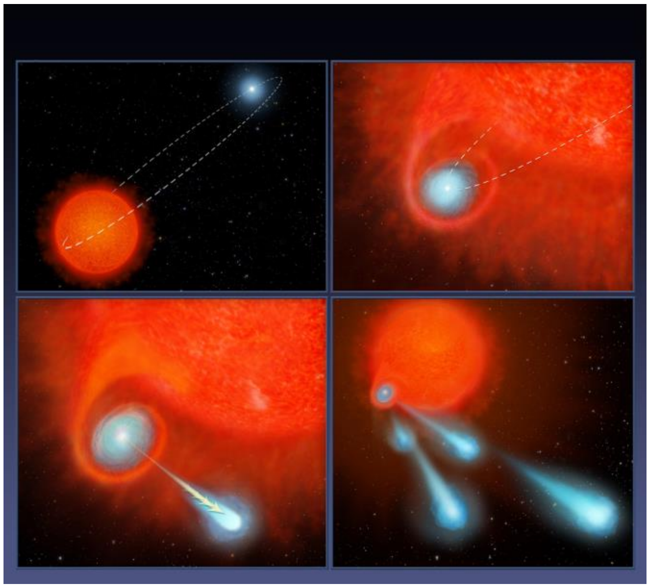
When the red giant exhausts its fuel, it will shrink and get very hot, producing ultraviolet radiation that will excite the shell of gas blown off from it in the past. This shell, with cavities carved in it by the cannonballs that continue to be launched every 8.5 years, will thus become visible as a beautiful bipolar or multipolar planetary nebula.

The astronomers also discovered that the companion's disk appears to wobble, flinging the cannonballs in one direction during one orbit, and a slightly different one in the next. As a result, every other orbit, the flying blobs block starlight from the red giant, which explains why V Hydrae dims every 17 years. For decades, amateur astronomers have been monitoring this variability, making V Hydrae one of the most well-studied stars.

Because the star fires plasma in the same few directions repeatedly, the blobs would create multiple lobes in the nebula—and a pretty sight for future astronomers.

If you'd like to teach kids about how our sun compares to other stars, please visit the NASA Space Place: http://spaceplace.nasa.gov/sun-compare/en/

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov/ to explore space and Earth scienc



This four-panel graphic illustrates how the binary-star system V Hydrae is launching balls of plasma into space. Image credit: NASA/ESA/STScI

NASA Space Place spaceplace.nasa.gov