

The High Desert Observer



June 2016



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

Individual Dues are \$30.00 per year
Family Dues are \$36.00 per year
Student (full-time) Dues are \$24.00

Annual dues are payable in January. Prorated dues are available for new members. Dues are payable to ASLC with an application form or note to: Treasurer ASLC, PO Box 921, Las Cruces, NM 88004. Contact our Treasurer, Patricia Conley (treasurer@aslc-nm.org) for further information.

ASLC members receive electronic delivery of the HDO and are entitled to a \$5.00 (per year) Sky and Telescope magazine discount.

June Meeting --

Our next meeting will be on **Friday, June 24**, at the DACC Main Campus, Room 141, Technical Studies Building, starting at 7:00 p.m.

The speaker will be Steve Barkes

Topic: The Texas Star Party 2016

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Member Info Changes

All members need to keep the Society informed of changes to their basic information, such as name, address, phone number, or email address. Please contact Treasurer@aslc-nm.org and jkile3916@gmail.com with any updates.

Outreach

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

Events

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

At our Leasburg Dam State Park Observatory, we hold monthly star parties. Located just 20 miles north of Las Cruces, our 16" Meade telescope is used to observe under rather dark skies. Please see *Calendar of Events* for specific dates and times.

* * *

Outreach Events For May 2016

by Jerry McMahan

Mercury Transit, Monday, May 9, 2016

I remember Rich Richins writing that he planned to set up a scope at NMSU. Others that I am not aware of, at this time, may have participated in an outreach event for the transit of Mercury across the Sun. Since I don't know about others, I will just report on my event.

I set up the ETX and had the event on the scope from 10:30 to 12:30, or when the transit ended. I was on the South side of the General Studies Building on the Central Community College campus. The wind was blowing, but, at my position on the grass it did not effect the scope. The wind did prevent some people from hearing me when I invited them over. I may be a blabber-mouth, but I am not a loud-mouth. The wind did not effect the hearing of one guy who was sitting on a bench three feet away from me. I invited him twice. He just looked at me with out saying anything, and lit up a joint. I guess he had some thing else to do in an alternate reality.

At a magnification of 48, Mercury did show a small, black disk. A large Sunspot was also visible. A few people had trouble understanding that the large, bright, white thing, was the Sun. That is not unusual when a person is not sure what they are supposed to be seeing.

After the event ended, I went upstairs to tutor students for the final exam scheduled for the next day. Three students did show up. I spent hours in the Sun counting observing and set up and take down. I spent another 5 hours tutoring. Where is my Medal of Honor!??

New America High School, Thursday, May12

The school is a Charter School located at the South end of the down town mall area. Ed Montes brought his 50mm refractor, Tracy Stuart had his 8 inch LX90 and Chuck Sterling set up the 10 inch. After narrowly avoiding suicide from grading final exams, I did make it with the ETX 125.

Early clouds cleared allowing clear views of the Moon and Jupiter. The session was arranged for the Seniors last day of school. One student asked Chuck if we were there just for them. Chuck told him that we were there for them, explaining that their teacher had contacted him to arrange for the telescopes to be brought. Some of the students demonstrated a knowledge of what they were looking at, having just finished some lessons on Astronomy.

The students were polite and appreciative of the experience.

Tombaugh Observatory Open House, Friday, May 13

This was the last open house until the Fall semester starts. It was also Friday the 13th. It really looked like bad luck for the open house. Thirty minutes before starting time, the clouds were so thick that you could not even see the glow of the Moon. Ten minutes before start time, the Moon and Jupiter appeared and remained visible for the remainder of the evening. Steve Shaffer and I stayed on Jupiter. One of the 12 inch scopes was also on Jupiter with the other on the double star Castor. The 16 inch Dobsonian was on the Moon.

The Astronomy department presentation was about Pluto and the New Horizons mission. It worked out pretty good for a Friday the 13th.



Calendar of Events (Mountain Time - 24 hr. clock)

Jun	03	22:24	Saturn at opposition
	04	21:00	New Moon
	11	20:30	OUTREACH; MoonGaze, International Delights Café
	12	02:10	First Quarter Moon
	20	05:02	Full Moon
	20	16:24	Summer Solstice
	24	19:00	ASLC Monthly Meeting; DACC Main Campus, Room 141
	25	20:30	Dark Sky Observing at Leesburg Dam State Park
	27	12:19	Last Quarter Moon
Jul	04	00:00	Independence Day - All Day
	04	05:01	New Moon
	09	20:30	OUTREACH; MoonGaze, International Delights Café
	11	18:52	First Quarter Moon
	19	16:58	Full Moon
	22	19:00	ASLC Monthly Meeting; DACC Main Campus, Room 141
	23	20:30	Dark Sky Observing at Leesburg Dam State Park
	26	17:00	Last Quarter Moon

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

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Announcements

June's ASLC speaker is Steve Barkes. The topic will be The Texas Star Party 2016.

Every year a contingent from ASLC attends the Texas Star Party, near Ft Davis, TX and MacDonald Observatory. This is one of the premier star parties in the country and is highly regarded for its very dark skies. It is so popular that you have to register in January for a drawing to win the chance to purchase tickets!

Steve and friends will tell us about their experiences this year and all the fun that we missed out on if we did not attend. We are expecting lots of photos of people sleeping in the day and the results of any practical jokes. We might even get some astrophotos as well.

* * *

Old Business:

1. Speakers – A speaker is still needed for the September meeting. Steve Barks will report on Texas Star Party (TSP) 2016 at the June meeting. Howard Brewington will be the speaker at the January 2017 meeting. Let Daniel know if you have suggestions for speakers or topics of interest.
2. Star-B-Que – Mary Alba, Walter Haas' (Society founder) daughter, has offered to host a star-b-que at her home northeast of Las Cruces for the Society. The potential date is 15 October. Cristina Lugo coordinating this with Mary.
3. Cecil Post telescopes – These are two large reflectors Cecil built, that his family donated to the Society, and that are currently stored at the home of Cristina Lugo, ASLC Vice-President. Daniel believes the Society should consider building a dedicated observatory to house these telescopes and would like to form a committee to study the feasibility of such a plan. If there is no interest in such a project on the part of the Society, he suggests approaching New Mexico State University or other potential users that could put the telescopes to good use. Daniel went on to discuss the potential observatory project in more detail including his concerns about supporting another observatory project at this time. Sid Webb asked about possibly building another structure at LDSP and Howard Brewington asked for details about the telescopes, including their potential historical significance. Daniel feels the next step will be to determine the level of interest among the membership to take on such a project. The sense of those present was not favorable.

There was no additional old business discussed.

New Business:

There was no new business for discussion.

Announcements:

Items for Sale:

Howard Brewington has a 2" diagonal for sale. Interested parties should make him an offer.

General Announcements:

Albert and Ann Grauer provided fliers regarding the celebration of the Cosmic Campground being named the first International Dark Sky Sanctuary in North America (second in the world). The celebration will be 04 June at the Cosmic Campground 8 miles north of Alma, NM. More details at cosmiccampground.org. RSVP at nmcanopus@gmail.com.

Bert Stevens has copies of the Reflector, Planetary Society Reports and International Dark Skies Association (IDA) information for anyone interested.

The Enchanted Skies Star Party will be held from 26-29 October near Socorro, NM. Tours of the Very Large Array (VLA) and Magdalena Ridge Observatory (MRO) will be offered. Daniel has tried to get more details regarding the observatory tours but has been unsuccessful so far.

Recognitions/Achievements:

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

The business portion of the meeting was adjourned at 7:50 pm.

Presentation:

May's presentation was by ASLC member Dr. Alex Woronow. Alex began his presentation by inviting members of the ASLC to a star party at his Black Range Observatory on 02 June (03 June will be a weather backup date). He then proceeded with his topic: "The Secret Lives of Stars – How Stars Originate, Grow, and Die". At one time, Herbig-Haro objects and T-Tauri stars baffled astronomers. Now we know they indicate the protostar stages of star collapse and ignition in the nurseries of interstellar molecular clouds. All stars start out with similar birth events, but, because of their varying chemistries and initial masses, they have greatly varying life spans, diverse evolutionary stages, and remnants ranging from white dwarfs to black holes, neutron stars, pulsars and magnetars. The evolution of single stars is remarkably well known, in large, and this presentation will reprise much of that knowledge.

Daniel reminded members that the next meeting will be 24 June in Room 141 at DACC. The Society will start meeting at Good Samaritan beginning 26 August.

The May meeting of the Astronomical Society of Las Cruces concluded at 8:41 pm.

-Respectfully submitted by John McCullough, ASLC Secretary

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Back at the Telescope

by Bert Stevens

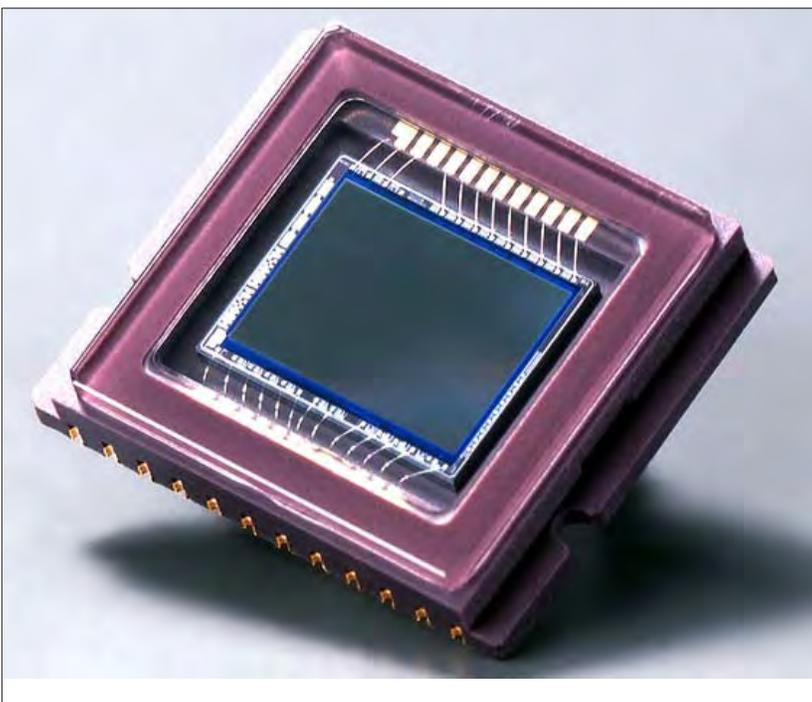
Last month we talked about photometry in the early years. Doing photometry with a photoelectric photometer was time-consuming and required a reasonable understanding of mathematics since computer software (and computers themselves) were not available to amateur astronomers. You had to be able to point the photometer at the star, flip mirrors, change filters, and apertures without losing the target. You then had to repeat the process on a comparison star and then a check star. It could take a long time to get one measurement.

The Charge-Coupled Device (CCD) was invented in 1969 at AT&T Bell Labs by Willard Boyle and

George E. Smith, who received a Nobel Prize in 2009 for their invention. CCDs were first developed as a memory device. The earliest CCD was a semiconductor device that performed as a shift register. The linear semiconductor had a series of electrodes on, but insulated from, their surface. If a positive charge is placed on

A CCD - Charge Coupled Device

A typical Charge-Coupled Device (CCD) is a piece of silicon, which has been processed to add electrodes and a photosensitive layer. The individual cells are too small to be seen, but you can see the wires that connect the clocking pulses to the CCD chip and carry away the charge as it is shifted out of the final cell. The entire cell is mounted in a holder that plugs into a socket on a printed-circuit board.

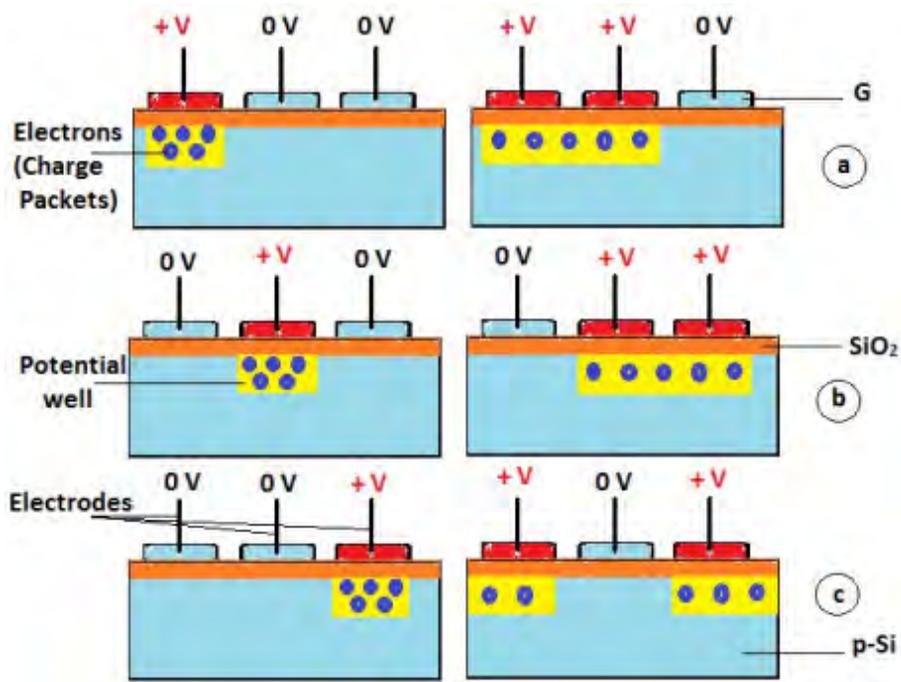


an electrode, the area under it becomes very attractive to any loose electrons in the area. This area is called a potential well.

The potential well is, in effect, a capacitor. Capacitors can store a charge. A perfect capacitor could store a charge forever, but, of course, there is no perfect capacitor and the charge will slowly leak away. The same thing can happen to the charge in the potential well, but we will get back to this leakage later.

To operate the shift register, a positive voltage would be applied to the first electrode. A bit value (negative charge) would be input on the end of the semiconductor, charging the well under the first electrode with a negative charge of electrons. The positive charge keeps the electrons in the well. When you want to shift the bit over, you put a positive charge on the electrode over the next well, attracting the electrons into that well as you drop the voltage to zero on the first well's electrode. The charge is now in the second well. The process is repeated shifting the electrons in the well through the register until it exits the far end of the device.

While the CCD was designed as a memory device, storing bits of data until they are needed, it was also recognized that it could be an imaging device. Each well on the device can be made photosensitive by putting a coating on the CCD that makes it easy for photons to knock electrons out of its atoms. A negative electric charge is placed on the bottom of the device. When a photon strikes the photosensitive coating above the well (or



The Workings of a CCD:

A CCD gets its name from its ability to transfer the charge in a well into an adjacent well. Here you can see a schematic of the process. A positive voltage is applied to the first electrode, trapping the electrons underneath it. The next electrode is now given a positive voltage and the electrons start to stream toward it. The voltage is reduced on the first cell and the remaining electrons stream toward the second electrode. At the end of the device, the charge flows into a wire that takes it to the analog-to-digital converter.

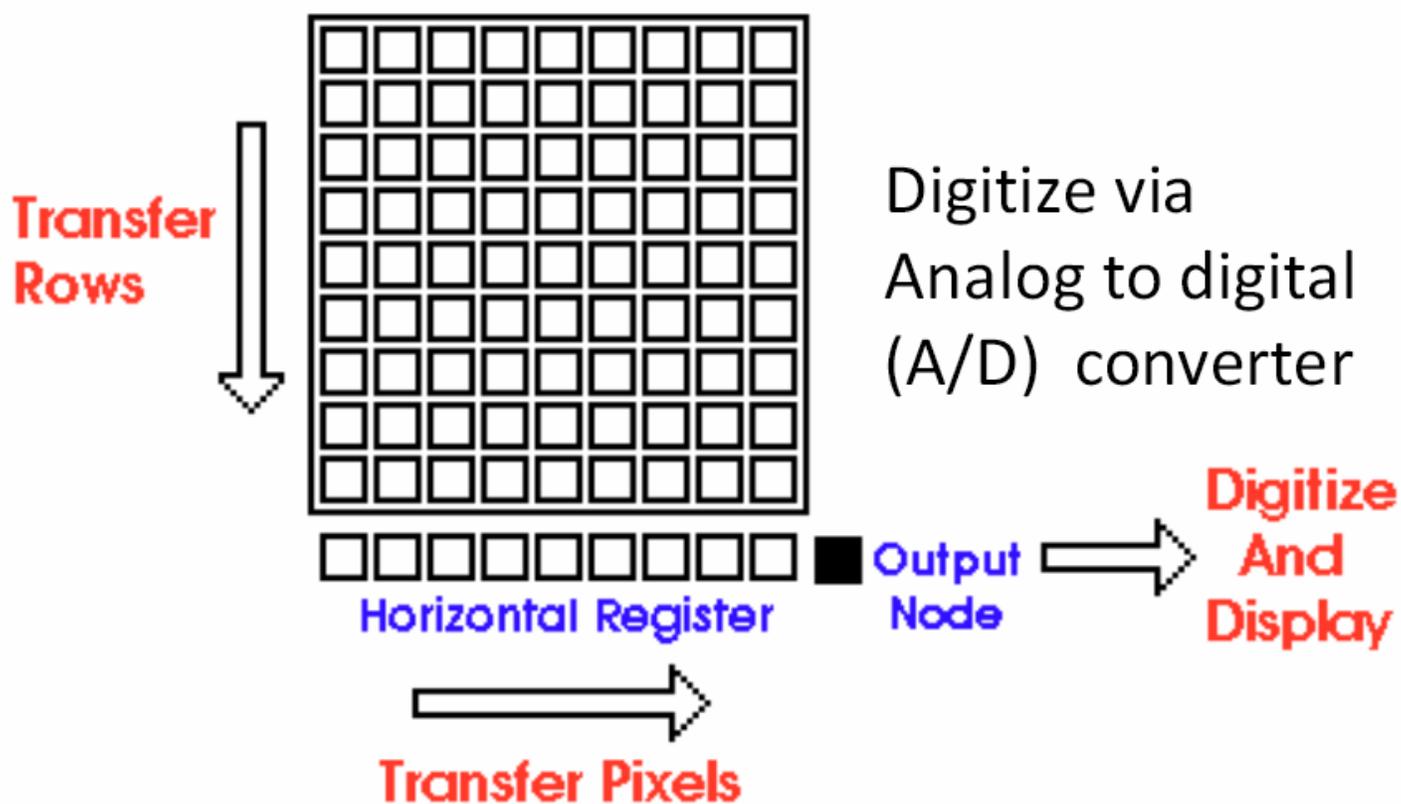
as it is often called, the cell or pixel), it knocks an electron out of an atom. The electron is pulled toward the area under the well's positively charged electrode while the positive charge migrates toward the negative charge at the bottom of the device.

As each photon knocks out an electron, they are held under the well's electrode for the duration of the exposure. Each well has an electron for each photon that hits it. Therefore, the different wells will have different charges, depending on the brightness of the image at each cell. While most of the electrons will be held in the well, some of the electrons will "leak" away from the well. This means that CCDs can suffer from reciprocity failure just like film. However, the reciprocity failure is much lower than film, so for most exposures, it can be ignored.

The other problem is that the wells can only hold so many electrons before they start to push each other out of the well. This happens with very bright light and it means the CCD no longer responds linearly to the amount of light hitting it. Often the electrons leak into adjacent cells, causing streaks in the image. This is called a “full well” condition and it is listed in the specifications for the CCD.

In a linear CCD, it would take just a single line in the final image. The electrons in each well are now shifted toward the end of the device. There the electrons from each well are transferred to an analog-to-digital converter that generates a number for each cell proportional to the amount of light that that cell received. The value output from the analog-to-digital converter is usually fed into a computer for assembly into a final image.

For the far more common image sensor in our cameras, the CCD device is a grid of cells that are composed of many columns of cells. The charge in each cell in the column is transferred to the end of the column. The last cell at the end of the column also connects transversely to the cell in the next column. To read out an image, the charges in each cell are transferred all at once toward that end column.



Horizontal register = Serial register

How Readout Works:

A CCD image is read-out by shifting an entire column of pixels downward, shifting the last image pixel into the last row (known as the horizontal or serial register). There the pixels are shifted across until they are output into an amplifier and then an analog-to-digital converter. This means that the entire image is converted to digital by a single analog-to-digital converter. The time it takes to read out the whole image depends on the speed of the analog-to-digital converter and how long it takes to shift the charges from one row to another.

Once each column's next cell has been transferred into the last cell, the charges are transferred across the last row, with each charge finally coming out of the device and into an analog-to-digital converter. This converter outputs a number proportional to the charge in the cell. Once all the charges in the last row have been read-out, all the columns shift the charges down one row, reloading the last row, starting the process again. This continues until all the cells have had their charge converted into a number. The numbers are collected and passed to a computer for reassembly into the actual image.

The electrode on the top of the CCD cell holds the charge in place, but it is also opaque, and any photons that hit it are reflected. This loss of photons reduces the efficiency of the CCD. To improve the sensitivity, the backside of the CCD is ground away in a process called thinning. Then a photosensitive layer is placed on the back. The CCD is now turned over, so light hits the back of the CCD. Without the electrodes in the way, these back-illuminated CCDs are more sensitive than the equivalent front-illuminated CCD.

Electrons in the CCD can also be generated when two atoms in the device bump against each other, knocking out an electron. As you probably know from physics, the warmer an object is, the more its atoms jiggle around and run into their neighbors. This is actually the definition of temperature, and the higher the temperature of the CCD, the more atoms bump into the neighbors, releasing thermal electrons. These thermal electrons are trapped in the well along with the photon-generated electrons.

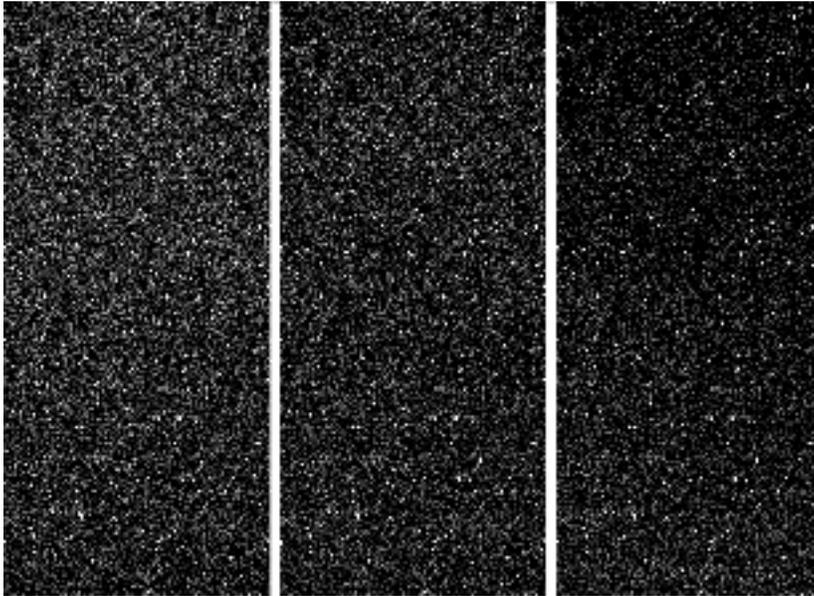
To reduce the number of these thermal-electrons, the CCD is cooled down as much as possible. This is usually done with a thermoelectric cooler, which uses electricity to cool one side, which is connected to the CCD, while the other side becomes warmer, and is often air-cooled with a fan. There are also systems that use a liquid cooling system to carry away the heat, while the professionals use liquid nitrogen to really cool down the CCD.

When the CCD is employed to observe variable stars, an image is taken that has the variable star and a number of neighboring stars. The entire image is analyzed, and the stars in the image are matched to the stars in a star catalog. The star catalog has the right ascension, declination and a magnitude for each star. Star catalogs have magnitudes that are often the result of only a few observations and then averaged together, which are not accurate enough for variable star work. They could also be variable stars in their own right, so it is often necessary to select specific stars to be used as comparison stars.

To get good comparison stars for variable star work, the AAVSO has selected a group of stars near each variable to be monitored. These stars have been monitored over time to make sure that they are not variable. Good magnitude measurements require a good-to-excellent signal-to-noise ratio.

This requires an adequate exposure to make the signal (brightness of the star) much higher than the brightness of the background. The higher the desired accuracy, the higher the signal-to-noise ratio must be to reach that accuracy. Longer exposures reduce the number of measurements that can be made in a night, so it is necessary to balance accuracy (exposure time) and frequency of observation (number of images per night).

The AAVSO prefers measurements be made through multiple filters, whether the measurements are taken with a photoelectric photometer or a CCD. Much like was discussed last month, the CCD must be calibrated against standard stars with the different filters. Using red and blue pairs of nearby stars, the color index of the system is also computed. CCDs have a lower sensitivity to ultraviolet light, so U-band measurements are often not made by amateurs. Conversely, the CCD is more sensitive to near infrared, so it is easier to make measurements in the R- and I-bands.



Darks: *The same section of a CCD dark image taken at different temperatures is shown here. The left segment is taken at -25° C. The middle was taken at -35° C., while the right one was taken at -40° C. The image shows that the dark current drops as the CCD is cooled, making the dark image darker at lower temperatures.*

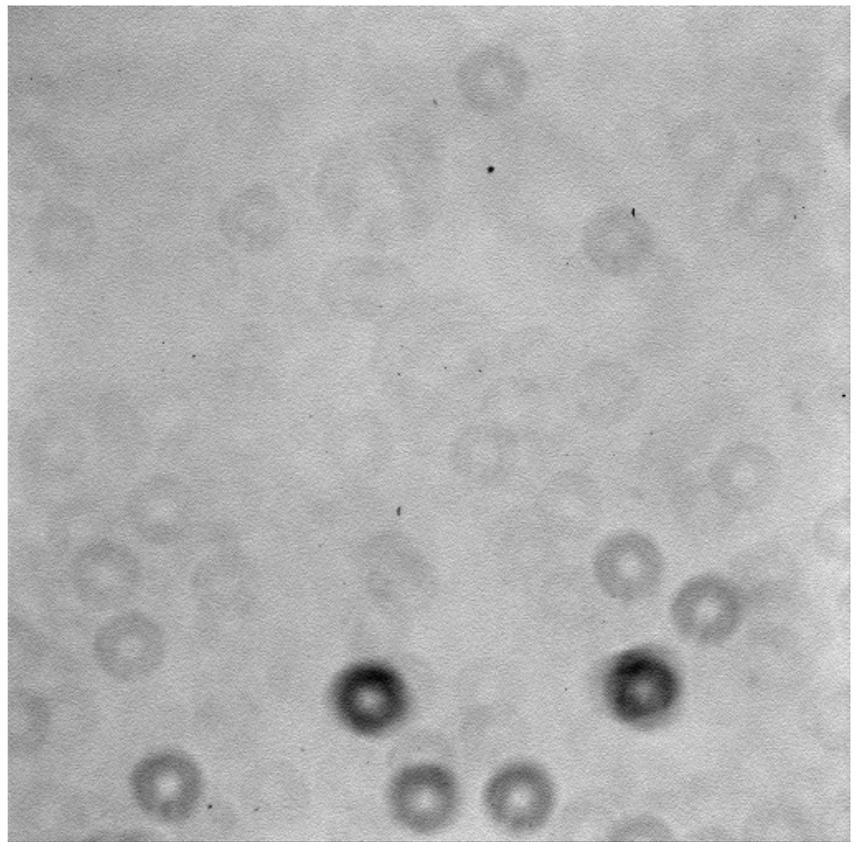
The science image needs to be calibrated before it can be analyzed. This eliminates some of the problems that CCD cameras experience. The first step is to subtract a master dark from the image. Darks are images take with all light blocked from the CCD, either by not opening the shutter, or covering the telescope.

This dark represents the thermal electrons that accumulate during an exposure. These vary from cell to cell so you must get a full dark image. Since the number of electrons varies randomly, a series of these darks are taken and combined to form a master dark that best represents the dark noise in each CCD cell. Since dark noise varies with temperature and exposure time, a master dark must be generated for each exposure time and CCD temperature.

The second calibration step requires a flat image. The flat is taken by pointing the telescope at a uniform white field. This could be a large piece of white paper on the inside of the observatory's dome or a white t-shirt placed over the aperture of the telescope. You can also image the sky during dawn or dusk, but it is hard to keep up with the changing sky brightness as the Sun's altitude changes.

Unlike the dark, the flat image does not need to be taken at the same temperature or exposure time as the science image. Flat images are generally taken with enough exposure to have the CCD's cells be at about seventy-five percent of maximum value. This means that a sixteen-bit CCD readout (maximum reading 65,535) should have a flat with the peak pixels having a value of around 50,000. These have to be dark subtracted

Flats: *A typical flat is used to remove defects caused by the optical system. These include dust doughnuts (out-of-focus dust particles in the optical train) and vignetting in the optical system. The dust doughnut is bigger the farther the dust particle is from the CCD and darker when the particle is larger.*



just like any other image. After that, a series of flats are averaged together to create a master flat. The same flat can be used until the optical system is changed.

The flat measures characteristics of the optical system. Such things as vignetting and dust doughnuts are greatly reduced up by using a flat. If the image was not calibrated with a flat, the variable might be in a doughnut, while the comparison stars are not. This would lead to an offset in the measured magnitude.

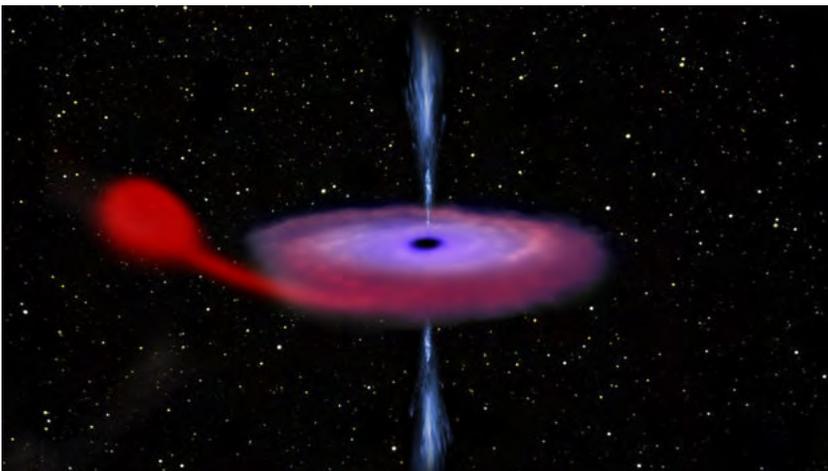
The calibrated science image is now analyzed with software that compares the measured brightness of the variable star to the brightness of the comparison stars. With a photoelectric photometer, a circular aperture stop allows only the star's light to reach the photomultiplier. With the CCD, the same result is accomplished by adding together the measured brightness of the adjacent pixels around the variable.

The measuring software usually has a variable aperture setting. It tells the software how many pixels inside a circle around the star being measured to add together to get the total brightness for that star. The diameter of the circular aperture is usually set so it gets all the pixels that are above the background level for the brightest star and one ring of pixels around them. If the aperture is larger, additional noise from the dark pixels in the image will reduce the accuracy. If it is too small, some of the light from the star will be lost in the pixels outside the aperture.

The contribution to the total brightness of the star from the background sky brightness has to be subtracted from the final reading. The software computes this value by averaging the brightness of the pixels encircling the aperture. The number of pixels out from the aperture used for computing the background might be fixed or variable depending on which software product that is being used.

The software now uses the final, calibrated, brightness of the comparison stars to compute the magnitude of the variable. It includes all the factors, such as air-mass, color-index, and other calibration information in the final measurement. Once the comparison stars are identified to the software, a series of images of the same target can be quickly analyzed to give a light curve for that night. The observations can be formatted for transmission to the AAVSO.

With a CCD, it is possible get many measurements in a single night. However, different variable stars vary at different rates. Some need only one measurement a night, while others need measurements as often as possible. Amateur variable star observations have been featured in the magazine Nature. There, ASLC member Bill Stein was listed as a co-author in a paper on the black-hole binary variable star V404 Cygni. The AAVSO can help you get involved in this exciting field of amateur astronomy. You can contact them at aavso.org.



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V404 Cygni:

Artist's conception of V404 Cygni, a black hole that is surrounded by an accretion disc formed out of the material from a companion star. This object can vary rapidly and has emitted gamma ray bursts (Credit: ESA).

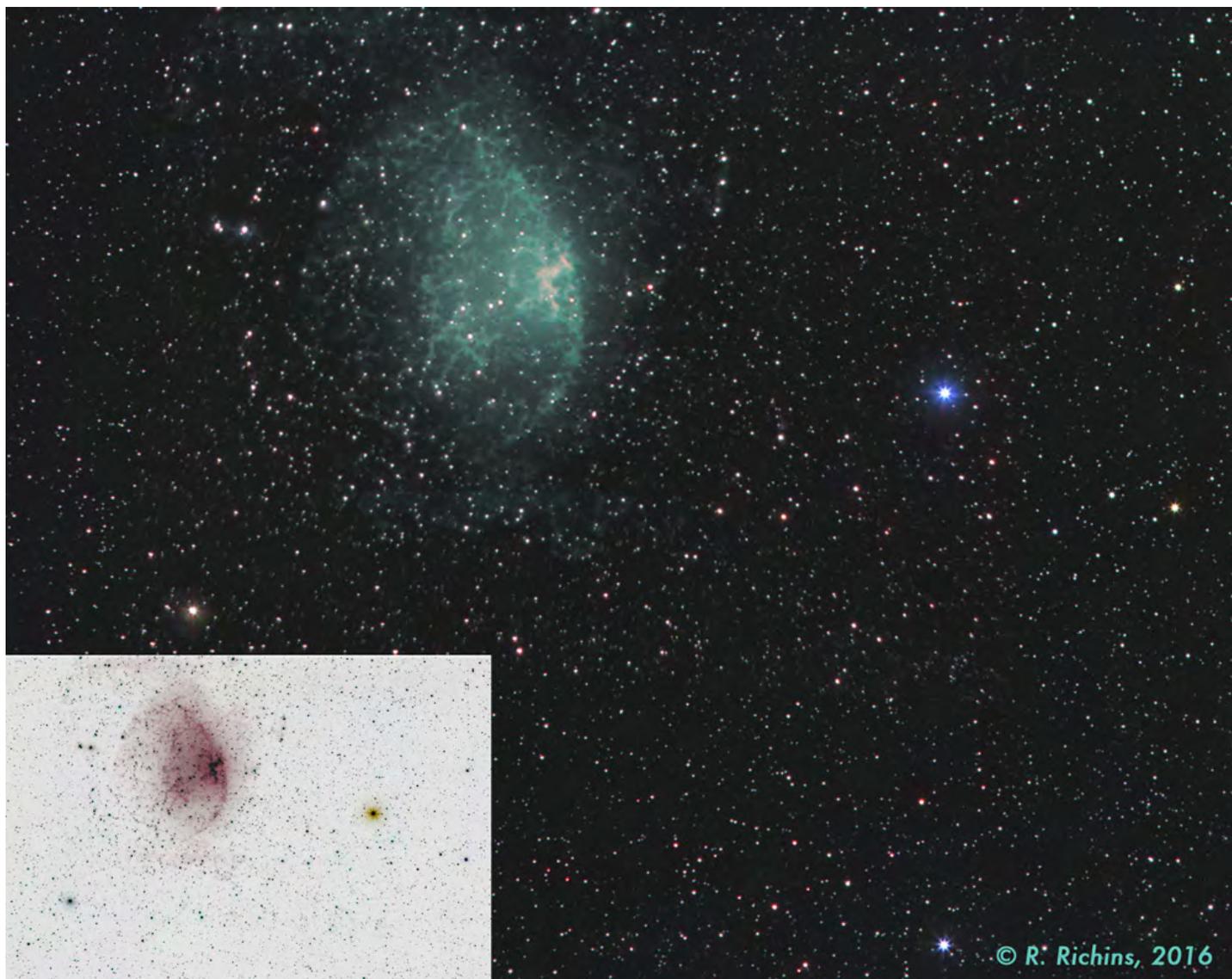
Photo of the Month



Barnard 72 “The Snake”

This image was taken with a Tak Sky90 operated remotely in Siding Springs, Australia. The camera was an ST2000XCM one shot color camera. There were 32 exposures of 300 seconds each. The images were calibrated and debayered to “super pixels” and separated into RGB, then realigned all colors and images. The RGB were individually stacked and combined into a new color image. Subsequent processing included color and saturation enhancement, along with contrast adjustments. All processing was done in Pixinsight and required total processing time of 7-8 hours. Copyright by Alex Woronow, Black Range Observatory, Mimbres, NM.

Photo of the Month



OBJECT: Hewett1 Planetary Nebula in Sextans

Hewett1 is a large but very faint planetary nebula in Sextans. It was reported in the early 2000's from SDSS data, but very few images exist. I found the nebula in a list of advanced OIII targets on the CloudyNights forum, and decided to see what I could obtain.

I took DSLR color images, but saw no hint of nebulosity. However, the Atik picked up faint nebulosity using 10-minute OIII filtered subs. A few faint blotches were also acquired using the Atik and an Ha filter. The OIII image was considerably brighter.

The nebula was imaged over four nights at the 2016 Texas Star Party. Transparency each night was good to very good. Copyright Rich Richins 2016

Telescope: Canon 200mm f/2.8 lens

Cameras: Canon T2i (color); Atik 460 (Ha and OIII)

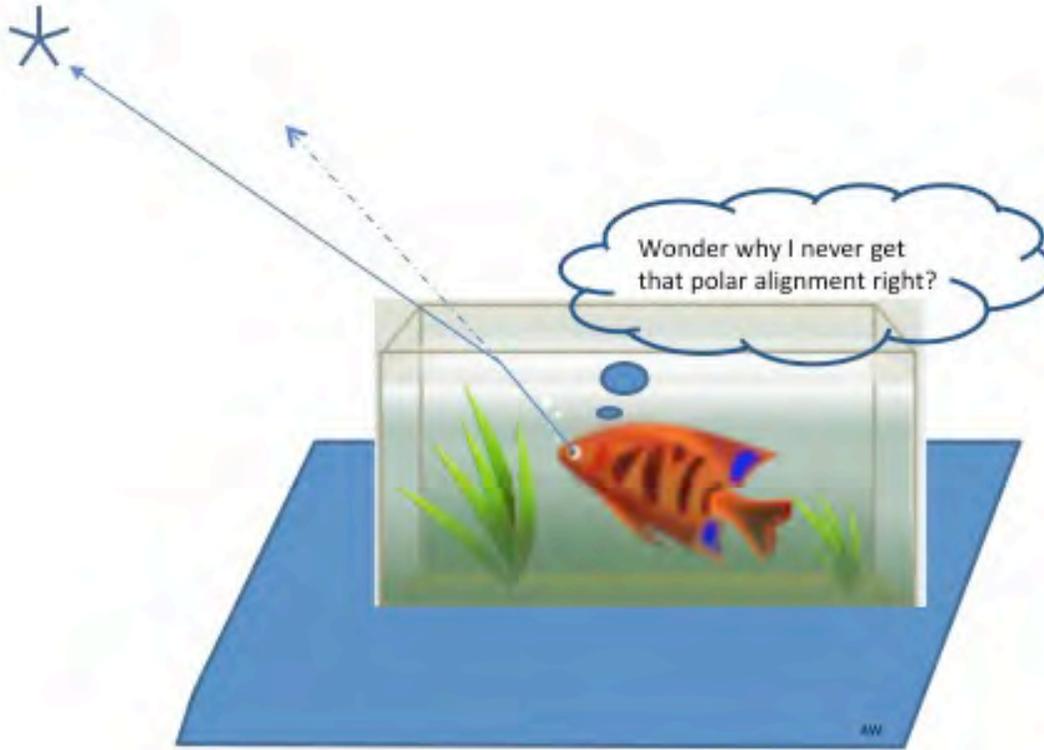
Filter(s): 2" Baader Ha and OIII filters

Exposures: Canon - 4-minute subs @ iso 1600; Atik - 10-minute (-10°) subs.

Guiding: Using PhD guiding software with an Orion ED-80 and Lodestar X2.

Processing: Images aligned and stacked in Nebulosity. Curves/levels and sharpening with Photoshop CS5.

Yuk of the Month



Submitted by Alex Woronow