Huachuca Astronomy Club
Sierra Vista Arizona

NIGHTFALL

A PUBLICATION OF THE HUACHUCA ASTRONOMY CLUB

SEPTEMBER 2016

PRESIDENT'S NOTES

Are you having this dream as well? It's September, pitch black, and I have a claustrophobic feeling of being engulfed in dark clouds. Then, I think I see the end of the tunnel, and it looks as if the sky ahead is clear. Are those stars I see? I move to open the dome, only to find myself waking up to the sound of rain.

If it is clear, there are so many things to see, and you don't even need a telescope to see many of them. As I have been writing for months, the summer Milky Way is well placed for discovery. While a bit past its best placement, it is still there for viewing much of the night. In researching this article, I was amazed at the number of websites out there to help you find the Milky Way, including one entitled, "Yes, You Can See the Milky Way with the Naked Eye." We have it good here; just look up. A recent net article, "Paddle the Milky Way's Dark River," by Bob King, has a wonderful overview of the Milky Way and the Great Rift, that is invisible to so many, but is quite easy to see in our rural skies.

I also promised to come back to the subject of what to take to the total eclipse next year. I think many have already decided how they are going to record the event. My plans aren't completely solidified yet, but we can go over some possibilities. This month, let's look over the simplest approaches to recording the eclipse. Just looking and enjoying the eclipse, and cameras on tripods.

By far, the easiest and maybe the most satisfying experience is just watching the eclipse unfold. First, with filtration, as the moon slowly covers the sun, then at totality with your bare eyes you get complete context. You can let the experience sink in. Looking around at others in the crowd, all having personal moments, is life changing for many. You will also undoubtedly see multitudes of astro-techs fiddling with cameras and telescopes, and you can soak in those visions as well. Look around at the sky; see the stars and planets. Feast your eyes on the Sun's halo, the corona, as its ethereal wisps flow and branch from behind the Moon. Along the geographical centerline, you will have a minute or more to "mentally record" the sights, sounds, and feel of the event. Yep, sounds. Listen for diurnal animals to quiet, and the twilight and nocturnal animals to begin to voice. As the eclipse gets closer to totality, feel the temperature drop. It will be August, so there may be a great deal of change. There have been reports over the years of skies clearing or, sadly, clouding up as totality nears. Without a camera to distract from the moment let every nuance, sink in. Remember to breathe.

Nevertheless, you really want to take a picture of the eclipse. I can understand that. You could take shots of the reactions of people around you with a point and shoot camera. That shot may be the real keeper, as you catch the excitement of friends and loved ones at the momentous event. Please turn off the flash.

You can take images of shadows through the trees, as the eclipse gets closer to totality. Small openings between objects such as tree leaves act like pinhole camera apertures. The small dapples of light landing on the ground below the partial eclipse will, each and every one of them, show the crescent shape of the partial eclipse. On non-eclipse days the pinhole effect is still there, but we don't think twice about the round images that blend together.

Another fascinating phenomenon is shadow bands. These are slow-moving waves of light and dark observed to move across light-colored surfaces, such as smooth concrete, just before and after totality in a solar eclipse. They are thought to originate from the effects of irregular atmospheric refraction. They have been very difficult to photograph using film, but high-speed video cameras may overcome the photographic problems. Even camera phones, in video mode, may work to catch these bands. You might want to bring a large white sheet of paper or fine threaded cloth to place on the ground, and a tripod is a good idea.

You can take simple camera shots with a midrange lens on a tripod, as you would a total lunar eclipse. During totality, there is no need for a solar filter, but you will need a tripod. Using a DSLR you will want to pre-focus on infinity, and bracket your exposure times and f-stops. With a wider camera lens on a DSLR, you could pre-focus and pre-frame at the sky where the Sun will be at totality, and take a timed series of shots before, during, and after totality to combine later into a time-lapse image. This setup would need to include a solar filter to cover the lens before and after totality.

This probably means you will need to buy a filter, or make one. Either way, you had better decide soon, and order the filter or parts real soon. There will be millions of people readying for this eclipse, wanting to take a picture or two, so supplies will dry up. The solar filter will need to come off and go on the camera lens easily and you will have to practice that action before the event to become comfortable in the semi-dark. Again, you will need to adjust apertures and exposure times as the event unfolds. The more you practice the actions needed to perform these tasks, the more likely you will have success, and the more time and energy you will have to visually appreciate the eclipse.

Next time clock drives, telephotos and more.

Welcome our new members

We welcome back Jeff Ofstedahl of Huachuca City who re-joined the club in August. Tony Lemak of Hereford joined the club at our September Public Night. Tony observes with a C8 housed in a Sky Shed Pod. Welcome! We are glad you joined.

Mark Your Calendars

October 29th is the annual Dine under the Stars fundraiser for the University South Foundation, Inc. The foundation owns the Patterson Observatory and HAC has a very special relationship with it. In order to ensure continued access to the Patterson Observatory, HAC maintains a member on the foundation's board of directors. Our current representative on the board is Ted Forte. Not only will your DUTS ticket purchase help to support the students, faculty, and staff of the University of Arizona, South but it will also help Ted fulfill his obligation as a board member. 100% of the money collected at DUTS goes toward the charitable purpose of the foundation. (The cost of the event is deferred by the event sponsors).

This year's event is themed "Cosmic Celebration". The dinner will be catered by the Outback Steak House with desserts provided by La Casita Mexican Cantina. There will be live entertainment, visits by local celebrities, a silent auction and a 50/50 raffle. And weather permitting, the Patterson Observatory will be open for observing. DUTS is held adjacent to the observatory. Adult tickets are $45 each. Please see Ted Forte to purchase tickets.

HAC Holiday Party

Last year's holiday party at the Pizzeria Mimosa was a great success, so your HAC Board of Directors has voted to again hold our holiday celebration at Mimosa. The party room has been secured for December 16 and a dinner will replace the December meeting scheduled for that date. Just like last year, we will be selling tickets in advance (seating is limited). Special dietary needs can be accommodated with advance requests. Stay tuned for details on the menu and pricing.

Handbooks and Calendars on Sale!

The treasurer, Ted Forte, will be taking orders for the 2017 RASC Handbooks and the 2017 Deep Space Mysteries calendar from Astronomy Magazine. Please plan to pay in advance for the handbooks and calendars. The handbooks are $21 each (regular $27.95) and the calendars are $6.50 each (regular $12.99). If you miss the meetings, you can order by sending a check to PO Box 922, Sierra Vista 85636.

You may also pay for handbooks and calendars through Pay Pal by using the "Donate" button on the HAC website www.hacastronomy.org. Be sure to indicate your desired merchandise as the purpose of your donation. PLEASE NOTE that when paying through Pay Pal, the price for the handbooks will be $21.85 and for the calendars, $6.75. You do not have to have a Pay Pal account to pay through Pay Pal; you can use your credit card.

The handbooks and calendars will be ordered after the November 18 meeting and should be available in December. You'll be able to pick yours up at any December HAC event or you can contact Ted to arrange an alternate plan.

The September Meeting Program

NASA Solar System Ambassador and OSIRIS REx Mission Ambassador, Ted Forte, will update us on the OSIRIS REx Asteroid Sample Return Mission.

HAC Officer Elections

Just like America, HAC holds elections in November. HAC is governed by a Board of Directors consisting of four officers, four members-at-large and the past president. All regular HAC members in good standing are eligible to serve on the board. Terms are for one year. Members wishing to be considered should make their intentions known to HAC President, David Roemer. The election will be held at the November 18 meeting. Board positions having only a single candidate will be filled by affirmation at the November meeting. Members must be present to vote. All of the current board members have indicated their willingness to serve another term. No other candidates have yet declared.

Club Dues

Most HAC memberships expire in December. A new member's initial membership expires 12 months after their first full month of membership. At that time, a pro-rated amount will be charged to adjust membership expiration to December. If you joined in 2016, you should be getting a due notice in your email.

All members are encouraged to pay their 2017 dues by the November 18 meeting. Remember, you can always pay your dues by mailing a check to PO Box 922 Sierra Vista AZ 85636 or via Pay Pal through the Join or Donate links on our website www.hacastronomy.org

Membership is $25 individual, $35 family, $20 active military, $25 military family and $10 student.

The OSIRIS REx Launch Party

Ted Forte

On September 8, members of the Huachuca Astronomy Club held a launch party at the Patterson Observatory for NASA's OSIRIS REx asteroid sample return mission to the asteroid Bennu. It was a great success!

OSIRIS REx is managed out of the University of Arizona and thanks in large part to the University South Foundation, HAC received the support of both the main campus in Tucson and the UA Sierra Vista campus in setting up this party.

The Flandrau Science Center and Planetarium graciously donated a family pack of tickets as a door prize, and UA provided a large amount of OSIRIS REx materials for giveaways. We also had cool stuff from the NASA Space Place and from Dolores Hill of LPL. Dolores manages the OSIRIS REx ambassador program and provided a TAGSAM simulator in addition to lot of stickers and bookmarks. The NASA Museum Alliance's Jeff Nee also provided assistance and encouragement for the event.

However, HAC's launch party could not have happened without the hard work of several HAC members. A big part of the afternoon's activities was the comet-making demo organized and delivered by Nancy Hannaford, Connie Kelher and Sylvia Conklin. They went above and beyond to gather materials (who knew there wouldn't be a single piece of dry ice in all of Sierra Vista?) and produced a professional and informative demonstration that our guests enjoyed.

Outside on the porch, Rick Burke and Scott Conklin were set up to show the sun and the moon through gaps in the clouds. Our normal Patterson Public Night followed the launch party event and more HAC members added their scopes for the evening event. David Roemer, Ken Duncan, Bert Kelher, and others joined the patio crew after sunset, while Gary Grue and I manned the 20-inch.

We had approximately 45 guests at the observatory for the launch party and about 30 for the Public Night. The real star of the launch party was OSIRIS REx itself atop an Atlas 5 rocket and its flawless, on-time launch from Cape Canaveral.

While I did a lot of the organizing for this party myself, I would like to thank Bob Gent for suggesting the party in the first place and for his and Gary Grue's help in setting up and everyone's help in cleaning up. Stephan Gallo of UA Sierra Vista IT was an essential element too – he insured that the live feed from NASA TV was delivered uninterrupted.

Thanks to all who helped and all who attended.

Space Place Article August 2016

Is there a super-Earth in the Solar System out beyond Neptune?

By Ethan Siegel

When the advent of large telescopes brought us the discoveries of Uranus and then Neptune, they also brought the great hope of a Solar System even richer in terms of large, massive worlds. While the asteroid belt and the Kuiper belt were each found to possess a large number of substantial icy-and-rocky worlds, none of them approached even Earth in size or mass, much less the true giant worlds. Meanwhile, all-sky infrared surveys, sensitive to red dwarfs, brown dwarfs and Jupiter-mass gas giants, were unable to detect anything new that was closer than Proxima Centauri. At the same time, Kepler taught us that super-Earths, planets between Earth and Neptune in size, were the galaxy's most common, despite our Solar System having none.

The discovery of Sedna in 2003 turned out to be even more groundbreaking than astronomers realized. Although many Trans-Neptunian Objects (TNOs) were discovered beginning in the 1990s, Sedna had properties all the others didn't. With an extremely eccentric orbit and an aphelion taking it farther from the Sun than any other world known at the time, it represented our first glimpse of the hypothetical Oort cloud: a spherical distribution of bodies ranging from hundreds to tens of thousands of A.U. from the Sun. Since the discovery of Sedna, five other long-period, very eccentric TNOs were found prior to 2016 as well. While you'd expect their orbital parameters to be randomly distributed if they occurred by chance, their orbital orientations with respect to the Sun are clustered extremely narrowly: with less than a 1-in-10,000 chance of such an effect appearing randomly.

Whenever we see a new phenomenon with a surprisingly non-random appearance, our scientific intuition calls out for a physical explanation. Astronomers Konstantin Batygin and Mike Brown provided a compelling possibility earlier this year: perhaps a massive perturbing body very distant from the Sun provided the gravitational "kick" to hurl these objects towards the Sun. A single addition to the Solar System would explain the orbits of all of these long-period TNOs, a planet about 10 times the mass of Earth approximately 200 A.U. from the Sun, referred to as Planet Nine. More Sedna-like TNOs with similarly aligned orbits are predicted, and since January of 2016, another was found, with its orbit aligning perfectly with these predictions.

Ten-meter class telescopes like Keck and Subaru, plus NASA's NEOWISE mission, are currently searching for this hypothetical, massive world. If it exists, it invites the question of its origin: did it form along with our Solar System, or was it captured from another star's vicinity much more recently? Regardless, if Batygin and Brown are right and this object is real, our Solar System may contain a super-Earth after all.

A possible super-Earth/mini-Neptune world hundreds of times more distant than Earth is from the Sun. Image credit: R. Hurt / Caltech (IPAC)

Calibrating Images using Superbias

Alex Woronow, Black Range Observatory

Astro-imagers quickly learn the value of light-frame calibration. Calibration removes patterned noise from light frames that record the deep-sky astronomical object of interest. The process usually involves three different calibration images, each intended to remove one or more of the patterned-noise signatures.

Let us backup: An image of an astronomical target (or of any subject) contains a signal representing that target. But the image also contains several contaminants in the form of random noise (arising from multiple sources) and a diverse set of patterned noises. By definition, random noise cannot be subtracted directly from an image. If you tracked just one pixel in a set of identically targeted and exposed images, its value will jump about. On a scale of 0 to 1, in one image, it might be 0.33, in the next 0.31, then 0.25, then 0.27. There is no way to know which, if any, of these values is the true value. But, the central limit theorem tells us that the average of these values is a good estimate of the true value. Furthermore, the uncertainty associated with the estimate of the true average decreases as the number of identical exposure increases. The uncertainty is $1/\sqrt{n}$, where n is the number of exposures averaged together. That is one simple reason that imagers stack many “sub-exposures.” However, if a calibration image has a large random error, then applying it to light frames actually can degrade the light frames. That, clearly, runs counter to best-processing interests, so making calibration images having very low random noise has obvious benefits too.

In fact, if there were no patterned noise in our light frames, then averaging a large number of them would be the beginning and end of the image-calibration recipe. However, patterned-noise sources equate to a swarm of flies in the ointment. Several sources of patterned noise exist, and Master Bias, Master Flat, and Master Dark calibration frames have the task of isolating and characterizing each source for removal. [The descriptor, “Master,” indicates that single-frame averaging has been used to suppress the random noise.]

Before We Get to Superbias...

Our principal interest here is a little known alternative to the “Master Bias” calibration frame, namely, the “Superbias” frame. As we will find, a Superbias frame emulates a Master Bias frame constructed by averaging hundreds of separate bias frames. Therefore, the Superbias frame has very low random noise. But, constructing a Superbias calibration frame requires only 10 or so bias frames, not hundreds. This is very good! Not only are we spared the drudgery of taking and stacking a hundred or more bias frames—assuming our image-processing program will even allow that— but we are assured that the low level of random noise in our Superbias calibration frame will not contaminate our light frames.

But, two other types of calibration frames also serve in calibrations: The “Master Flat” and the “Master Dark” (Figure 1). Of course, they too can have a level of noise that could infect our light frames. A visual inspection of the Master Flat and Dark frames can help us assess their likely utility in achieving a quality calibration. However, we must know what we want to see in them.

The flat frames are exposures through the entire optical path (tube, mirrors and lenses, focuser, filter, focal reducer, and camera) targeting a uniformly illuminated, fairly bright surface. Because the illumination level is relatively high, exposures are short and dark currents are minimal. The Master Flat allows us to remove vignetting and dust motes’ shadows from the light frames. Vignetting and dust shadows constitute patterned noise. As such, they would be part of every light frame and likely attain a discernable presence in the final stack of light frames if not removed. Figure 1 shows obvious vignetting recorded in a Master Flat frame. By dividing our light frames by a scaled Master Flat, this vignetting, and other repeatable anomalies that may occur in the imaging train, can be suppressed or removed. However, if the system shows few anomalies other than vignetting, an image-processing program capable of measuring and flattening the background may make flats largely unnecessary.

[Note: Flat frames do not remediate light pollution. That must be handled outside of the calibration activities.]

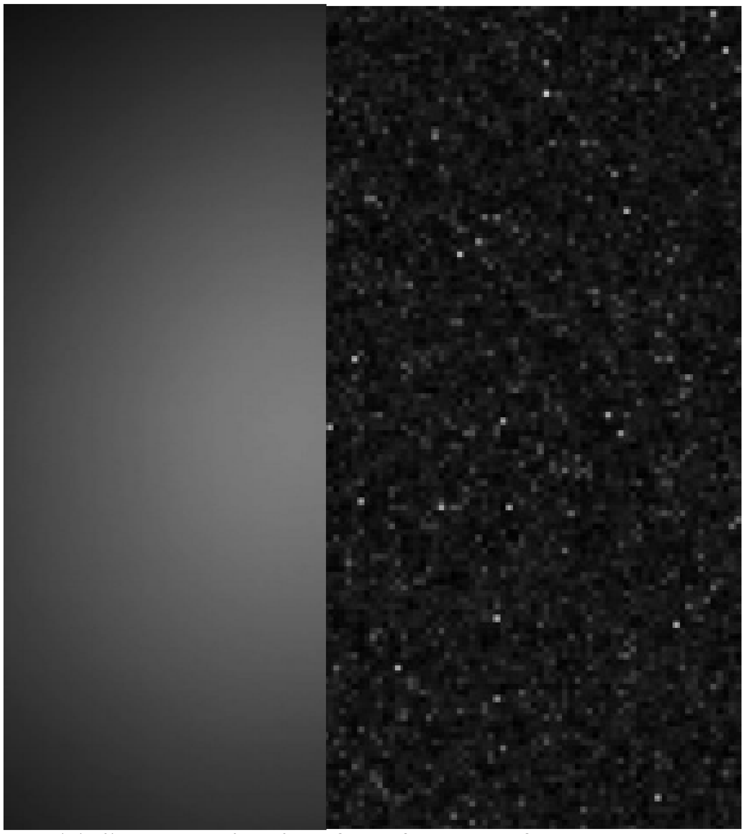

Figure 1: (Left) A Master Flat frame for my Canon T2i and a cheap Canon zoom lens. The bright center, dark corner illumination typifies vignetting. No shadows from dust motes appear in the image. (Right) Greatly zoomed portion of a Master Dark from the T2i. Hot/warm/cold pixels are apparent.

Moving on to dark frames, they consist of exposures at the same camera temperature and exposure duration (and ISO) as the light frames. However, all light is excluded from the camera while it exposes its dark frames. The Master Dark determines the difference in the pixel-to-pixel rest states under conditions identical to those of the light frames. Thus, we can identify dead pixels, hot pixels, and warm pixels (Figure 1). These also represent patterned noise superimposed on the target images. The dark images also record a “dark current,” which results from thermally generated electrons being trapped by the pixels. These dark-current electrons accumulate monotonically over time, but cooling the camera sensor can reduce thermal-electron production to a level that often allows them to be ignored. In that case, the astro-imager might use a cosmetic-correction algorithm to subdue hot and cold pixels reasonably effectively.

Finally, we come to the bias frames. A bias frame is an exposure of zero duration (or as short as the camera will allow) with all illumination blocked from the sensor. It serves to identify and to quantify fixed-pattern noise, largely caused by camera electronics. Every column of the sensor has its own voltage-read circuitry and other electronics. Variations among these electronic components, in sensitivity and efficiency, lead to repeatable variations in apparent signal strength across the sensor. Of course, we would like to suppress this patterned noise, and a Master Bias frame allows us to do that. Superbias frames are better still—more below.

As the ultimate beneficiaries of the calibration, we must also consider the light frames. Of course, the light frames each record the photographic attributes of the target object. The light frames (particularly those of faint targets) also have a significant source of noise of their own: shot noise. The number of photons hitting a pixel varies randomly, following a Poisson distribution. Stacking a larger number of calibrated light frames suppresses all sources of random noise inherent in the light frames in accord with the Law of Large Numbers. However, noise introduced from the calibration masters into each and every light frame no longer appear random, but acts like totally repeatable signal, frame-to-frame. It constitutes a form of patterned noise at this point. It cannot be reduced by simply stacking identically composed light frames. This may be a shocking fact to some, but it totally justifies the investment of considerable time and effort to make the highest quality, lowest-noise calibration masters possible

The following summary indicates the frame types used in the calibration and acquisition of astronomical images and what function they serve. Not each and every source of noise receives explicit recognition.

Bias Frames: Exposures without sensor illumination for the shortest interval possible (for some cameras, the exposure can be zero seconds)

- Random Noise (remove by stacking): Read noise + Reset noise
  - Source: Electronics
- False Signal: Striping and Banding
  - Source: Column amplifier gain and offset variations
    - Action: Characterize = Master Bias /Superbias
- Patterned Noise: Pixel value offset
  - Source: Variable pixel quantum efficiencies, stuck pixels (hot/cold)
    - Action: Characterize = Master Bias/Superbias

Dark Frames: Exposures with no sensor illumination, but with the same duration, ISO, and at the same sensor temperature as the light frames

- Random Noise (remove by stacking): Dark current + above source
  - Source: Thermal electrons contaminating pixel signal
    - Remediation: cool camera sensor
- Patterned Noise: Dark current fixed pattern
  - Source: Time-dependent accumulation of thermal electrons
    - Action: Cool sensor, Characterize = Master Dark
- Patterned Noise: Local regions of warm pixels (those registering an apparent signal)
  - Source: Amp glow…
    - Action: Characterize = Master Dark

Flat Frames: Exposures of a uniformly illuminated target, with exposure durations to fill the pixel potential wells about ½ full. Must be taken through the optical system used for the light frames

- Random Noise (remove by stacking): above sources
- Patterned Noise: Vignetting + pixel response non-uniformity (Hot/Dead… pixels)
    - Source: Optics
        - Action: Characterize = Master Flat

- Light Frames: Exposures of the astronomical object of interest
    - Random Noise (remove by stacking): Shot noise + above sources
        - Source: varying flux of photons
    - Patterned Noise: All the above
        - Remediation: Image calibration
    - Patterned Noise: Artifacts
        - Source: Satellite trails, cosmic ray trails…
            - Remediation: Dither and stack multiple images
        - Source: Light pollution
            - Remediation: Gradient removal software applied to linear image stack

Note: some programs produce Master Flats and Master Darks with the Master Bias already subtracted. Others do not. Also, if the light-frame sensor temperature is not controlled by a fixed-point cooler, but varies considerably over the course of imaging, then dark frames probably have no utility. On the other hand, if a sensor is highly cooled, then dark current may be minimal and dark frames may be superfluous.

If the camera is a one-shot color camera or a DSLR, then the generation and application of the calibration masters should be done using the Color Filter Array images (DSLR raw images, for example) not the color de-mosaicked images.

SUPERBIAS—AT LAST!

This may be a new term for many amateur astro-imagers. Uncovering the inaugural use of superbias frames for image calibration eluded my efforts. However, some references seem to indicate that StScI (Space Telescope Science Institute) developed the method c.2000 and professional astronomers have utilized it since. Amateurs have had limited exposure to both the concept and the implementations. To my knowledge, only PixInsight has a Superbias module. Maybe, in part, that is because a Superbias equates to a Master Bias frame built from a couple of hundred individual frames. Maybe! The Superbias frame shown as part of Figure 2 below was formed from just 10 individual Bias frames. The middle part of the image shows a Master Bias frame assembled from 10 individual bias frames. [The camera was a modified, but uncooled, Canon T2i. As with many Canon cameras, it has both the common vertical column defects as well as horizontal Banding.] Note that the Superbias frame incorporates both row and column information, if implemented in PixInsight as follows:

1. Create a Master Bias frame from 10 to 50 or so individual bias frames and name it “MB”
    a. See http://www.pixinsight.com/tutorials/master-frames/index.html
2. Run Superbias in column mode on MB and rename the output “SBc”
3. PixelMath: MB-SBc+0.5 and set the output to file name “Intermediate”
4. Run Superbias in row mode on “Intermediate,” and rename the output to “SBr”
5. PixelMath: SBc+SBr-0.5 and name the output to “Superbias”--DONE

While horizontal and vertical patterned noise can be seen in the patches of the single bias frame in the upper left of Figure 2, and traced into the 10-frame Master Bias, they appear most prominently in the Superbias frame. The reason the latter shows the patterned noise most clearly is its low random-noise component. A Superbias frame, then, does not add significant noise when applied to the light, dark, and flat frames.

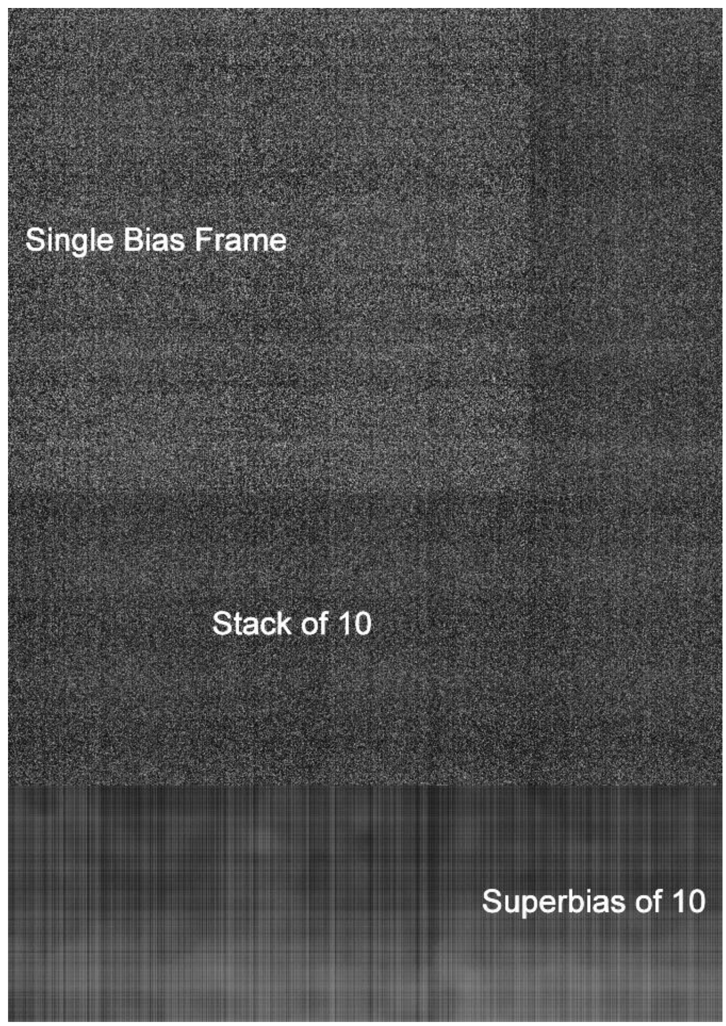

Figure 2: Registered panels from a single Bias frame, a 10-frame Master Bias frame, and the Superbias frame derived from the Master Bias frame. The patterned noise, which we seek to remove from the light frames, stands most prominently above the noise in the Superbias frame.

Hopefully, this small discourse will motivate the careful and extensive removal of both random noise and patterned *noise from light frames and the calibration frames used on them. I would be happy to take a try at answering any questions on this topic. Maybe our Yahoo site is a good place for such discussions.*

Pictures from HAC Members

Venus, Moon and Jupiter – By Doug Snyder

Venus and Jupiter – By Bert Kelher

want Ads

For sale: Meade 10" LX200 classic telescope

In very good condition, with tripod, 120v AC and 12v DC power converters with 25' power cords, dew shield, 8x50 finder scope, electric focuser, piggy back bracket, and soft sided carrying case. Also includes a set of Meade CCD color filters, Meade CCD 3.3 focal reducer, and CCD variable T-adapter. Plus some other equipment. Asking $ 1,800.

Contact Bob Stroxtile at strox@ssvecnet.com or call 520-249-0875.

For Sale: Pier Tech electric telescoping pier with Lati-wedge made for the latitude of Sierra Vista

All the hardware, bolts, nuts, washers and plates are with the pier. Pier Tech can make new legs for it to make it correct for anywhere in the world. The pier and wedge have never been used and the only time the pier was out of the box was to take the photos. New today, the pier and wedge are $3,400. Asking $2,800.

Contact Bob Stroxtile at strox@ssvecnet.com or call 520-249-0875.

For Sale: Planewave CDK14 corrected Dall-Kirkham telescope.

Includes the OTA, {new November 2014}, optional truss rod shroud and optional upper dovetail and the accessories that were included with the telescope (primary to secondary spacing tool). There is NO FOCUSER (they do not come with one, you need to add one) but the adapter for an Optec TCFS3i (which is the focuser I used) is included. I also have the factory wooden shipping crate. The telescope has been in use every clear night in the observatory in Sonoita. This is an outstanding instrument and a great imaging scope.

FOR SALE: StellaCam

StellaCam II video camera with video to computer adapter to view on a computer monitor. $150.00.

Contact Bob Kepple at 520-366-0490, or Astrocards@aol.com.

FOR SALE: Meade Starfinder 8" Reflector Telescope

Will Sell at a very reasonable price. Included are a Telrad Finder, Filters, and additional Lenses.

Contact Mr. Jim Moses at (520) 803-0913 or by email jjmoses2@gmail.com

FOR SALE: Celestron Celestar 8 inch S/C Deluxe - $1200.

Will also sell pieces individually

Contact Rhonda and Terry Taylor at (520) 366-2378 or by email at twrl2@yahoo.com. Or See Craigslist at http://sierravista.craigslist.org/bar/4523742100.html

Please Support Our Sponsors

Our sponsors have been keeping us supplied in door prizes for some years. If you have not contacted them lately, please consider this. They have a lot of great astronomical products that we all need.

For more information on products and contact information, their websites are:

Farpoint Astronomy	http://www.farpointastro.com/
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HAC Sept/Oct Calendar of Events

SU	MO	TU	WE	TH	FR	SA
11 Sep	**12**	**13**	**14**	**15** HACBOD Mtg 7PM Patterson	**16** **3:05 PM** HAC Meeting Student Union Ted Forte	**17**
18	**19**	**20**	**21**	**22** Autumnal Equinox	**23** **5:56 AM**	**24**
25	**26**	**27**	**28**	**29**	**30** **8:11 PM** Patterson. Ft. Huachuca Souces Club	**1 October** Astronomy Day Kartchner Caverns SP 10A-10P
2	**3**	**4**	**5**	**6** Patterson Public Night 6:30 p.m.	**7** Draconid meteors	**8** Draconid meteors
9 **12:33 AM**	**10**  	**11**	**12**	**13**	**14**	**15** Uranus at Opposition
16 **12:23 AM**	**17**	**18** Cub Scouts at Patterson 6 PM	**19**	**20**	**21** HAC Meeting Student Union Megan Kiminki	**22**2 **13:14 PM**
23	**24**	**25**	**26**	**27**	**28**	**29** **DINE UNDER THE STARS**
30 **1:38 PM**	**31** 	**1 Nov**	**2**	**3** Patterson Public Night 6PM	**4**	**5**
6 Daylight Savings Time Ends	**7**	**8**  	**9**	**10**	**11**  	

All event times MST. Join Haclist to keep up to date with all of the Huachuca Astronomy Club events
Send an email to: haclist-subscribe@yahoogroups.com