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CCD Views Vol 2 No. 4

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C C D V I E W S

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1. INTRODUCTION: HAPPY HOLIDAYS & WINTER SOLTICE

Happy holidays and Winter Solstice to all our observers out there!

Our final issue of CCD Views for this year focuses on some basics in CCD imaging. We have two excellent contributions about planning an observing program and choosing the correct equipment for variable star photometry. Both can be time consuming but important (and fun!) parts of CCD observing.

JAM's LPV notes will most likely return in the next issue of CCD Views, expected out in the first of February. Until then please

continue observing the last issue's list and check the AAVSO Bulletin for LPVs nearing minima in the next two months.

We shall end this introduction on a special note of cheer. The AAVSO has access to a small number of Schuler Johnson V and Cousins R filters that we have decided to loan to our observers! If you need either or both filters please fill out the form below and e-mail it to aavso@aavso.org. Unfortunately our supply is limited so we will be choosing recipients based on the quality of past CCD observations, current activity, and geographic location. Ties will be decided based on who submitted the request earliest. Please have your requests submitted by Monday, December 17.

Thank you have an enjoyable holiday season with crystal clear skies and steady seeing!

Aaron Price
AAVSO Headquarters

Gary Walker
Chairman, CCD Committee

CCD V & R FILTER REQUEST FORM

Name:

Observer Code:

Full Mailing Address:

Telephone Number:

CCD:

What size filter do you need?:

Which filter(s) do you need? (V, R, or both):

2. MORE ON OBSERVING FAINT CV'S

We have had good response on the article titled "Observing Faint CV's at Quiescence". Arne Henden, of the US Naval Observatory in Flagstaff sent a letter with tips and more information on the CV's listed in the article. The article is reproduced below.

For many of the CVs that you list as needing quiescent magnitudes, you can look at the tables on my anon ftp site:
ftp://ftp.nofs.navy.mil/pub/outgoing/aah/cv3/cv3_obs.log
ftp://ftp.nofs.navy.mil/pub/outgoing/aah/cv3/cv4_obs.log
ftp://ftp.nofs.navy.mil/pub/outgoing/aah/cv3/cv5_obs.log

I would suggest listing the expected quiescent magnitudes for the CVs in your table, whether from my logfiles or other sources, so that the people who might be going after these stars have an idea as to how faint the CV is at quiescence. You might also contact John Thorstensen as he has been observing many of these stars at quiescence as well.

Also, I've seen many cases now where CVs undergo minioutbursts (that is, well above quiescent levels but too faint for visual observers). Your CCD observers should be prepared for such outbursts and report them.

Finally, the quiescent state is often much redder than at outburst, depending on which star in the binary is dominant. Since most observers will be unfiltered to reach these faint magnitudes, you will have significant transformation differences between observers, even using the same comp stars. Keep this in mind.

Arne

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We plan to continue developing this project in the future including work on charts, observing schedules, and more background information on the stars. Stay tuned to the next issue of CCD Views for more information. In the meantime please observe these stars!

3. PX AND: A NEGLECTED CV WITH SHORT, BRIGHT PERIODS (AND A NEW CHART)

PX And (0024+25) is an interesting cataclysmic variable (CV) that was observed in CCDV by AAVSO member Lasse Jensen of Denmark (JLT) in 1997 but then promptly forgotten. A new AAVSO f-scale CCD chart with .01 magnitudes and B-V will hopefully stir up new interest in this star.

One of the traits of PX And that makes it intriguing to observers is its variability. During JLT's observing run changes in brightness of as much as 1.5 magnitudes in around 1 hour were detected!

PX And is a SW Sex star, a classification created by John Thorstensen for novalike objects that have peculiar characteristics. Some of these strange characteristics include the complete absence of UV emission from the white dwarf while in the low state (because it

is completely obscured by the accretion disc), zig-zag type features in the wings of the spectra (possible caused by the stream of material overflowing or punching a hole in the disc), and many SW Sex stars show infrahumps (negative superhumps!). Also, some SW Sex stars appear to be non-eclipsing (such as LS Peg). The current theories suggest that we are looking along the edges of the cool outer rim of a flared disc around the white dwarf.

Long term observations of PX And would be valuable to the research of SW Sex stars. Accurate, high-speed photometry of PX And is needed, especially in V and I. Observe every few minutes for several hours or get good coverage of the minimum by observing once per night over several nights. The key is to get as much coverage as possible.

The new PX And charts are available at the AAVSO Charts WWW site:

<http://charts.aavso.org/updates.stm>

For background reading on PX And consult the following URLs:

http://cdsads.u-strasbg.fr/cgi-bin/nph-bib_query?1994ApJ...431L.107H&db_key=AST&nosetcookie=1

http://cdsads.u-strasbg.fr/cgi-bin/nph-bib_query?bibcode=1998PASP..110..420H&db_key=AST

http://cdsads.u-strasbg.fr/cgi-bin/nph-bib_query?bibcode=2001A%26A...368..183G&db_key=AST

4. TIPS ON STARTING AN OBSERVING PROGRAM

By **Gary Walker (WGR), CCD Committee Chair**

So you have finally got your CCD camera and your telescope and software and you are ready to go. You may even have set up your equipment, as you have done many times before. Everything is working well. You are ready to go. And then it hits you, Brain Fade. What to observe? Well with deep sky, its easy, just pan over to M42 and you have a start. While looking at this beauty, you usually will remember another interesting object by looking up at the sky. Then someone usually say's "I've got M-xx", you go over and look at it, and then move your scope there. The next thing you know, the night is over an you have observed many of your favorite objects.

But what if you intend to do some photometry? If you are an old hand at visual variables, then you probably have a list of favorites. But what if you are new to variables and did a lot of deep sky imaging

with your camera, and now have found that you want a new challenge? You are not in the minority, it seems that many of us purchased our cameras to do pictures first, and did not have photometry in mind. Now you find yourself wondering what to observe.

I used to have this problem and never knew what variables to observe until I did a couple of things. They are easy and pretty obvious, but my observing program really took off after I did them. I want to pass them on, because I have not seen anyone write them up, and we all assume that this is really too basic to mention, but I get this question a lot. Fortunately, planning an observing session is a cloudy night or daytime activity. As we all know, after purchasing a new telescope or CCD camera, you are usually in store for some of this, unless you live in Arizona.

The first thing that I did, was make up a spreadsheet on my computer, so that I could edit the objects and list their RA and Dec. This was done mostly to convert the Epoch 2000 coordinates on the AAVSO charts to the Epoch 1990 coordinates on my digital setting circles. Most of you will not have to worry about this, but it caused me a great deal of grief until I figured it out. While I did this to get the proper coordinates, it provided an observing check list that I keep at the scope to select the next object. This spread sheet can be sorted by RA, which makes it very convenient for observing. My site is open and reasonably dark for the 45 degrees overhead.

So to start my spreadsheet, I started with the 8 BVRI Standard Stars from the CCD Program. Since these were spread from RA 2 hours to RA 14 hours, they were a good start. I next added the 28 Faint CV and LPV stars from the AAVSO program. These stars were a little more prevalent and typically passed right overhead. Even this list was a little thin in some parts of the sky. About that time, I got a notice from HQ that some new CCD charts had just been added to the web. I added these to my spread sheet. Some months later, another notice announced that additional charts were available. Those too were added.

So now I have 84 stars on my list. The RA and Dec is listed for each. In addition, a bright calibration star is listed nearby which can be used to re-sync the setting circles if necessary. I have increased the font size and used bold print, so that they can be read by an old guy like me easily. They cover 3 pages, and I have a

clipboard with a ruler, that can be placed on any line.

I start an observing run by pointing at Vega. I use this star because I can recognize it easily, I have my 7x50 finder with illuminated cross hairs lined up so that when a star is centered, it is always on the chip of my ccd. My field is 15 arc minutes. This is a real time saver, and I urge you to try it. I found that the center of my ccd chip is not where the center of my eyepieces are, particularly when using a diagonal, so you may have to realign your finder specifically for this purpose.

After I have centered Vega in my finder, I go in the house and take a quick shot. I use this shot to trim the centering to the exact center of the chip, and also tweak the focus. Next, I go back outside and sync my setting circles and display the RA and Dec. Then I go to my list and choose a variable close by (LL Lyr this time of year) and re-aim the scope. I go back inside and start the exposure. I use 10 minutes for most of these objects, as they are faint and the signal to noise helps. When the exposure is done, I do the photometry and obtain my estimate.

Here is another tip that I use. I have a log book where I write on one line, the Star name, JD, Mag, Std Dev, Comp Stars and time of observation. I have been keeping this log for about a year, and find it very useful. Its just an old lab notebook, but it is easy to refer back to earlier observations, and it much more accessible than my computer data. I also find that the discipline of filling out each line during and after the exposure to be beneficial. The log book also provides all the info I need to submit my observations over the WWW, so I use it often.

The cycle runs about 17 minutes for a 10 minute exposure. Then I walk out and point to the next object. I do not observe every object on my list each clear nite. I skip over some. As the seasons change, my first star must change as it gets too low to observe. I choose objects that are well placed-some nites my scope stays just about at zenith, as I pick off each one. As fall and winter approached, the early darkness offset the annual progression across the sky nicely. In the spring, I won't be so lucky.

So those are the two things that I heartily recommend. Have a list of objects that you evolve. Add objects and take them off. Keep a

whole year's objects on your list. That way, when you observe very late in the evening, you will have a new supply of objects to point to. Keep a log in a small notebook that summarizes your work. This makes it easy to submit them electronically.

I try to observe about 6 stars a night. That takes about 2 hours on a good night. Some nights, I only get 1 or 2. One night/morning I got 15 observations. It is really surprising how fast they add up. I never set a definite goal, after all this is relaxation, not work. I observe until I feel like stopping. Some nights that means no observations, as the clouds win. However, I have found that if one devotes just an hour or two most nights, that a large number of nights are partly usable. While I never planned this, I have found that a reasonable number of times, I have an observation that either supports the quiescent state or signifies the outburst. Its really neat to see your observer initials on the Alert Notices.

Clear Skies and Good Observing.

- WGR

5. STARTING OUT IN CCD PHOTOMETRY PART ONE: EQUIPMENT

The following is the first installment in a series of contributions written by **Keith Graham (GKA)**, who is in his 20th year as an AAVSO observer. The series will be continued in the next few issues of CCD Views.

Please note that all views here are views of the author. No specific makes or models of equipment are officially endorsed by the AAVSO. The hardware mentioned in this article is here to illustrate issues that apply to all CCD equipment.

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Part One: Equipment

Let's begin with the equipment required. By now, you probably have the telescope and maybe even a CCD camera. I knew when I was looking for a camera that I wanted to use it primarily for photometry. My knowledge of CCD cameras was limited to say the least. So I researched web sites and user groups. Upon reading the many posts on user groups (such as MAPUG and SBIG) I soon learned who on those lists knew and had experience with CCD cameras. I would write to

them, and found them to be extremely helpful. In fact, I don't know I would have gotten this far without their help. Their comments helped me to decide on the right camera based on my intended use (photometry) and my telescope system (LX200 12" f/10). I narrowed my choices down to the SBIG ST6 and SBIG ST7 cameras.

I should mention here that the ST6 is no longer manufactured, and has since been replaced by the SBIG ST9. The ST9 has everything the ST6 has and more, including a larger FOV and an onboard guiding chip (more on this later). There are other brands of cameras out there with similar characteristics as the ST6 and ST9 and very suitable for photometry. But never having used them, I will leave their attributes to those who know their capabilities. I am comparing the ST6 with the ST7 to show my reasoning in selecting an appropriate camera for photometry. New cameras can cost \$3,000 - \$4000 and up. If you want to save some money, you might be lucky enough to find a used ST6 and have a camera that is very well suited for photometry.

I ultimately decided on the ST6 camera for a number of reasons. First, the ST6 has 23x27-micron pixels compared with the 9 micron pixels of the ST7. These larger pixels of the ST6 had a larger well capacity, meaning they can absorb many more photons than can the smaller pixels of the ST7 before they become filled to capacity (or saturated). By comparison, think of a juice glass versus a larger drinking glass. Just as the larger drinking glass can hold more water than can the juice glass before overflowing, so, too, the larger pixels can hold more photons before they "overflow" than can the smaller pixels. When a pixel is full to the brim, it is saturated. The problem here is that if you continue to expose beyond saturation, you will not be able to determine the true magnitude of the star because you will not know at what point it became saturated. If you expose your image so that your stars are always well below saturation (1/2 well capacity is about right), your software can accurately compare the number of photons collected by the comp and variable in the same time period. Another plus for the larger pixels is that they are more sensitive than the 9 micron pixels. This is like comparing a 12" scope to a 4-inch scope. Due to its larger aperture, the 12-inch scope absorbs many more photons than the 4 inch in the same period of time. This means with the ST6, I would need far less time to take images than with the ST7 resulting in more images taken during an observing session.

Another advantage of the ST6 over the ST7 was the higher QE (that's quantum efficiency) of the ST6. You want your CCD camera to have a QE conducive to photometry. QE is simply an expression of just how sensitive your CCD chip is to the various wavelengths of the spectrum. I found that the QE of the ST7 was almost 0 at the blue end of the spectrum and was lower at most other wavelengths than the ST6. This meant that the ST7 was almost blind to the shorter wavelengths and did not see the other wavelengths as well as the ST6. Ideally, you would want a chip that has a high and even QE for all wavelengths of the visible spectrum, but don't look for that to happen.

Another factor I considered was the field of view (FOV) of the CCD chip. The ST6 had a slightly larger FOV than the ST7. This might not seem too important at first glance, but when you are trying to fit a small piece of the sky onto a small CCD chip, it is much easier to put it on a larger chip. The larger FOV is also very helpful when comparison stars around the variable are not always adjacent to the variable. When doing the photometry on the image, you definitely want your comp and check stars on the same image as the variable (more on check stars later).

Finally, you will want your camera to have a chip with a NON anti blooming gate. Although the ST6 chip is not totally NAB, it can be set to low, medium or high AB. I keep it at the low setting, and this has produced good results. The problem with ABG chips is that part of each pixel is used for this purpose of bleeding off excess electrons to prevent saturation. This means the pixel size is reduced, resulting in less sensitivity and a reduction in well capacity. The ABG does work very well for those who use their cameras to take "pretty pictures", but it reduces the chip's ability to get good photometric data.

(Editor's Note: Those of you who already own ABG cameras can still do good photometric work, you just have to follow special rules and your camera's sensitivity is somewhat compromised. We will have an article on that issue in a future CCD Views.)

When choosing a camera, you must also be certain that your camera is a match for your scope. There have been MANY, MANY discussions about pixels, focal lengths, etc. on user lists. I will not go into this here except to say that if you are going to err, then err on the side of oversampling rather than undersampling. If your images have

square stars, then you are undersampled. My particular set up employs an LX200 12". At F/10, I get nice round stars with my ST6. At F/6.3 (using a focal reducer) I am just teetering on the brink of undersampling. Since I have been getting good photometric results when imaging at F/6.3 I continue to use that focal ratio, because my imaging time is reduced and I get a larger FOV.

Once you have your scope and camera, the only other required piece of equipment is a V filter. The filter will screw into the nose of your camera. This filter is used to record stellar magnitudes in the 480-650 nm (peaking at about 540 nm) range of the visible spectrum. (As you may have determined, a camera that has a high QE in this range would be optimal.) This filter best replicates what the human eye sees, so it keeps CCD observations on a close plane with visual observations. If you were to perform BVRI photometry, you would need the entire set of 4 filters so you could record magnitudes for each of these ranges. When doing V photometry, you need to take only 1 image of the variable and use your software to determine the V magnitude. If you were to perform BVRI, you would need to take 4 images - 1 through each filter- and then use your software to determine the magnitude as portrayed in each image. (There is actually much more to it than that, but that is another story). There are circumstances in which you can do unfiltered photometry, but it is highly recommended that for AAVSO variable star observations, you use a V filter.

So you have your telescope, CCD camera, and V filter. The fun now begins. I might interject a side note here. Like me, you probably spent some time observing variables visually before making the decision to enter the realm of CCD photometry. I began observing variables about 20 years ago. I started out with my trusty C8, and spent many hours using setting circles and craning my neck just to get the variable into the field of view. I now have my GOTO LX200 that does the entire finding for me. A CCD chip is quite small, and it is much more difficult to place the variable's FOV onto the chip than it is into 40 mm eyepiece. The LX200 places the variable onto the chip every time. Whereas some might say that this takes the fun out of it, I say that I would rather spend my fun time imaging variables and doing photometry. I can accomplish more science in one observing session if the effort of finding the variable is done by the scope. If you can afford it, I would highly recommend a GOTO mount for photometry.

6. FAINTEST AAVSO CCD OBSERVATIONS

For you trivia buffs, here are the faintest observations found in the AAVSO International Database.

Unfiltered: HT CAS at 19.3 on Jan 14, 1997 by DRG
B: VX UMA at 18.78 on April 5, 2001 by ZRE
V: HT CAS at 21.500 on Sep 22, 1996 by ZRE
R: FO PER at 16.45 on Nov 7, 2000 by SFK
I: BHS 1804+67 at 15.6 on Sep 18, 1996 by RR

Currently Ron Zissell (ZRE) holds the record for the faintest overall observation in the AAVSO database for his 21.5 observation. Here are some notes from him about the observation, made with a 24" telescope and Photometrics CH250 CCD:

"My CCDV observation of HT Cas at 21.500 should have an error bar of +/- .1 mag. The HT CAS observation occurred during mid-eclipse of the system. The eclipse lasts for only about six minutes. The exposures for that eclipse were 180 seconds.

Unfiltered faintest mag is a function of the color of the star. A Mira variable at $M_v=21.0$ may have an Unfiltered (V+R+I) mag of 16.5 which is an easy observation. If one quoted the Mpg for that star one would get an even fainter magnitude than 21.0"

- Ron Zissell (ZRE).

7. AIP4WIN & MAXIM DL PHOTOMETRY BUGS & PATCHES

If you are using AIP4Win or MaximDL for your photometry please be aware that some versions of these packages have bugs regarding the calculation of julian dates. Fixes for both of these software programs have been posted online at the URLs below. Please update your software where appropriate.

MaximDL 3.03 Update: <http://www.cyanogen.com/upgrades/3x/>
AIP4Win 1.3.14 Update: <http://www.willbell.com/aip4win/AIP.htm>

8. CCD POINTS

As we stated in the last issue, we are beginning a new system of assigning points to each CCD observation. These points are based on the quality of observation and the difficulty of the target. Lots of "variables" go into the formula (pun intended), which is still secret but we may be persuaded to reveal some hints in the future! Stay tuned.

Remember, these points are only for fun and are not official in any way. So without further ado..

3093	RSE	ROBINSON, STEPHEN E.	MD, ROCKVILLE
1345	DRG	DIETHELM, ROGER	SWITZERLAND, RODERSDORF
828	OFA	O'FEARGHAIL, AENGUS	IRELAND, DUNSHAUGHLIN
684	GKA	GRAHAM, KEITH A.	IL, MANHATTEN
651	ZRE	ZISSELL, RONALD E.	MA, SOUTH HADLEY
630	WJD	WEST, JERRY DOUG	KS, MULVANE
563	SFK	SCHEDER, FRANK L.	MD, LEONARDTOWN
555	WGR	WALKER, GARY	MA, SHERBORN
512	OAR	OKSANEN, ARTO	FINLAND, MUURAME
428	MDW	MACDONALD II, WALTER J.	CANADA, OSHAWA ONT.
304	OCN	O'CONNOR, STEPHEN D.	CANADA, NORTH MONTREAL, QUE
176	COO	COOK, LEWIS M.	CA, CONCORD
172	HDU	HURDIS, DAVE	RI, NARRAGANSETT
152	JEA	JENKINS, ALLAN C.	SC, TAYLORS
147	MTK	MICHALIK, TOM	VA, LYNCHBURG
130	WRX	WILLIAMS, ROGER	MI, KALAMAZOO
106	NMI	NICHOLAS, MIKE	AZ, GLENDALE
95	SDY	SCHARNHORST, DANNY	GERMANY, ERFURT
61	RIX	RICHARDS, THOMAS J.	AUSTRALIA, ELTHAM, VI
50	CLF	COHEN, LOUIS	MA, CAMBRIDGE
48	SDB	STARKEY, DONN RAY	IN, AUBURN
22	SYZ	SANCHEZ, CRISTINA	SPAIN, GIJON-ASTURIAS
16	GBL	GARY, BRUCE L.	CA, SANTA BARBARA
14	RGY	RUBRIGHT, GARY	PA, LANCASTER
14	CJI	COLOMA, JOSEP MARIA	SPAIN, BARCELONA
13	MDA	MORTON, ART	WA, EDMONDS
12	MAU	MACIOLEK, ARDIS	MI, PLYMOUTH
10	MZG	MAINTZ, GISELA	GERMANY, BONN
10	RZD	RODRIGUEZ, DIEGO	SPAIN, VILLALBA, MADR
10	MHE	MAIER, HARALD	GERMANY, MUNICH

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Good observing!

Aaron Price, AAVSO Technical Assistant (PAH)
Gary Walker, Chairman of the AAVSO CCD Committee (WGR)

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