STAR STUFF

The Newsletter of the Ford Amateur Astronomy Club

March 1999
Volume 8 Number 3

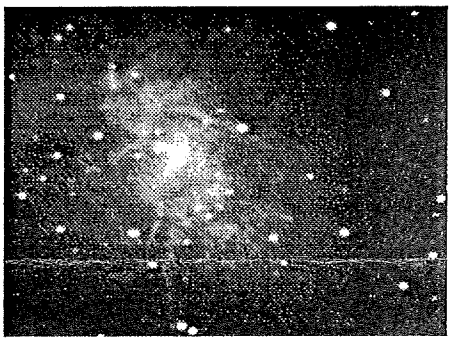
☆☆☆ MARCH 20: FIRST DAY OF SPRING! (EQUINOX 8:46PM) ☆☆☆

IN THIS ISSUE...

CCD IMAGING BASICS

by Jack Kennedy

The CCD or Charge Coupled Device is a digital camera for astronomy. This is not to be confused with the digital imaging available in digital cameras and camcorders. These devices are not as sensitive to light and because of the high signal value, are not as concerned with noise. The CCD is made up of a silicon chip, which is actually a grid of small squares or rectangles called Pixels (*from "Picture Elements" -Ed.).* The incoming photons hit the chip and generate electrons and get stored as a voltage of that pixel. When all the pixels are recorded the result is an analog signal. Because the signal is very weak, an amplifier is required. To get this signal into the computer and display it requires an Analog to Digital Converter or ADC. The digital output is then displayed on the computer screen as an image. Doing CCD imaging requires a computer to receive the signal from the camera at the time the exposure is taken. How does a CCD camera do all this? Let's first look at the chip.



The Crab Nebula (M1) taken with Jack Kennedy's telescope and Doug Bock's CCD camera

The Chip

A chip is made up of rows and columns of pixels. This matrix captures the image. Resolution is the number of pixels used to represent the desired object. A good rule of thumb is for each pixel to cover 2 arc seconds of sky. Under normal viewing this would have a star represented by two pixels or more. To find out how much of the sky you can capture you simply divide the pixel size by the focal length of the telescope. You then multiply by 206 and you will get the number of arc second per pixel. You then multiply this by the number of pixels and you have the field of view of the chip. This number is in arc seconds. You will need to divide you 60 to get the arc minutes. Example:

You have a telescope with a focal length of 1600mm. The camera you are using has a pixel size of 10 by 10 microns. Your camera has 320 by 240 pixels. Then,

10/1600 = 0.006 x 206
= 1.16 arc seconds per pixel

320 x 1.16 = 371.2 arc seconds
= 6.2 arc minutes

240 x 1.16 = 278.4 arc seconds
= 4.6 arc minutes

What this tells you is how big an object you can capture with one image. You have a field of 6.2 x 4.6 arc minutes. This is the size of one of the smallest Messier objects. Lets look at a different configuration. Lets say that you have a telescope with a focal length of 1024mm:

10/1024 = 0.009 x 206
= 2.01 arc seconds per pixel

320 x 2.01 = 643.2 arc seconds
= 10.7 arc minutes

240 x 2.01 = 482.4 arc seconds
= 8.04 arc minutes

We now have the desired 2 arc seconds per pixel. We can now capture all but the very largest Messier objects. You can shorten the focal length of a telescope with a focal reducer. Let's try one more configuration. You now have a camera with pixels of 23 by 27 microns. For your calculations we will use 25 microns. This new camera has 375 by 241 pixels.

STAR STUFF
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STAR STUFF
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Your submissions to STAR STUFF are welcome. Please write to the address above or contact the editor...

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Ford Amateur Astronomy Club

Officers:

President	Dan Kmiecik
Vice President	George Korody
Secretary	David Beard
Treasurer	Ray Fowler

General Meetings:
The Ford Amateur Astronomy Club holds regular general meetings on the fourth Thursday of each month (except the combined November/December meeting held the first Thursday of December) at 5:00 PM in conference room 1491 in the Ford Credit building in Dearborn, Michigan.

Observing:
The Ford Amateur Astronomy Club observes at Spring Mill Pond within the Island Lake State Recreation Area near Brighton, Michigan. The club maintains a permit for after-hours access. Weather permitting, the club observes on Friday nights, Saturday nights, and nights before holidays.

Hotline:
Observing schedules and additional club information is available by calling the Observing Hotline at (313) 390-5456.

Club Membership:
Membership in the Ford Amateur Astronomy Club is open to Ford employees and non-employees. Write or call for an application.

Annual Individual or Family	$ 20
Lifetime Membership	$100

Membership include a subscription to the STAR STUFF newsletter, discounts on ASTRONOMY and SKY & TELESCOPE magazines, after-hours access to the observing site, and discounts at selected area equipment retailers.

Then,

25/1600 = 0.016 x 206
= 3.22 arc seconds per pixel

375 x 3.22 = 1,207.5 arc seconds
= 20.1 arc minutes

241 x 3.22 = 776 arc seconds
= 12.9 arc minutes

This setup will image a much larger object. The larger pixels also will not saturate as quickly because they can collect more photons before becoming full. All of this is not without a cost. The larger pixels will also have an increased dark current, which are electrons generated not by photons but internally by the camera. Dark current is proportional to the surface area, and shows up in your images as light points. Generally the bigger pixels are better for planetary images where the pixels will not saturate as quickly.

Cooling

For a CCD camera to operate more efficiently it must be cool. For each drop in temperature of 6 degrees C, the dark current is divided in half. The most common way of cooling a CCD camera is with a Peltier cooler. The Peltier is a thermoelectric cooler. When a current is passed through it heat is drawn from one side of the cooler to the other where it can be expelled. There are different ways to expel the heat. Many of the amateur cameras available today expel the heat by convection to the atmosphere, or ambient air. The CCD camera has fins on the backside of the body that helps this convection. With this type of cooling there is a maximum difference produced between the ambient and the amount the chip can be cooled. The chip temp will always be a function of the ambient temperature.

Most professional camera use liquid nitrogen in a heat exchanger on the camera. The temperature of liquid nitrogen is −196 degrees C. At this temperature it is necessary to heat the chip with heating resistor to avoid damage. Other cameras have an external cooling source. A coolant is pumped past the Peltier and carried out to an external cooler. The cookbook camera has this type cooler. These type coolers are not limited to expelling heat to the air and we can control the CCD temperature by controlling the temperature of the coolant.

The exposure

The CCD is attached to the telescope the same way that an eyepiece is attached. A cable is run to the computer to control the exposure and for data transfer. You then expose the chip just as you would film. At the end of the exposure the signal is amplified, and then run through the ADC, and sent to the computer. Within a few seconds you see the image displayed on the computer screen. Often the image is not optimal. But because we have a digital file, we can process the image. This is often necessary to bring out all the information that was captured.

To take an exposure, we need to start and stop the exposure of photons. CCD's accomplish this in different ways. Some chips are twice as large as the area used to collect photons. As the image is completed the image is transferred to the other side of the chip which is not exposed to the incoming photons. This type of system is called frame transfer. The more expensive cameras have an electromechanical shutter that opens and closes for the exposure.

To eliminate the dark current we mentioned, a dark frame is taken. This is done by exposing the chip without opening the shutter or by covering the aperture of the telescope. We need to take a dark frame of the same exposure time as the exposure we plan to take. With software we then subtract the dark frame from the image and much of the dark current is removed. Because dark current varies, the dark frame takes out the average dark current.

One more method deserves mention. Because of less than ideal sky conditions and tracking errors of many telescopes, short exposures are desirable. If we need a longer exposure for a faint object, we

can take multiple short exposure images and combine them into one image. This is done quite easily by most CCD camera control software.

Conclusion

Up until now the ability to image faint objects was reserved for professionals. With CCDs amateur astronomers are producing amazing images of deep sky objects as well as planetary objects. Many amateur astronomers are doing real science by looking for minor planets such as asteroids and comets, while others are doing Photometry of stars and extended objects. The CCD represents a whole new way to do astronomy. ☆

ROAD TRIP REVIEW: Amateur Astronomy in Tucson!

by Clayton Kessler

As some of you may know I recently had the opportunity to vacation in Tucson Arizona. With my interest in all things astronomical it only made sense that I try to "hook up" with some local astronomers and find out "what's happening in Tucson". I was aided in these efforts by having met Roger Tanner, a former local astronomer (and Ford Engineer) who followed his dream, moved to Tucson and is now an optical engineer at the University of Arizona's Lunar and Planetary Lab. Roger was very gracious and generous with his time. He made sure that I got in on some fantastic trips and tours!

I planned my arrival to allow time to attend the Tucson Amateur Astronomy Association February meeting. This was a lot of fun! As with most amateur astronomy meetings that I have attended as a guest I was made to feel very welcome and everyone was very nice and helpful. The meeting is in two parts, the beginners meeting and the regular meeting. The "beginners meeting" included a lecture on setting circles, what are they, how they work, how to use them in the field and the difference between analog setting circles and digital setting circles. After a short break, the regular meeting commenced. February at the TAAA is "Members Night", kind of a large scale "show and tell". Now – I have to tell you, the club vice president apologized to me for having such a simple program in February. Somehow he thought that I would enjoy listening to the "normal" program which consists of a professional astronomer discussing his research, new developments and new technology instead of hearing the local amateurs "show and tell". HA! About five club members came forward to talk and it was great! One fellow showed a simple flip mirror he developed to assist him in centering a guide star for astrophotography. There were several discussions of current observing programs and their progress. And then Jim McGaha projected the pictures of the LATEST asteroid that he discovered! We had quite a lively discussion on techniques for asteroid searching and reporting.

At the meeting an announcement was made that the East Valley Astronomy Club, in Phoenix, would have astrophotographers Tony and Daphnie Hallas as guest speakers at their Wednesday meeting, and was anyone interested in going? Well, that settled the question of what to do on Wednesday night! I was fortunate enough to get invited to go along with Roger, Dean Ketelsen, Steve Peterson and another new guy (did I mention I joined the TAAA?) named Chuck.

All this happened on the first full day I was in Tucson! Things just got busier from here! I went to the EVAC meeting to see Tony and Daphnie, I spent a couple of nights at the TAAA "dark site" in the Empire Ranch area (5.5 magnitude skies, dark to the horizon, Zodiacal light visible, small Tucson light dome), I made a "pilgrimage" to Kitt Peak, visited Apogee Instruments (great research grade CCD instruments), went to Stellar Vision Astronomy Shop and dropped in at Starizona. I had nights observing at Rogers Rita Ranch Observatory, a wonderful tour of the U of A Mirror Lab and the Lunar and Planetary lab. The topper was a Saturday night observing session at Organ Pipe Monument in the Chiricahua Mountains. The observing sites are high in the mountains (around 6500 feet) and are scenic turnout parking lots. The Echo Canyon lot that we used even had a bathroom – what luxury! The skies were very dark with no light domes visible in any direction – easily comparable to last year at the TSP. The Milky Way was visible from horizon to horizon with only that pesky Zodiacal Light providing any hint of sky-glow. To give an idea of the sky darkness and contrast I could easily see M1, the Crab Nebula, in Roger's 11X80 binoculars! This pristine location was a mere two-hour drive from Roger's house, about like going to Lake Hudson from the FAAC meeting room.

Truly I had a wonderful time. I just had too little time! All too soon it was time to pack up, ship my mount back home and climb on that plane for my flight. Many of the places I went and the things that I did deserve an article all their own, and I will write about them in the upcoming issues of Star Stuff. So – what is the state of amateur astronomy in Tucson? I can classify it as 4 F – Fabulous, Fun, Fulfilling and Frenzied! I highly recommend the trip to anyone who can get there. ☆

AURORA ALERTS

by Chuck Boren

The following is part of a report published by the Space Environment center that tries to forecast solar activity for the next 27 days (one solar rotation). I my last column I stated that I would start to explain some of the terms used in these reports and so I shall. Flares are classed by the amount of electrical energy (charged particles like electrons and protons) given off by the sun. The flares are classified as:

Class	(in Watt/sq. Meter)
B	I < 10.0E-06
C	10.0E-06 <= I < 10.0E-05
M	10.0E-05 <= I < 10.0E-04
X	I >= 10.0E-04

Where I = peak burst intensity

The flares to watch for are M and X class flares as they are the ones that get the aurora started (M class) or knock power grids and telecommunications out (X class). I should mentions that for these types of flares to have any effect on our atmosphere, the Sun's corona has to develop a weak spot in its atmosphere called a coronal hole. A Coronal Mass Ejection or CME escapes through the coronal hole and without a coronal hole any class of CME cannot effect our atmosphere.

FORECAST OF SOLAR AND GEOMAGNETIC ACTIVITY: 24 FEBRUARY - 22 MARCH 1999

SOLAR ACTIVITY IS EXPECTED TO BE LOW DURING MOST OF THE PERIOD. HOWEVER, AN INCREASING TREND IS EXPECTED DURING 07 - 21 MARCH AS PREVIOUSLY ACTIVE SOLAR LONGITUDES (ROUGHLY L = 275 - 260) RETURN TO THE VISIBLE DISK. ISOLATED M-CLASS FLARES ARE POSSIBLE DURING THIS PERIOD.

NO SIGNIFICANT PROTON ENHANCEMENTS ARE EXPECTED AT GEOSYNCHRONOUS ALTITUDE.

THE GREATER THAN 2 MEV ELECTRON FLUX AT GEOSYNCHRONOUS ALTITUDE IS EXPECTED TO BE AT NORMAL TO MODERATE LEVELS DURING MOST OF THE PERIOD. HOWEVER, FLUXES MAY REACH HIGH LEVELS DURING 11 - 12 MARCH.

THE GEOMAGNETIC FIELD IS EXPECTED TO BE AT QUIET TO UNSETTLED LEVELS DURING MOST OF THE PERIOD. HOWEVER, ACTIVE LEVELS ARE POSSIBLE DURING 10 - 11 MARCH DUE TO RECURRENT CORONAL HOLE EFFECTS. ☆

HEARD ON THE NET

by Bob Lambeck

From the sci.astro.amateur newsgroup...
Yucatan: Mayan Ruins; Southern Milky Way, Original Posting:
tony_hoffman@my-dejanews.com wrote:
I will be spending 10 days in the Yucatan in mid-January, and want to visit some of the Mayan ruins there. Are there any that are of particular astronomical significance? I am thinking of renting a car, and wonder if that is sensible in terms of road quality and safety.

I will be at about 21 degrees North, from Jan. 15-25. Will Crux and Centaurus have risen out of the predawn glare? What are your favorite binocular objects, in the belt from Carina/Puppis/Vela through Crux and Centaurus?

Followup to Original Posting:
It was a fantastic trip. I rented a car, and had no problems (though as someone pointed out, it was a bit disconcerting passing through military checkpoints). I got to Chichen Itza the first night, in time to catch the sound and light show. I thought the Mayan history they told was very well done. The sky was partly cloudy, and the heavens were skewed northward 20 degrees from what I'm used to; I expected to see Canopus rise over the Pyramid of Kukulkan, but it was too early. The next day I visited and explored the ruins. Apart from the Caracol (observatory), the Pyramid of Kukulkan is of great calendrical if not astronomical significance. It has four stairways of 91 steps of each, plus a top platform, for a total of 365, 18 platforms on each side to correspond to the number of days in the Mayan month, and 52 panels to correspond with the 52- year Mayan cycle. On the equinoxes, the light and shadow make the image of a snake (Quetzalcoatl, the plumed serpent) appear to crawl down the pyramid. One guidebook suggested that the pyramid was built around 850 A.D., at the end of a 52-year cycle, in gratitude for the Earth being saved from the exceptionally close passage of Halley's comet in 837 A.D., but most literature I've seen had the pyramid being built a couple hundred years later. But the early city was built by the Mayans, later buildings were added by the Toltecs, and the pyramid was built on top of an earlier structure, so it's possible that it was the early structure that they had in mind--or they could be dead wrong.

I did some observing from Isla Mujeres. It was nice to have Canopus visible each evening. Several mornings I got up before dawn, and in my 7 x 50 binocs viewed Omega Centauri, the Jewel Box, Eta Carinae, and other objects. It was heartening to see the Southern Cross, Alpha and Beta Centauri with the naked eye, when they weren't caught in the horizon mists. The friend-of-a-friend with a telescope never materialized, but I still got an eyeful.

One other astronomical note: while in the Yucatan, I visited several cenotes: wells, sinkholes, underground caverns filled with water. It is believed by some that they were created when the ground fractured after the dino-killer asteroid hit off of Yucatan's north coast. (And yes, I passed on the Chixholub crater rim-walk. ;-)) --Tony ☆

MEETING MINUTES

by Dave Beard

Minutes for the February 25th 1999 meeting of the F.A.A.C.

The meeting was called to order at 5:03PM by President Greg Burnett. As is the custom, the members were welcomed to Pizza and Pop provided by George Korody and Bob Fitzgerald.

President Burnett talked about the recent Astronomy 101 presentation given to three scout groups. Cub Scout Pack 1082 gave $50 to the scholarship fund, and Cub Scout Pack 1232 gave another $50 to the club. A hearty thanks to the members who gave the show: Bob Fitzgerald, George Korody, Bob McFarland, Dan Kmiecik and his son John, and Greg Burnett.

Thanks and appreciation went out to Pat and George Korody and all of the others that helped to organize the Annual Dinner Party. Greg solicited the membership for an article on the event for the newsletter.

F.E.R.A. business; Visteon employees are still considered to be full time Ford employees as far as any F.E.R.A. or other club business is concerned, included qualifications for holding office.

This week's handouts from Greg included a circular on the Grand Canyon star Party of the 12th to 19th of June, Many articles from the N.Y.Times, including one about the slowing of the speed of light.

George Korody brought his laptop in for a discussion of some interesting uses related to astronomy, he had a demo of the setting sun, the Jupiter – Venus conjunction, a Mercury transit, and an Analemma. Interested members were invited to check these out at the end of the meeting.

On February 19th 2000, the Eastern Michigan University Astro group would like to hold a GLAAC–like conference. More information will be forthcoming. As well, the annual Fish Lake Under The Stars field trip takes place March 19-21 1999, at the Eastern Michigan University's Kresge Environmental Education Center, Located 7 miles Northeast of Lapeer MI. For more details, visit their website at http://www.physics.emich.edu/astrclub

The Treasurer's Report – Treasurer Ray Fowler mentioned that in accordance with club policy, Dues will go up to $25 next month for those late to make payments for the year. The Balance in the club's accounts is positive to the tune of about $4500, which includes the scholarship fund!

Bob McFarland reported out on the last Great Lakes Association of Astronomy Clubs meeting. There was interest in starting a Kensington based astro club, but as there were no volunteers for officers, the idea did not come to fruition. The G.L.A.A.C. will continue to be an advisory group for now. And there is planning right now for a star party on the 20th and 21st of August out at Kensington.

President Greg solicited for a special "Program Chairperson" volunteer from the membership to take care of the task of arranging for each meeting's entertainment/lecture/demonstration etc. Also, Greg solicited the membership for a volunteer to take care of posting the direction signs before each meeting, John Kmiecik volunteered on the spot to be "Communications Director", many thanks and our appreciation to John!

As there was a full quorum, the election for officers was held and the following candidates were announced:

President:	Dan Kmiecik
Vice President:	George Korody
Secretary:	Dave Beard
Treasurer:	Ray Fowler

The room was solicited for any other candidates, none responded.. A motion to accept the slate was made and seconded; A vote was taken, and the results were unanimous in favor of the proposed slate.

Greg called for old business, none.
Greg called for new business; Doug Bock mentioned the upcoming Northern Cross Observatory club meeting coming up on march 13th.

Then, a Video was offered to the group, part of the "Practical guide to the Universe" series hosted and narrated by Tom Selleck, Part 2, "The Inner Planets" ☆

FROM THE EDITOR
by Greg Burnett

WOW! Thanks to everyone who submitted articles for this issue of *STAR STUFF*! Some items didn't make it in this month due to space limitations, but they will be included in the next issue.

Good luck and a many thanks to the new club officers for 1999: President Dan Kmiecik, Vice President George Korody, Secretary Dave Beard, and Treasurer Ray Fowler.

Hope to see you soon! - G.B. ☆

INSTRUCTIONS TO AUTHORS

STAR STUFF wants your articles, announcements, letters, etc. MS-Word format is preferred, but the editor will work with anything you submit.

Pretty simple instructions, huh? Submit your contributions today!! The deadline to be included in a particular issue is the Monday following the general meeting, but pay that no mind, just send your stuff along whenever! ☆

NEXT GENERAL MEETING

The next meeting of the Ford Amateur Astronomy Club will be held on Thursday, March 25, at 5:00PM in conference room 1491 in the Ford Credit building in Dearborn.

The program for the meeting has not yet been determined, but as always, pizza and pop will be provided.

The Ford Credit building is the low building immediately northeast of (but not attached to) Ford World Headquarters. The building is secured with a card entry system. The easiest way to enter for meetings is to park in the lot east of the building and enter thru the lower east or lower northeast doors. At 5:00p no one seems to have much trouble entering, because many people are leaving about that time. At the lower east door you can dial 911 on the security phone and say you are there to attend a Ford club meeting, and security will admit you. The meeting room is on the lower floor, on the east side of the building, about mid-way along the north-south corridor. Usually, signs will be posted to direct you to the room. ☆

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