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this month

monday nights

Astronomy Cafe
Fairfield Community Centre,
1330 Fairfield, Victoria
7-11pm
Call 477-2257 for directions or more information.
New comers are especially welcome. Come and enjoy!

second wednesday of the month

Monthly Meeting
7:30 PM, Elliott Lecture Theatre, Rm 060, UVic

as sky and interest dictate

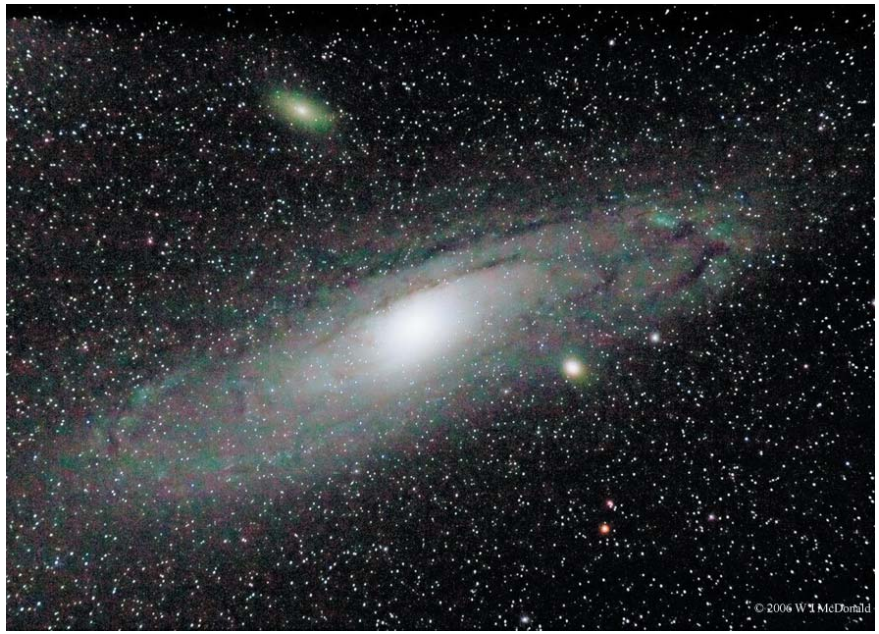
New Observers Group
Hosted by Sid Sidhu
1642 Davies Road, Highlands
Call 391-0540 for information and directions.

by email

Observer/CU Volunteers/ Members email lists
Contact Joe Carr to subscribe to these email lists for important, timely, member-related news.

Royal Astronomical Society of Canada ✦ Victoria Centre

skynews



this month

Members Night
Joe Carr - Solar Eclipse 2006
Wednesday, September 13, 7:30 pm
Elliot Lecture Theatre, Room 060, University of Victoria

Joe Carr - Solar Eclipse 2006 in the Libyan Sahara - an astronomical travelogue of Libya & Italy

Astro Imaging/Sketching Highlights - all members are welcome (bring your CD or notes). Please contact Bruno, so he can coordinate the presentations.

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up coming

Wednesday, October 11
Dr. Florin Diacu, UVic
The Lost Millennium - History's timetables under siege

Wednesday, December 13
Dr. Eric Steinbring, HIA/DAO
Astronomy in Canada's High Arctic - Long nights and clear skies

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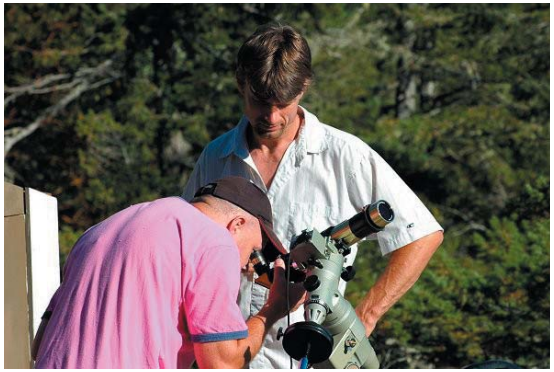
centre elections

This years 2006 Annual Dinner and General Meeting is tentatively schedule for Sat. Nov. 4 at the Gorge Vale Golf Club (with regrets, final confirmation remains pending to date)
Under our RASC by-laws, a 60 day notification of AGM and Council Elections is required.
This announcement is to serve " as formal notice " of our early November elections, positions in Council include : President, 1st. Vice-President , 2nd. Vice-President and possibly various others. All individuals seeking nomination and wishing to serve are ask to contact Past-President Chris Gainor or former Past President David Lee for further details.

I thank you... for your understanding and support...
Bruno R. Quenneville outgoing 1st VP RASC Victoria Centre.

victoria centre summer bbq



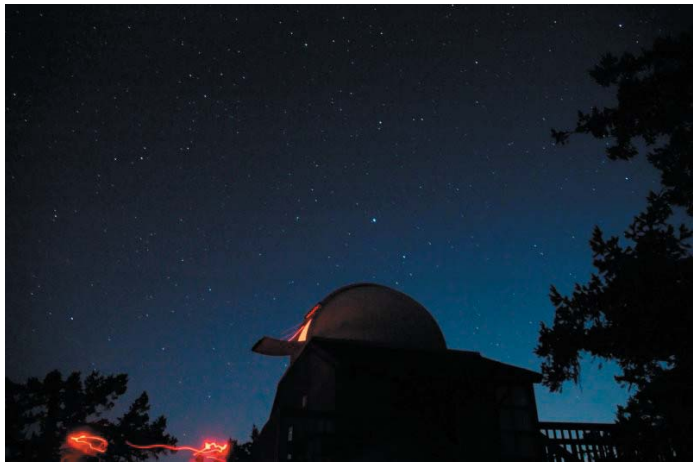
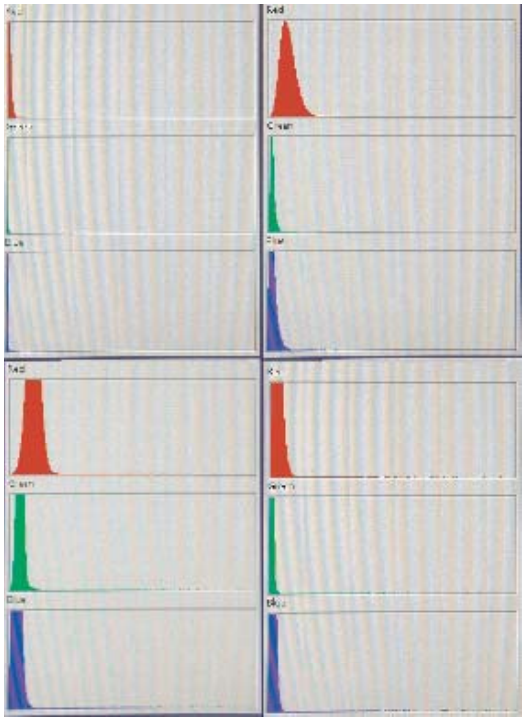


Image 2: This shows the relative importance of Bias noise, Dark noise and Sky glow for some typical Victoria sky conditions:



a) The UPPER LEFT shows a typical bias frame histogram. The bias noise is quite low. As a result, there is not a huge need to subtract bias in DSLR imaging although every bit of noise you eliminate helps. This is different for astronomical CCDs because they are cooled and the exposure noise is much reduced so that readout noise can be significant. Bias Frames are also necessary in Astronomical CCDs for another reason. Astro CCDS add a "Bias" offset (typically 100ADU) to the output of the analogue to digital convertor. (ADU stands for Analogue to Digital unit. In an 8 bit format like JPG there are 256 units with 0 meaning black and 256 fully saturated color). The output of DSLR cameras is different in that this "Bias" offset has been removed or was not there to begin with so the only need for Bias frames in DSLR work is to reduce readout noise and this is the less important factor.

b) The UPPER RIGHT shows a typical DARK FRAME with the noise suppression function of the camera turned off. This noise is significant compared to the LIGHT MINUS DARK result that is shown in the BOTTOM LEFT. The latter is dominated by sky glow (on a fairly good night). The last histogram on the BOTTOM RIGHT is LIGHT MINUS DARK on a still darker night. Comparing the dark noise (upper right) with it shows that the dark noise is even more important when you have a darker sky. Ergo- You need to take more darks on a good night than on a poor one if you want to get the best image a dark night can give.

on the cover

M31 - Andromeda Galaxy

John McDonald

Now that I am home and have all the tools at hand, I have reprocessed the image of Andromeda to tease out all the detail. This is my personal best for M31. I benefited from a very clear dark sky at the Saskatchewan Summer Star Party on August 25 and some inspiration from Jack Newton.

Telescope - Williams Optics 105 mm
Mount - Skywatcher HEQ5
Camera - Pentax ist-DS with WO 0.8x focal reducer
Exposures - 41 light frames, 60 sec at ISO 800 with dark subtraction in camera for total exposure of 41 min light and 41 min dark. Also used 12 Flat and 10 bias frames.
Processing: ImagesPlus, Photoshop, Astronomy Tools and Neat Image.

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observers group

RASC Victoria Centre and the NRC have signed a License to Use Land Agreement which gives members of Victoria Centre expanded access to NRC property on Observatory Hill/
If you are a member in good standing of Victoria Centre RASC, consider yourself an "active observer", and wish to take advantage of this opportunity, please send an email to the 1st or 2nd Vice President. More information on this program see: http://victoria.rasc.ca

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this and that

Earthy Word Games

The interdependent web of life on Earth is a fine principle to each kids and adults. A good way to introduce some basic concepts to kids is through a small, simple model wherein life forms survive by depending on each other. Such is the EcoSphere®, a small, closed-system aquarium that needs only light to stay healthy and in balance. A new game activity on The Space Place (http://spaceplace.nasa.gov/en/kids/) explains the EcoSphere® as a microcosm of Earth. Visitors to the page can then choose one or more interactive word-find puzzles to solve, using words related to air, water, land, and life.

NASA's Spitzer Digs Up Troves Of Possible Solar Systems In Orion

Astronomers have long scrutinized the vast and layered clouds of the Orion nebula, an industrious star-making factory visible to the naked eye in the sword of the famous hunter constellation. Yet, Orion is still full of secrets.

A new image from NASA's Spitzer Space Telescope probes deep into the clouds of dust that permeate the nebula and its surrounding regions. The striking false-color picture shows pinkish swirls of dust speckled with stars, some of which are orbited by disks of planet-forming dust.

This infrared image from NASA's Spitzer Space Telescope shows the Orion nebula, our closest massive star-making factory, 1,450 light-years from Earth. (Image credit: NASA/JPL-Caltech/Univ. of Toledo)

Spitzer, with its powerful infrared vision, was able to unearth nearly 2,300 such planet-forming disks in the Orion cloud complex, a collection of turbulent star-forming clouds that includes the well-known Orion nebula.

The disks - made of gas and dust that whirl around young suns - are too small and distant to be seen by visible-light telescopes; however, the infrared glow of their warm dust is easily spotted by Spitzer's infrared detectors. Each disk has the potential to form planets and its own solar system.

"This is the most complete census of young stars with disks in the Orion cloud complex," said Dr. Thomas Megeath of the University of Toledo, Ohio, who led the research. "Basically, we have a census of potential solar systems, and we want to know how many are born in the cities, how many in small towns, and how many out in the countryside."

A look at Orion's demographics

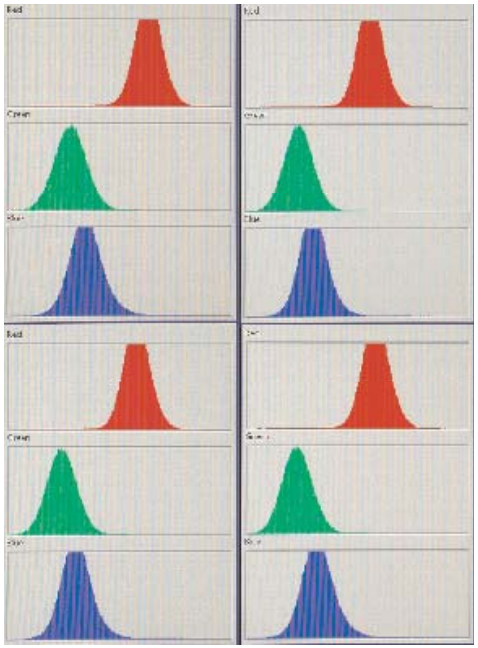

Image 1. This shows how the image quality varies with noise. The result may surprise you. First, I need to explain what the images are. They show histograms of dark frames taken for differing ISO (200 ISO top left, 400 ISO top right, 800 ISO bottom left and 1600 ISO bottom right) but adjusted in Photoshop to give the same sensitivity, i.e. - the lower ISO frames were boosted by the appropriate number of stops so that a desired signal such as a nebula would have the same intensity in each. What they show is that the noise (represented by the width of the peaks for each color) is pretty much identical for all values of ISO. This may seem counter to what you expect but remember that in ordinary photography you get less noise with lower ISO only BECAUSE YOU OPEN THE LENS DIAPHRAM OR USE A LOWER SPEED - i.e. you send more photons to the sensor so the signal is higher. In astro imaging just as in the test image, the number of photons was set by the optics and the exposure time. Signal to noise does not depend on ISO because digital cameras have only one sensor and it has fixed sensitivity. The ISO setting is an electronic dodge to mimic what different films do. All that changes when you set ISO on a DSLR is that the readout amplifier is cranked up or down to adjust the conversion gain. As a result the signal (an image of a Nebula for example) and the noise are both changed by the same amount. After processing there is no difference in the signal to noise.

Bottom line:- you can use any ISO that gives an acceptable image for the exposure period. The final signal to noise will be set by the total exposure (or the sum of all the stacked frames). The main thing to avoid is setting the ISO so high that the brightest objects are overexposed and bloom or so low that you don't record anything.

source of vibrations. What about the platform the mount is on? Is it solid or shaky? Decks are common culprits and even concrete pads can be a problem if their base is not good.

Mistracking
All mounts mistrack to some extent. If you suspect that you have serious mistracking, a long exposure can be helpful for verifying it. Look for sharp jumps and jogs that repeat more or less regularly.

Shutter Clank
All SLRs including the digital kind have noisy shutters that produce a lot of vibration when they trip. The clue for this is a faint wiggle on the edge of the star. It will be less pronounced in long exposures but can be a devil for shorter ones. The main offender is the mirror that directs light to the viewfinder and flips out of the way with a loud clank when the shutter is tripped. The cure is to use the cameras mirror lock if you have one and if not, cover the lens for a moment when the shutter is opened to let the vibrations die down (the Hat Trick).

There are many resources on the web that provide help for specific problems that you have identified. One resource that has proven to be helpful to some of the new imagers in the area is Andy's Shot Glass: http://www.andysshotglass.com/introduction.html

Appendix II - Measurements
The following describes some measurements done on my DSLR, a Pentax ist-DS to see how ISO, Bias frames and Dark frames affect the quality of images. Anyone interested in understanding digital imaging should consult the excellent book, "Handbook of Astronomical Imaging" by Richard Berry and James Burnell. I am grateful to Charles Banville who loaned me his copy. I found the handbook to be a helpful guide for understanding what things contribute to image quality. Its primary focus is on Astronomical CCD imagers which have some important differences from Camera imagers as discussed below.

The two images that follow illustrate the results obtained from measurements on my Pentax DSLR. It is possible that your cameras are different but I expect only in the level of noise present and not in the variation with ISO, Bias etc or the conclusions below.

reveals that the potential solar systems populate a variety of environments. Megeath and his colleagues found that about 60 percent of the disk-sporting stars in the Orion cloud complex inhabit its bustling "cities," or clusters, containing hundreds of young stars. About 15 percent reside in small outer communities, and a surprising 25 percent prefer to go it alone, living in isolation.
Prior to the Spitzer observations, scientists thought that up to 90 percent of young stars, both with and without disks, dwelled in cities like those of Orion.
"The Orion image shows that many stars also appear to form in isolation or in groups of just a few stars," said team member Dr. John Stauffer of NASA's Spitzer Science Center at the California Institute of Technology in Pasadena. "These new data may help us to determine the type of environment in which our sun formed."
Astronomers do not know whether our middle-aged sun grew up in the stellar equivalent of the city or countryside, though most favor a large city scenario. Newborn stars like the ones in Orion tend to drift away from their siblings over time, so it is hard to trace an adult star's origins.
Megeath and his colleagues estimate that about 60 to 70 percent of the stars in the Orion cloud complex have disks. "It is an interesting question why this number isn't 100 percent. Eventually, we may be able to understand why some stars don't have disks," said Megeath.
Spitzer's infrared vision also dug up 200 stellar embryos in the Orion cloud complex, most of which had never been seen before. Stellar embryos are still too young to have developed disks.
The Orion cloud complex is about 1,450 light-years from Earth and spans about 240 light-years of space. Spitzer's wide field of view allowed it to survey most of the complex, an area of the sky equivalent to 28 full moons. The featured image shows a slice of this survey, the equivalent of four full moons-worth of sky, and includes the Orion nebula itself.
NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center. Caltech manages JPL for NASA. Spitzer's infrared array camera, which made the observations, was built by NASA's Goddard Space Flight Center, Greenbelt, Md. The instrument's principal investigator is Dr. Giovanni Fazio of the Harvard-Smithsonian Center for Astrophysics.
For more Orion graphics and information, visit: www.spitzer.caltech.edu/spitzer

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General enquiries - natonaloffice@rasc.ca

stars are good the focus is likely OK.
- Set the camera to Raw format if that is available and take 10 frames without moving anything.
- Don't worry if the images are faint. You will get the detail to show up when you "stack" the images later.
- Use a freeware or commercial program for image stacking. Good choices are DeepSkyStacker - http://deepskystacker.free.fr/english/index.html , a freeware program or some good ones that you have to purchase are ImagesPlus - http://mlunsold.com/ and RegiStar - http://www.aurigaimaging.com/

Reviewing and analyzing your results

Once you have some processed images, take time to look at them carefully. If there are some problem areas, try to analyze them to identify the causes. Here are some examples of common problems and how they can be identified.

Poor Focus

When the stars or star trails in your images are consistently fat or in the form of open circles focus needs to be improved. However there are other problems that can easily be mistaken for poor focus. If your star trails and/or wiggly star patterns are narrow, you can be sure the focus is OK and you have some other problem, possibly one of those described below.

Polar alignment errors

If the polar alignment is off, all of the stars in the image will be oblong blobs or long trails rather than small circles. All of the light frames will have similar trails lined up in the same orientation. If you are not sure, try a long exposure (3 minutes or more) of a star or star field. The star trailing should increase in proportion to the exposure time and result in even tracks always in the same direction if polar alignment is the problem.

Vibration

You may see wiggly star patterns that are not consistent from frame to frame. If it only is present in a few of the frames something may have jiggled the telescope. It is not unusual to have to discard some light frames for this reason. If all the frames show inconsistent wiggly patterns the mount might not be steady enough. Wind is a frequent

Camera on fixed tripod

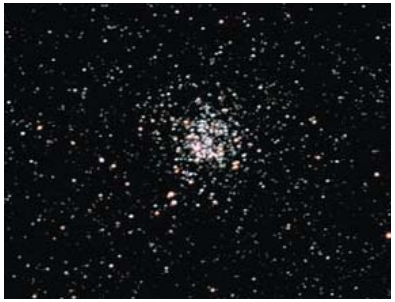
- Set your ISO to either 400 or 800 for now.
- Use the highest quality JPG setting of your camera for now.
- Turn on the noise reduction and mirror lock features of your camera if it has them. If not don't let it worry you.
- Open the lens diaphragm all the way to start.
- Set the exposure time. To avoid star trailing, avoid anything larger than 1500 divided by the focal length. For example for a 150mm lens use 10 seconds or less.
- Pick a fairly easy target to start with. Your favorite constellation or the Pleiades for example.
- Focus at infinity.
- Use a delayed shutter and/or a remote shutter control to avoid shaking the camera. If that is not available, hold a hat over the lens at the beginning of each exposure to let the vibrations will die down before any light gets to the sensor (the Hat Trick).
- Take some exposures and don't hesitate to play with exposure time, lens opening and ISO to see if you can get any improvement. If you want to stack to get fainter stars, follow #s 20, 21 and 22 below.

Camera on driven mount, piggyback or telescope mounted

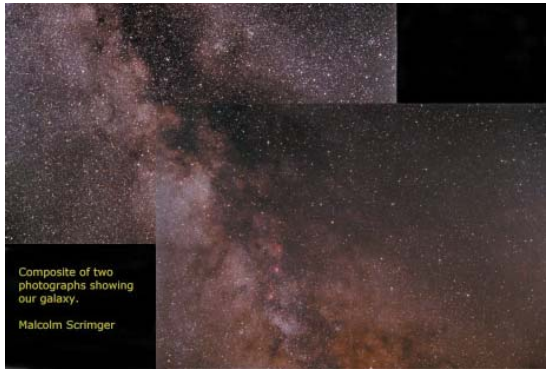
- Do as careful a polar alignment of your telescope as you can conveniently manage.
- Set your ISO to either 200, 400 or 800 for now and don't change it.
- Use the highest quality JPG setting of your camera for now.
- Turn on the noise reduction and mirror lock features of your camera if it has them. If not don't let it worry you.
- Set the exposure time to 30 seconds.
- Pick a fairly easy target to start with. The double cluster in Perseus or the Hercules cluster for example.
- Focus as well as you can with the eyepiece on a bright star.
- Use a delayed shutter and/or a remote shutter control to avoid shaking the camera. If that is not available, hold a hat over the lens at the beginning of each exposure to let the vibrations will die down before any light gets to the sensor (the Hat Trick).
- Take some images to check the focus. Use the cameras control to blow up the image on the LCD screen as much as possible to see if the stars are sharp. Make small adjustments in focus until you are satisfied. This is the hardest part. Note that you may have to reduce the exposure time to avoid blooming that will spoil the focus when the stars you are using for this are quite bright. If the dimmer

astrophography

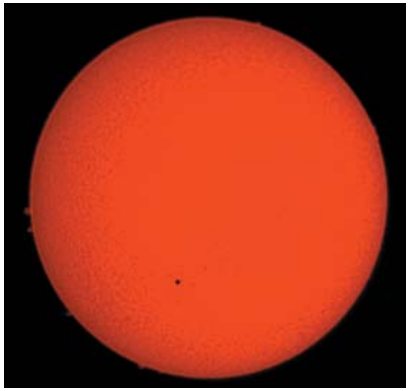
Jim Cliffe - Moon
Mt. Tolmie, August 8, 206, 0600
Olympus E-500 camera on my Celestron C80ED.
Processing with Photoshop: A slight adjustment to the contrast,and a 150% unsharp mask applied.



Malcolm Scrimger - Milky Way
Mount Kobau Star Party, August 9th 1988.
They were taken with my Minolta SRT101 with Konica 3200 ASA with
a 50mm F/2.8 lens using a deep sky filter mounted on my Celestron Ultima 8.



Guy Walton -
M 11, Wild Duck Cluster
Pearson College
August 18/19 /06.
Camera: Nikon D50, with NR
Telescope: Orion 100mm, F9 ED Apo Refractor on EQ 4 mount
Processing: 11 exposures of 30 sec. at ISO 800 in Images Plus, PhotoShop CS2 and Noise Ninja.



Charles Banville - Sunspot 904
Mount Tolmie Park, 13 August, 2006, 14:40hrs
Optics: Coronado Solarmax 40 with 2x barlow on Vixen GP-DX mount.
Camera: Canon 20Da
Exposures: 11 light frames of 1/500 sec @ISO 200.
Processing: ImagesPlus.

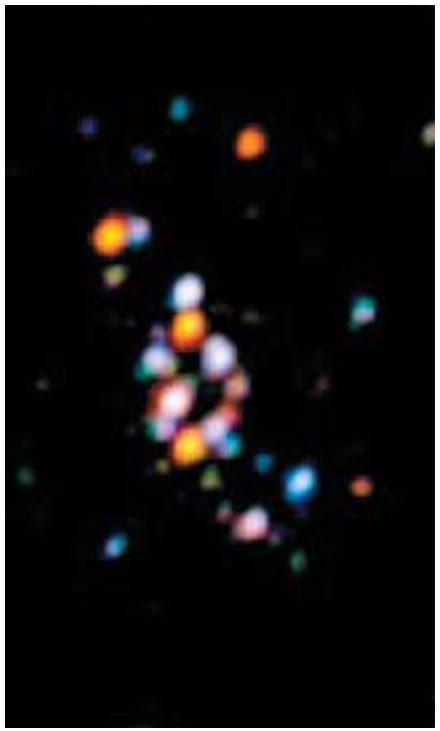
Key stars have different birthdays Astronomers tear up textbooks over stellar nurseries.

Jenny Hogan

In a complex Universe, astronomers thought they had at least one simple system to tell them how stars are born. Turns out they were wrong.
Results from Hubble confirm what some had feared for years: stars in 'globular clusters' are born in several bursts, rather than all at once. This means that globular clusters — small, dense groups of stars found orbiting galaxies — aren't as simple as astronomers used to think.

"It's changing our ideas completely," says Giampaolo Piotto of the University of Padua in Italy. "We have to change our textbooks."

The nature of these stellar nurseries means that previous models of these apparently simple systems are now wrong. And that means trouble for modelling more complex creatures, such as galaxies. "If you have problems reproducing star formation in globular clusters, you will have problems with a galaxy," says Piotto



Colour conundrum

Astronomers had long assumed that globular clusters were the simplest stellar systems in existence. They thought that the hundreds of thousands of stars in each cluster were born in one go, condensing from a dust cloud early in the Universe's history, billions of years in the past. These dense balls of stars are now found in orbit around galaxies such as the Milky Way.
But some evidence counted against this simple picture.

can be used to remove the average value of the noise. Note that it can never remove its random part. Flat frames are short exposures of blank areas such as a featureless clear sky. They contain the same vignetting and dust spots that are in the light frames. Bias frames are very short exposures with the lens covered to sample the readout noise. Programs such as ImagesPlus can be used to combine dark, flat and bias frames to make master light, flat and dark files. These are used to "calibrate" the light frames.

Is there any way to avoid the noise altogether?

Both the noise that builds up during the exposure and the readout noise both are caused by heat. It is possible to reduce that noise by cooling the camera and cool nights can help as well. High end cameras designed for astrophotography have coolers built in for this reason. Some amateur photographers have designed coolers to use with DSLRS but using them can be tricky because cooling also raises the possibility of dew formation since the sensors are not isolated from the surrounding atmosphere.

What else can go wrong?

Three things that often give difficulty in photographing dim objects are mistracking, vibrations and lack of sharp focus. Mistracking can result from imperfect polar alignment and/or instabilities in the mount. Vibrations arise from shutter clanking, wind and, in the case of high magnifications even the ground shake when the photographer is moving around. For help in identifying the source of problems, see the section on Reviewing and analyzing your results in Appendix 1

Astrophotography is a challenge but it is also very rewarding. Good luck with your imaging and clear skies.

I am grateful to Bruno Quenneville, David Lee, Joe Carr and Charles Banville from the Victoria Chapter of the Royal Astronomical Society of Canada for helpful comments and suggestions.

Appendix I - Quick Start – for new imagers

If you are new to DSLR imaging the following quick guide may help you avoid some frustration and get you off to a successful start.

that situation.

So, what combination of ISO and exposure time should I use?

A good rule of thumb is to expose each frame for long enough at your favorite ISO (any ISO will do) to make the bright objects come close to, but not go over, the top of the brightness scale. Then take enough frames to give the total exposure time you need. How many that is depends on how dim the target is but in general, the more frames the better. For setting the frame exposure, some DSLRs have a readout mode that shows overexposed parts blinking on the screen. If you don't have that, or even if you do, you can just look at the bright stars in the image. If they are seriously oversized compared to the dim ones and/or have ugly halos, you probably need to use shorter exposures and take more frames to get the total exposure time needed.

How does stacking several frames help?

Stacking programs are normally set to use an averaging method so the bright parts do not get any brighter for a stack than they were in a single frame. There is however an improvement in quality because the averaging of the noise allows detail in the dimmer parts of the image to come out. The improvement increases as the square root of the number of frames that are combined.

Is there any disadvantage to using short exposure times?

There is some extra noise added every time an image is read out so a stack of several images will have a bit more noise than a single one. The contribution of this noise is normally small enough in DSLRs that it can be ignored. As a result, there is not likely to be any significant disadvantage with short exposure times. Image quality depends on the total exposure time rather than the length of each exposure. When in doubt, it is better to under, rather than over expose each frame and take more to compensate.

What are Light, Dark, Flat and Bias frames?

It is possible to "Calibrate" images using Light, Dark, Flat and Bias frames to partially correct for noise, vignetting and dust on the sensor. Light frames are the ones taken of the subject. Dark frames are exposed for the same time as the Light frames but with the lens covered. The average noise in each pixel is the same for both so the dark frames

Astronomers noticed as much as 30 years ago that helium-burning stars within a globular cluster come in a range of colours. Colour is usually linked to a property such as age or the chemical make-up of a star. But astronomers still thought that globular clusters ought to be uniform in age and composition, so they assumed something else — some unknown parameter — had to be responsible.

This became known as the 'second parameter problem', but it proved impossible to resolve.

Then, in 2004, researchers reported that hydrogen- burning stars in a globular cluster known as Omega Centauri (NGC 5139) seemed to fall into two distinct classes1. One set of stars was somewhat bluer than the other.

This was stronger evidence that something funny was going on. But it wasn't entirely convincing, because Omega Centauri is odd in other ways, too.

Alison Sills of McMaster University in Hamilton, Canada, says her reaction was to "file it under 'Omega Cen equals weird' and be done".

Normal surprise

"Now we can't do that," she says. On 23 August, in Prague, Piotto presented data to the General Assembly of the International Astronomical Union, showing that a normal globular cluster also has two sets of stars.

An analysis of Hubble Space Telescope images taken on 9 August of object NGC 2808, a globular cluster considered utterly normal, shows that its hydrogen-burning stars fall into two groups. "You see two sequences, there's no doubt about that," says Piotto.

"It is a beautiful achievement," says Francesca D'Antona of the Astronomical Observatory of Rome in Monteporzio, Italy.

Double burst

So how are the stars born? D'Antona suggests that the first burst of stars evolve in just a few million years into extended, billowing states that shed matter rich in heavy elements, such as helium, before collapsing into black holes and neutron stars. The debris could then condense into a second burst of stars.

References

1. http://arxiv.org/abs/astro-ph/0406076 (2006).

DSLR Astro-Imaging - tips for shortening the learning curve

John McDonald

The purpose of this article is to pass on some of the things I have been learning about astro-imaging with digital single lens reflex (DSLR) cameras. You likely know some of these things already but most of us are somewhere on the learning curve and I have included tips for beginners and for those with experience. There is also a Quick Start section in Appendix I for those who have just purchased a DSLR and want a guide for getting off to a good start and identifying the source of problems. More experienced readers who want an understanding of how ISO settings, exposure times and calibration affect the quality of an image should read the following Section, ISO, Exposure Time, Calibration and Image Quality. For those that want all the details, the results of observations on my DSLR that show the effects of ISO, Bias and Dark frame noise are given in Appendix II - Measurements. Whatever stage you are at, I hope there is something here that helps you on the path to make better images.

ISO, Exposure Time, Calibration and Image Quality

Quick summary - Image quality depends almost entirely on the total exposure time and the optics. In most long exposure situations ISO setting does not matter. Calibration can be helpful in removing some though not all of the effects of noise, vignetting and dust on the sensor.

What is the best ISO to use?

The answer may not be what you expect, especially if you are familiar with film astrophotography. Higher ISO when using film means getting an image with shorter exposure at the cost of somewhat increased grain. So the decision about what film to use involves a trade off. Pick a higher ISO film to get an image faster or a lower ISO one to get less grain. What about DSLRs? For single exposure astro photos with digital cameras this is still the case and the ISO setting does affect noise. However, the situation is quite different for long exposures and stacked images using digital cameras. In most cases, you can use any ISO that you want for stacked and long exposures without affecting the quality of the final image you get after processing.

What does the ISO setting do in a digital camera?

In digital cameras, the sensitivity of the image sensor is fixed and the ISO setting does not change it. When the ISO is raised, the signal (the

image you want) and the noise (the speckles that look like TV noise and are very roughly the equivalent of grain in film images) are both amplified electronically by the same amount. In ordinary photography and single exposure astro photos, the camera adjusts the exposure time by shortening the exposure when the ISO is raised. It is the shortened exposure time and not the ISO setting that result in a noisier image. In astrophotography, the subject is usually very dim, and the exposure is generally limited by the time available, sky glow, and the patience of the photographer. With the total exposure time fixed, the image quality is not affected by the ISO setting.

How does the exposure time affect the image quality?

For digital SLRs, the main noise contribution is a heat generated noise that is random in nature and builds up during the exposure according to the square root of the exposure time. That is, exposing 4 times as long doubles the noise. The signal (the precious image you want to get) increases in proportion to the exposure time so exposing for 4 times as long makes the signal 4 times as intense while the noise has only doubled. Therefore, to get a better quality (more signal compared to the noise) you need to use longer total exposure times. In most cases, changing the ISO will not make it better or worse. Processing always involves adjusting the intensity scale to get the same signal brightness (contrast stretching), so there is no difference in quality of the processed images taken for equal exposure times with differing ISO.

That is for most cases. What are the exceptions?

Just as in any photography, you want to have the signal large enough that there is something to see beyond the black end of the intensity range and not so large that it goes off scale at the bright end. This can be challenging in astrophotography because there is usually an incredibly wide range of intensity level between the brightest stars and the dimmest objects you want to show up. You can get into trouble using too high an ISO coupled with a long exposure if the subject contains bright objects (stars or galactic cores) that become overexposed. When that happens, the overexposed parts become blank white. In addition and often more importantly, the overexposed pixels can affect the surrounding ones by leaking some of their intensity out to their neighbors. The result is a “blooming” of the size of the bright object. Too low an ISO could also result in a loss of data if it is combined with a short exposure time such that there is not enough light collected to register any signal at all. For the ISO values on commercial DSLRs it is unlikely that you will run into